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Falkland Islands Government

FALKLAND ISLANDS WASTE DISPOSAL

Final Report

February 1998

HALCROW

The Queen's Award For Export Achievement

Falkland Islands Government

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GLOSSARY OF ACRONYMS

The following acronyms have been used in the text of this document. Most, if not all, are explained at some point in the document, but may be confusing for readers selecting parts of the report only. The abbreviations in common use in the Falkland Islands have not been included.

AD	Anaerobic digestion - a form of composting in the absence of air
BAS	British Antarctic Survey
BPEO	Best Practicable Environmental Option
BSE	Bovine spongiform encephalitis
C&D	Construction and demolition
CA site	"Civic Amenity" site, a location where householders can bring their wastes for disposal
DETR	The UK Department of Environment, Transport and the Regions
DoE	The UK Department of the Environment, now the DETR
EPA90	The UK Environmental Protection Act 1990
ERL	Environmental Resources Limited (now ERM)
IMO	International Marine Organisation, an organisation of the United Nations
MARPOL	A term used for the agreements under the London Convention on dumping at sea, implemented by the IMO.
MoD	Ministry of defence (UK)
MRF	Materials Recovery Facility
MSW	Municipal solid waste
PON	Petroleum Operations Notice
SBM	Specified bovine material - spinal columns and heads, which have particular risks for the spread of BSE

EXECUTIVE SUMMARY

An integrated strategy for waste management consists of more than merely the introduction of new physical facilities and processes. It also involves the enactment and enforcement of legislation, the establishment of a suitable organisation for its implementation, the development and implementation of a communications strategy and a financing plan. It should also be implemented working closely with the Military.

The key proposals for legislation are:

- An Environmental Protection Ordinance should be introduced requiring wastes to be deposited at licensed facilities, restricting or banning the import of hazardous wastes.
- Harbour dues should incorporate a charge for using waste collection and reception facilities provided at FIG's expense, with a requirement to use such facilities incorporated into the conditions.
- Offshore oil installations should be required to follow a code of practice which is incorporated into a PON.
- Optional additional measures could be introduced, including refundable deposits on imported oils and motor vehicles.
- A bilateral agreement needs to be signed with the UK to permit exports of hazardous wastes.

PWD should be charged with ensuring the provision of all necessary waste management facilities for the Falkland Islands. It should then be permitted to do this with its own direct labour or by contracting to the private sector, at its discretion.

The Environmental Planning Department should act as the waste regulation authority, supported by technical consultants.

A Strategy Implementation Team should be established, under the overall management and supervision of PWD. Most of the tasks should be performed by short term project management and technical consultants. We estimate the total costs of providing this consultancy to be in the region of £100-125,000. Whilst this is a large sum, we do not believe that it will be possible to implement the Strategy without assistance of this kind, due to the current and predicted workload of the Departments concerned.

Communication and education is an important element, if the necessary behaviour changes are to be achieved and the public is to accept the new waste management systems. The communications strategy should be developed and implemented by a local specialist, working closely with PWD.

Some issues which will require communication and education are:

- The overall content of the FIG waste management strategy, its benefits, costs and the changes required
- The provisions and implications of the new legislation
- The importance and approach to waste minimisation and avoidance
- The desirability of all commercial waste producers using a collection service
- The reasons for and benefits of the "bring" system for recycling
- Encouragement of public houses and hotels to use can crushers
- The benefits of and procedures for the new CA site
- The reasons for and benefits of the transportation of wastes to MPA
- The benefits of and procedures for the new transfer station
- The benefits of and procedures for CFC extraction from refrigerators
- The benefits of and procedures for the recovery and recycling of car batteries
- The dangers of stocks of sheep dip and the methodology for their safe handling and storage
- The reasons for not storing or dumping scrap metal, vehicles and tyres
- The benefits of and procedures for the collection of scrap metal
- The problems caused by litter, the benefits of reducing it and the prevention measures which will be taken
- The benefits of and procedures for the facilities being provided to shipping and the offshore oil industry.

Table S1: Summary implementation costs

	£ 000
Initial expenditure	
Capital expenditure	250
Project management of implementation	100
One off costs: Restoration of Eliza Cove Collection and export of sheep dip	50
Annual costs	
Operating costs and depreciation	100 pa

The waste management processes to be introduced should be:

- Develop a CA Site with authorised scavenging at Megabid
- Introduce a "bring" system for cans and bottles
- Use stronger healthcare waste bags
- Sort and store hazardous waste
- Provide a collection service for solid wastes from shipping, to be paid for via Harbour Dues
- Accept waste oils from shipping at FIPASS
- Recycle cans in UK
- Recycle scrap metal in UK
- Recycle glass in UK
- Recover lead from lead/acid batteries for recycling in UK
- Extract CFCs from refrigerators for recycling in UK
- Recover oils for use as fuel at Stanley Growers

- Oil waste from Albermarle can be blended with other waste oils and used at Stanley Growers, if no contractor volunteers to accept it under the current invitation to tender

- Produce compost from green waste produced at Stanley Growers for PWD's landscaping needs

- Upgrade healthcare waste incinerator

- Acquire redundant MPA incinerator for certain abattoir wastes and possibly tyres unsuitable for retreading in UK

- Export hazardous waste to UK

- Package sheep dip safely before shipment to UK

- Upgrade landfilling standards in Camp

- Close and restore Eliza Cove as soon as other landfill facilities are established

- Develop Mary Hill as a controlled landfill for Inert wastes only

- Non-inert wastes to be landfilled at MPA and transported via transfer station constructed at Megabid

- Provide a collection service for all commercial wastes and charge a fee

- Provide a range of at cost waste management services for the offshore oil industry

A number of opportunities for beneficial cooperation with the Military at MPA have been identified, in addition to the joint use of the MPA landfill. It is recommended that, before any firm decisions are taken on the installation of any of the above mentioned facilities, a waste management liaison committee is established between FIG and the Military, to ensure that there is no unnecessary duplication of facilities between the two communities. The respective strategies could then be harmonised to the mutual benefit of both parties.

1 INTRODUCTION

1.1 Background

This Final Report has been prepared under a contract between the Falkland Islands Government and Sir William Halcrow & Partners to advise as to the policies and strategies to adopt to introduce and maintain Waste Management and Disposal systems resulting in environmentally acceptable practices consistent with relevant international obligations and suitable to the circumstances of the Falkland Islands.

In the Consultants' proposal, the study was proposed to take place in two stages. Stage 1 was the preliminary assessment phase, in which all possible technical options and sub-options were identified and subjected to preliminary assessment and coarse screening against an agreed set of criteria, with a view to selecting a short-list of options for more detailed examination and assessment in Stage 2, following discussion with the client.

A Consultation Paper has been produced which presented the findings, conclusions and recommendations of Stage 1 of the analysis, together with the first part of Stage 2, whereby the short-listed options were evaluated and their implications identified. Following discussion and review with interested parties during the second visit to the Falkland Islands by the Consultants, the Stage 2 analysis has now been completed. This has been amalgamated with the Consultation Paper to form this Final Report.

1.2 Objectives

It is our understanding that the ultimate objective of the project is to develop an integrated policy and cost-effective strategy for the management of all wastes generated in the Falkland Islands and their territorial waters in order to prevent or minimise:

- any actual or potential adverse impacts of pollution on the environment, in particular to water, air, soil, animals, landscape or places of special interest
- risks to human health
- adverse impacts on, or risks to, the economic prosperity of the Falkland Islands.

The specific objectives of the Study are interpreted by us as being to:

- determine the probable quantities and types of wastes arising in the Islands, currently and in the future, taking particular account of possible future developments in the petroleum exploration and exploitation industry, as well as of the existing farming and fishing industries, domestic, harbour and shipping waste;

- investigate, evaluate and recommend technically appropriate and economically viable methods, systems, facilities and related arrangements for the segregation, collection, recovery, reuse, recycling, pre-treatment and reduction of the different waste streams;

- identify methods of encouraging recovery and recycling;

- to review the existing waste disposal facilities in the light of the known waste streams, both hazardous and non hazardous, and make recommendations for their future operation and management, together with any new environmentally-sound, operationally-secure and cost-effective facilities or arrangements which may be appropriate;

- to assess the need for additional waste management legislation and/or administrative procedures, including the relevance of the Basel Convention, and make appropriate recommendations;

- to determine the requirements for waste management facilities or other arrangements to comply with the obligations of MARPOL and the Vienna Convention on Ozone Depleting Substances;

- to advise on the organisational arrangements, staffing and training necessary to implement the recommended strategy;

To give specific consideration to the following issues:

- the existing landfill sites
- the existing incinerator and a possible role for incineration in general
- oily wastes
- wastes from ships
- CFCs and halons
- scrap metal
- stocks of sheep-dip
- wastes arising from the exploration and exploitation of petroleum
- wastes from the BAS
- cooperation with the military

In seeking to meet the above objectives, full account has been taken of the principle of BATNEEC (Best Available Technology Not Entailing Excessive Cost), whilst taking note of the fact that, in the special conditions which apply in the Falkland Islands, labour is in short supply and capital intensive solutions may in some cases be more economically appropriate.

BATNEEC implies the standards which are to be achieved. The methodology frequently used for achieving these standards is known as the Best Practicable Environmental Option (BPEO) concept. The stages typically involved in conducting a BPEO study are:

- Identification of objectives and constraints
- Collection of data and information
- Generation of options
- Screen options
- Evaluate options
- Decide on whether any modifications are necessary, feasible or justifiable
- Identify the preferred option
- Review the preferred option

1.3 Approach

The consultation paper which has already been presented incorporated Stage 1 of the Study, which consisted of the first four steps of the BPEO methodology, namely to:

- Identify the objectives and constraints
- Gather information about the existing situation
- Identify potential waste management options
- Coarse screen the options and prepare a short list for more detailed evaluation

In practice, we found it appropriate to incorporate part of Stage 2 for presentation in the Consultation Paper, namely:

- A technical evaluation of the short-listed options
- Comparison of short-listed options

Some issues, however, could not be finalised in the Consultation Paper, because further discussion and data gathering was necessary during the Consultants' second visit.

The Final report incorporates the important parts of the Consultation Paper, fills the data gaps and presents the final conclusions of the Consultants. It does not include all the detailed deliberations in the Consultation paper, so the reader may need to refer to this report in order to find the detailed logic of the derivation of certain statements and proposals.

1.4 Layout of Final Report

The Final Report presents the Consultants' preferred strategy for waste management in the Falklands Islands. It is structured as follows:

Section 1: Introduction and layout of report.

Section 2: Summarises the background against which the components of the strategy have been derived. It describes the relevant characteristics of the Falkland Islands, presents estimates of waste arisings, discusses the current legislative position and summarises the existing waste management practices.

Section 3: Considers and draws conclusions about waste management priorities in the Falkland Islands, identifying the existing problems and proposing a set of objectives.

Section 4: Presents recommendations for future waste management legislation.

Section 5: Presents recommendations for organisational arrangements for waste management.

Section 6: Summarises the technical options which have been considered and explains how the short list of options has been derived.

Section 7: Shows the evaluation and comparison of the short-listed options and the identification of the preferred options.

Section 8: Identifies and describes in detail the preferred technical options.

Section 9: Highlights the importance of cooperation with the Military.

Section 10: Reviews the communications and education needs in order to implement the preferred strategy.

Section 11: Presents the financial implications of the preferred options.

Section 12: Proposes an implementation plan, identifying the decisions that require to be taken and the tasks necessary in order to implement the preferred strategy.

Section 13: Comments on proposals for monitoring the water quality of Stanley Harbour

Section 14: Summarises the proposals made and the Consultant's conclusions.

The detailed supporting data presented in the Consultation Paper has been reproduced, after appropriate editing, in a separate document of Appendices.

Appendix A describes the markets for recovered materials and products and the factors which affect them. **Appendix B** describes the waste management options in detail, including their characteristics, economics, applicability in the Falkland Islands and advantages and disadvantages.

It should be stressed that, for those who wish to understand the logic and justification for the evaluation and comparison of the technical options, reading these two appendices will be a necessity.

Appendix C shows references, **Appendix D** a schedule of visits, **Appendix E** the questionnaires distributed to households and local commerce and **Appendix F** the questionnaire distributed to shipping. **Appendix G** describes the implications of the development of petroleum exploration and exploitation for waste management in the Falkland Islands. **Appendix H** contains the Terms of reference of this Study in Part 1 and, in Part 2, requests to carry out additional work in relation to water quality in Stanley Harbour. **Appendix I** contains recommendations for monitoring of the flora and fauna potentially impacted by the landfills at Eliza Cove and Mary Hill Quarry. **Appendix J** contains recommendations for landfill methodology in Camp. **Appendix K** contains written comments on the Consultation Paper. **Appendix L** details the morphological assessment of MSW arisings from Stanley.

2 BACKGROUND

2.1 Relevant Characteristics of the Falkland Islands

The specific characteristics of the Falkland Islands which need to be taken into account in developing an appropriate strategy are:

- Very small population
- Remote location from markets
- Not high rainfall
- Strong winds
- Unique wildlife
- Relatively pristine environment
- Income per capita high in global terms

There is significant uncertainty about the future growth of the economy, depending on the future of the fishing and offshore petroleum resources.

We have considered three scenarios:

"Most likely" - relatively static population, no oil development, GDP growth 4%
"Possible" - 1.7% population growth, modest oil find, GDP growth 5%
"Unlikely" - 2.9% population growth, large oil find, GDP growth 6%

2.2 Waste Arisings

Little recorded information exists on waste arisings. During the second visit, we undertook a survey and analysis of MSW (Municipal Solid Waste) being deposited at Eliza Cove. The detailed methodology and results are shown in Appendix L.

Based on a sample of one week's waste collected on behalf of PWD in Stanley, it is possible to conclude that the arisings of MSW in Stanley are 675 tonnes p.a. To this must be added the waste delivered to Eliza Cove directly by householders and others. From our observations during the time spent at the landfill, we estimate this to be about 125 tonnes p.a., giving a total of 800 tonnes p.a. - the same as originally projected. Waste produced in camp, on a *pro rata* basis, can be estimated to be a further 200 tonnes p.a.

This implies an annual household waste production of 490 kg *per capita*. It is interesting to compare this with the *per capita* household waste generated in the UK. In the non-metropolitan areas, *per capita* generation of household waste, including waste delivered to civic amenity sites, is about 350 kg. This figure, however, is currently being revised and is likely to be an underestimate. It is notable, however that one factor which tends to increase the apparent per capita production in the UK is the use of wheeled bins in some districts - which are believed to increase the amount collected as household waste by up to 20%, partly due to the collection of more garden wastes and partly because some commercial wastes are placed in the containers. In Stanley, of course, a large proportion of commercial wastes are collected as household waste.

We suspect that when the revised UK figures are produced, the Stanley figures will be found to be comparable for a wheeled bin collection in the UK.

It is also notable, however, that waste generation per capita varies widely between different cities and districts, especially across Europe as a whole. This is partly as a result of different definitions of household waste, but also reflects the specific values of the community. For example, in Adur District (UK) it is around 236 kg/capita, whilst the European average is 377 kg and in Paris the figure is 660 kg.

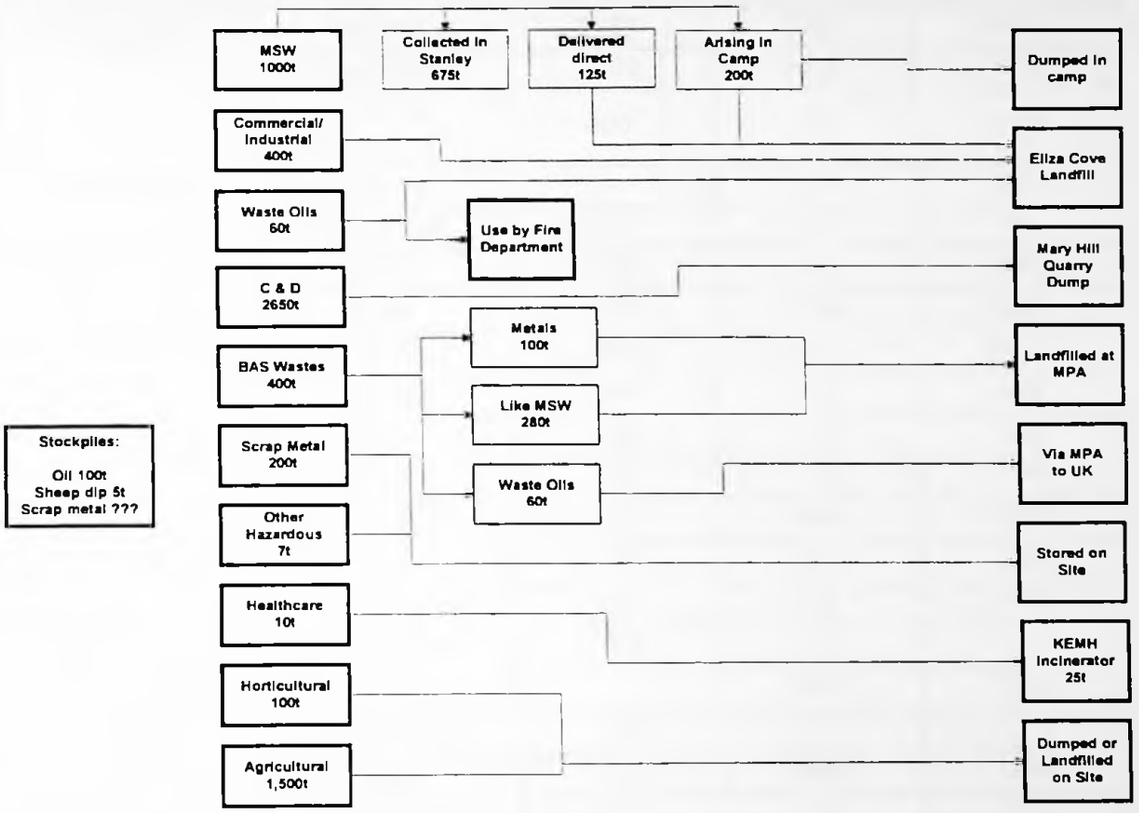
The composition of the waste is different from that which is typical in the UK, as is shown in Table 2.1. In particular, the amount of paper is less, no doubt because of the lack of daily newspapers and the prevalence of burning. The proportion of glass is noticeably higher

Table 2.1: Household Waste Composition

Material	Falkland Islands	UK - 1993	UK - 1994 wheeled bins
Paper & board	11.9%	33.2%	27.5%
Plastics	7.1%	11.2%	8.5%
Glass	27.2%	9.3%	7.1%
Food and garden waste	39.8%	20.2%	31.0%
Ferrous metal	4.9%	5.7%	3.6%
Non-ferrous metal	0.7%	1.6%	1.8%
Textiles	1.9%	2.1%	2.2%
Misc. combustible	n.a.	8.1%	7.3%
Misc. non-combustible & fines	6.4%	8.6%	11.0%

Our estimate of total waste arisings, together with the disposal methods are shown in Figure 2.1.

Figure 2.1: Current Waste Flows



Future projections of waste arisings for the "most likely" scenario are shown in Table 2.2.

Table 2.2: Projected Falkland Islands Wastes Arising "Most Likely" Scenario				
Waste Type	**Source**	**1997**	**2007**	**2017**
Like MSW	Households	1000	1000	1000
	Trade & commerce	400	600	900
	Shipping	-	650	650
	Offshore oil	420[1]	87	87
	BAS	280	280	280
	Total	**2100**	**2530**	**2830**
Inert	**C & D**	**2650**	**3900**	**5800**
Scrap metal	Onshore	200	300	450
	BAS	100	100	100
	Offshore	50[1]	40	40
	Total	**350**	**400**	**550**
Tyres	**All**	**20**	**30**	**40**
Oily wastes	Onshore	60	90	135
	Stockpile	100	-	-
	Shipping	-	1000	1000
	Offshore oil	24	2	2
	Total	**160**	**1090**	**1090**
Other Hazardous	Healthcare	10	10	10
	Other onshore	7	10	15
	Offshore	24[1]	2	2
	Total	**67**	**20**	**25**
Drilling muds		**10,000[1]**	-	-
Drill cuttings		**to seabed[2]**	-	-
Agricultural		**1,500[3]**	**75**	**75**
Horticultural		**200**	**200**	**200**

1 After drilling starts in mid 1998
2 Unless excluded by new environmental findings
3 Until abattoir constructed

2.3 Policy, Legislation and Standards

With the exception of the Litter Ordinance of 1986, there is currently no specific policy or legislation directly relating to waste management in the Falkland Islands. The only legislation which exists relates to Public Health and Land Use Planning.

The Falkland Islands are currently negotiating a bilateral agreement with the UK for the export of hazardous wastes. They also have obligations under the

Montreal Protocol relating to ozone depleting substances and under MARPOL relating to the disposal of wastes from shipping.

The EU and the UK have introduced significant directives and legislation relating to waste management, with which the Falkland Islands is not obliged to comply but may wish to do so. The notable issues which might be applied in the Falkland Islands are:

The requirement for waste management facilities to be licensed.

The forthcoming EU landfill directive, which places severe constraints on the materials that may be landfilled.

If the Falkland Islands were to adhere to this directive, landfilling of MSW and trade and commercial wastes, as they arise, would not be permissible and the waste would require some form of pre-treatment to reduce the organic content, such as incineration or composting. This would entail what would be, in our opinion, an unacceptable level of cost.

2.4 Existing Waste Management Practices

The existing waste management practices in the Falkland Islands may be summarised as follows:

MSW collection	In Stanley, a modern system of "wheelie" bins is used. In Camp waste is placed in drums.
Commercial wastes collection	A skip service is provided by FIC on behalf of PWD.
Segregation & recycling	None.
Facilities for hazardous wastes	None. Some is landfilled at Eliza Cove.
Healthcare wastes disposal	An incinerator exists at KEMH which does not meet modern standards - either in design or operation.
Landfill for Stanley	Biodegradable wastes are deposited at Eliza Cove landfill. Inert wastes and scrap metal are dumped at Mary Hill Quarry. Operational standards are low.
Landfill in Camp	In Camp, wastes are burnt or dumped.
Landfill for the Military	The Military currently have two landfills, one for inert materials and one for MSW. Consultants are currently advising them as to how the situation should be improved.

Waste from shipping	A small amount of waste from shipping is currently accepted at FIPASS and landfilled at Eliza Cove. The ultimate destination for the remainder is unknown but it is suspected that much is dumped at sea.
Oils	Oils are currently stored or dumped at Eliza cove or are used for fire practice.
Stockpiles of sheep dip	A stockpile of sheep dip chemicals exists at various locations in the Islands. This material is potentially very dangerous and is inadequately stored.

In conclusion, waste management facilities in the Falkland Islands are currently very basic and require upgrading.

Although land is plentiful in the Falkland Islands, prospects for additional landfills in the vicinity of Stanley are restricted. Apart from Eliza Cove, the life of which is likely to be limited by landscape considerations, and Mary Hill Quarry, most of the remaining land is either committed for other uses, lies within the drinking water catchment area or is unsuitable on amenity or environmental grounds.

In the Stanley area, the PWD have a significant amount of land which could be made available for waste processing facilities, provided they were constructed and operated in an environmentally sensitive manner.

Further from Stanley, there is an abundance of land, although additional transport costs would be incurred. The geology in areas reasonably accessible from Stanley is less suitable for the development of a new landfill than that in the region of MPA, due to the inability to extract cover material. The Military currently possess two landfills of relatively small size at MPA but have plans to construct a new one to higher standards. Whilst the management at MPA have identified a replacement site, it is understood that the Consultants employed by MoD have suggested that other possible locations may be more economic.

3 WASTE MANAGEMENT PRIORITIES, PROBLEMS AND OBJECTIVES

3.1 Introduction

A waste management strategy cannot be defined until the basic objectives are established. These, in turn, will be derived by addressing the identified problems. The strategy needs to achieve the objectives whilst taking account of the external constraints and issues which may have an impact on the choice of strategic options. The purpose of this section is to set out the key issues and constraints in the Falkland Islands and to identify the broad objectives which we believe should be established.

3.2 Key Issues and Constraints

3.2.1 Land Use and Availability

Land is in plentiful supply in the Falkland Islands and is consequently relatively inexpensive. Land around Stanley is somewhat constrained in the way it can be used but, compared with the UK, for example, is still freely available for many uses.

There is little land in the immediate vicinity which would be suitable for development as a landfill, with the possible exception of the two existing sites - Eliza Cove and Mary Hill. Eliza Cove, however, has little remaining space available, especially if the practice of burning were to be discontinued.

3.2.2 Environmental Issues

No specific environmental quality objectives have been set for the Falkland Islands. We assume, however, that it is the general objective to operate waste management services to environmental standards which are at least comparable with the UK in their actual environmental impact. Because of the small scale and remoteness of such operations from habitations, however, some of the provisions which would be applied in the UK may not be necessary - for example, full landfill gas and leachate control.

Land for development as a landfill is available at a reasonable distance from Stanley, but the geology is less than ideal, because cover material is not readily available. The situation improves nearer to and in the vicinity of MPA.

3.2.3 Technical Constraints

As a consequence of the small population, technical capabilities in the Falkland Islands are limited. Waste management processes requiring a high level of technical skills may not be suitable or sustainable.

3.2.4 Availability of Labour

Labour in the Falkland Islands is in extremely short supply. Any waste management policies proposed must take this factor into account, and labour intensive solutions are unlikely to be practical or sustainable. Even a requirement for, say, three or four additional jobs could present a noticeable problem.

3.2.5 Availability of Financial Resources

The Falkland Islands is a relatively cash rich country, with some £80 million available for capital expenditure projects in its Consolidated Fund. Current Government revenues are running at somewhat lower than the peak achieved in the 1980s, certainly in real terms. The future for these revenues is less than secure, because of uncertainty surrounding the future of fish stocks - and, of course, oil. Although policy is currently being reviewed, it has been customary to restrict annual capital expenditure to around £10 million p.a., following the recommendations of the ERL Prinn report.

There are, of course, a number of projects which compete for the available investment finance. Compared with many countries, however, finding finance for improving the environmental impact of waste management is not expected to be a major problem.

3.2.6 Scale

Waste arisings in the Falkland Islands are extremely low by international standards. The small scale is likely to rule out the practical possibility of some of the more sophisticated waste management processes.

3.2.7 Sustainability

Naturally, an important feature of any environmental programme should be its sustainability - not only in environmental terms but also in economic and social terms. Consequently, technical and labour availability aspects assume a greater significance in the Falkland Islands than they might do in many other countries.

3.2.8 Prevailing Perceptions and Attitudes

With the help of the PWD, we have undertaken a survey of public attitudes to waste management and the environment. A questionnaire has been distributed to every household in the Falkland Islands except MPA, a copy of which is shown in Appendix E.

226 replies were received, which represents, in terms of households, a 26% response. For Stanley, it appears that the response has been 32%. It must be assumed that those who did not respond generally had little interest in the subject of waste management, and possibly even the environment. The following results were obtained:

Question	Response	Number	% of total
Is environmental protection important to you?	Very	179	80%
	Quite	40	18%
	Not very	2	1%
	Not at all	0	0
Do you think your waste can affect the environment?	Yes	219	97%
	No	3	1%
Should the way your waste is dealt will be improved?	Yes	220	98%
	No	3	1%
If new ways of improving expensive management were more expensive would this be a good way for FIG to spend its money?	Yes	139	62%
	To some extent	80	36%
	No	3	1%
Would you take cans and bottles to a separate container located, say, near the shops?	Yes	199	89%
	No	24	11%
If you were given 2 wheelie bins would you separate food and and garden wastes?	Yes	211	94%
	No	10	4%

Of the responses, only 7 were identifiable as coming from camp, although since the questionnaire was anonymous, the proportion may have been higher. Respondents were encouraged to offer their comments. 115 people, being more than half the respondents, did so. Some of the more interesting comments are summarised below:

Want recycling (some mentioned "if economic")	27
Concerned about sewage	21
Want landfill standards upgraded	11
Concerned about wind scatter from the landfill or containers (or both)	8
Concerned about litter	8
Want opportunity to reuse timber	6
Concerned about waste oils	5
Want "better access to landfill".	5
Want incineration	5
Want burning	5
Do not want burning	4
Like wheelie bins	5
Do not like wheelie bins	4
Think public education is important	3

A questionnaire was also distributed to FIG departments and local businesses in Stanley. 40 replies were received. Unfortunately, little information was provided about physical quantities of waste but some interesting facts emerged, which are shown below.

29 respondents (74%) indicated that they would be prepared to separate their wastes, provided that sufficient bins were provided.
8 respondents requested provision of a container and regular collection service.
7 respondents requested recycling facilities.
21 respondents stated that their waste consisted mainly of paper, cardboard and plastic
7 respondents burn their waste regularly
3 respondents requested burning facilities at the landfill or an incinerator
11 respondents transport their own wastes to the landfill

3.3 Problems Identified

We have taken a rational approach to problem identification. To some extent, this repeats many of the points identified in the Terms of Reference of this Study. We believe, however, that it is helpful to formalise the problem analysis, identifying problems, causes and effects.

In our opinion, the core problem relating to waste management in the Falkland Islands is:

Waste management in the Falkland Islands is currently causing damage to the environment and, potentially, to human health.

From the foregoing sections, it has been possible to prepare a more detailed analysis of the sub-problems, together with their causes and effects, which is presented in Table 3.1.

3.4 Proposed Objectives

Using the problem analysis, it is then possible to formulate a series of objectives, means and ends. These are effectively the reverse of the problem analysis. The core objective may be stated as:

Develop and implement a policy for waste management which prevents significant harm to human health or the environment using technology which does not entail excessive cost.

The detailed analysis of sub-objectives, means and ends is presented in Table 3.2

Table 3.1: Falkland Islands - Existing Solid Wastes Management - Problem Analysis			
Area/Activity	**Key Problems**	**Principal Causes**	**Principal Effects**
Institutional Framework	FIG policy on solid waste management not sufficiently developed for an integrated system.	Policy not yet developed.	FIG intentions and policy objectives with respect to waste management not known or understood throughout the community. No clear and formal basis available for determining waste management plans, performance requirements or targets.
	Existing legislation governing waste management inadequate.	No legislation in place.	Policy & standards relating to waste management difficult/ impossible to implement/enforce e.g. low standards of landfill operation. Pollution/nuisance from open burning.
	No mechanism for enforcing legislation.	Resources for monitoring & enforcement are insufficient.	
	Organisational arrangements may not be suitable to implement policy	Policy not yet developed	Policy may not be able to be effectively implemented
Waste Avoidance	Waste producers not aware of potential opportunities for, and benefits of, avoiding wastes.	Information on opportunities & techniques for wastes avoidance not always readily available to waste producers.	Resources, including resources for wastes management, are not used efficiently, with potential economic & environmental consequences.
		The true costs of environmentally-sound & sustainable wastes management are not perceived or met by waste producers.	

Table 3.1: Falkland Islands - Existing Solid Wastes Management - Problem Analysis			
Area/Activity	**Key Problems**	**Principal Causes**	**Principal Effects**
Storage, Collection & Transport	Some commercial waste producers do not receive adequate collection service.	Collection service not provided to all waste producers. Available container systems are limited.	Waste stored on site or disposed of unsatisfactorily. Wind scatter of containerised waste.
Segregation & Recycling	No segregation or recycling services available.	No service provided. Lack of local market outlets for most potentially recyclable materials.	Recycling opportunities not exploited.
Waste Treatment	Treatment of wastes to reduce their volume, and/or their intrinsic potential to create pollution or hazards, either not practised or inadequate.	For most waste streams, facilities for treating wastes do not exist in the Falkland Islands. The long-term consequences of not pre-treating some waste streams are not widely known and understood. Existing hospital waste incinerator does not conform with internationally-accepted standards.	Enhanced pollution/hazard potential for some waste streams. Landfill resources are consumed more rapidly. Enhanced pollution/hazard potential from the incineration of hospital/clinical wastes.

Table 3.1: Falkland Islands - Existing Solid Wastes Management - Problem Analysis			
Area/Activity	**Key Problems**	**Principal Causes**	**Principal Effects**
Final Disposal	Existing landfill operations causing environmental damage.	Inadequate environmental standards applied.	Pollution, odours, vermin and litter emanating from landfills.
		No facilities for waste oils or other hazardous wastes.	
	Air pollution and offensive odours.	Open burning of wastes taking place.	Burning leads to air pollution.
	CFCs and other ozone-depleting substances being discharged to atmosphere	No facilities for collection of CFCs and other similar materials.	Damage to ozone layer
Waste stockpiles	Sheep dip and other pesticides stockpiled.	No disposal facilities available. No safety information provided.	Wastes are stored in unsafe conditions.
	Substantial stockpiles of scrap metal.	No recycling facilities available. Waste producers not properly informed.	Stockpiles are unsightly.
	Many other wastes stockpiled, e.g. vehicles, tyres.	No recycling or disposal facilities available. Waste producers not properly informed.	Stockpiles are unsightly.
Litter	Litter and untidiness are prevalent.	Lack of public awareness, suitable facilities and enforcement of legislation.	Litter and untidiness have an adverse impact on amenity and the environment.
Wastes from offshore activities	Wastes from shipping damaging marine environment.	No facilities provided for wastes from shipping vessels.	Wastes are injuring wildlife and contaminating beaches.
	Future potential problem with wastes from oil activities	No facilities provided for wastes from oil exploration	Wastes could damage environment.

Table 3.2: Falkland Islands - Solid Wastes Management Objectives			
Area/Activity	**Objective**	**Means**	**Ends**
Institutional Framework	Ensure integrated policy is prepared and effective.	Develop, communicate and apply a comprehensive, integrated waste management policy.	FIG intentions and policy objectives with respect to waste management are known and understood throughout the community. Clear and formal basis available for determining waste management plans, performance requirements or targets.
	Ensure that legislation is adequate to achieve the waste management policy.	Implement appropriate legislation	Policy & standards relating to waste management able to be implemented and enforced
	Ensure that waste management legislation is effectively enforced.	Ensure resources for monitoring & enforcement are adequate.	
	Ensure organisational arrangements are appropriate to implement policy	Ensure organisational arrangements are adequate.	Policy is able to be implemented.
Waste Avoidance	Ensure that all waste producers are aware of the potential opportunities for, and benefits of, waste avoidance.	Provide information on opportunities & techniques for wastes avoidance. The true costs of environmentally-sound & sustainable wastes management are perceived and met by waste producers.	Resources, including resources for wastes management, used efficiently.

Table 3.2: Falkland Islands - Solid Wastes Management Objectives			
Area/Activity	**Objective**	**Means**	**Ends**
Storage, Collection & Transport	Ensure that commercial waste producers receive adequate collection service.	Collection service provided to all waste producers. Suitable container systems are provided.	Wastes or disposed of satisfactorily and not stored on site. Wind scatter of containerised waste eliminated.
Segregation & Recycling	Segregate and recover recyclable materials wherever this is environmentally and economically justified.	Provide appropriate segregation and recycling services. Lack of local market outlets for most potentially recyclable materials.	Recycling opportunities are exploited.
Waste Treatment	Treat wastes to reduce their volume and/or their intrinsic pollution/hazard potential wherever this is environmentally and economically justified.	Provide environmentally and economically justifiable facilities for treating wastes. The long-term benefits of pre-treating some waste streams are widely known and understood. Existing hospital waste incinerator does not conform with internationally-accepted standards.	Reduced pollution/hazard potential for all relevant waste streams. Landfill resources are conserved. Enhanced pollution/hazard potential from the incineration of hospital/clinical wastes.

Table 3.2: Falkland Islands - Solid Wastes Management Objectives			
Area/Activity	**Objective**	**Means**	**Ends**
Final Disposal	Ensure landfill operations are environmentally sound.	Adequate environmental standards applied.	Pollution, odours, vermin and litter emanating from landfills eliminated.
	Prevent air pollution from burning waste.	Facilities provided for waste oils or other hazardous wastes.	
	Ensure that CFCs and other ozone depleting substances are collected and disposed of securely.	Open burning of wastes does not take place.	reduction of air pollution.
		Provide facilities for collection of CFCs and other similar materials.	Reduction of damage to ozone layer
Waste stockpiles	Provide safe method of disposal for sheep-dip and other pesticides.	Provide disposal facilities and safety information.	Wastes are safely disposed of.
	Eliminate or reduce stockpiles of scrap metal.	Provide recycling facilities and inform waste producers.	Stockpiles reduced or eliminated.
	Eliminate or reduce stockpiles of other wastes	Provide recycling or disposal facilities and inform waste producers.	Stockpiles reduced or eliminated.
Litter	Reduce litter and untidiness.	Increase public awareness, provide facilities and enforce legislation.	Litter and untidiness reduced.
Wastes from offshore activities	Prevent pollution from shipping.	Provide facilities for wastes from shipping vessels.	Reduce or eliminate pollution from shipping.
	Prevent pollution from oil activities.	Provide facilities for wastes from oil activities.	Reduce or eliminate pollution from oil activities.

4 RECOMMENDED WASTE MANAGEMENT LEGISLATION

4.1 Introduction

There is no requirement for the Falkland Islands to adhere to any of the EU or UK legislation mentioned in Section 2 above. We understand, however, that attempts will be made to conform, provided adherence is practical and in the interests of the Falkland Islands.

Naturally, given the small scale of waste production in the Falkland Islands, there will not be a need for the extensive and complex legislation that has been introduced in, for example, the UK. We also understand that, as a general principle, the people and government of the Falkland Islands do not welcome extensive legislation, which is alien to the local culture. The proposals which follow are therefore "minimalist" in nature.

New legislation should only be introduced if, without it, there is a significant risk that harm to the environment or public health cannot be effectively controlled and minimised.

4.2 Objectives

The identified objective for waste management legislation is that it should be adequate for the implementation of the waste management policy. It is therefore necessary to consider some of the other specific problems which legislation might solve. As we see it, the identified problems which legislation might address are as follows:

(a) Existing landfill operations causing environmental damage
(b) Treat wastes to reduce their volume and/or their intrinsic pollution/hazard potential wherever this is environmentally and economically justified
(c) Air pollution and offensive odours
(d) CFCs and other ozone-depleting substances being discharged to atmosphere
(e) Sheep dip and other pesticides stockpiled
(f) Substantial stockpiles of scrap metal and many other wastes
(g) Litter and untidiness are prevalent
(h) Wastes from shipping damaging marine environment
(i) Future potential problem with wastes from oil activities

4.3 Legislative Options and Recommendations

Against the background of minimising the amount of legislation introduced and keeping it appropriate to the scale of operations in the Falkland Islands, it first of all needs to be appreciated that it is the PWD that provides most of the waste management facilities. One possibility might therefore be for the PWD to operate to modern international standards, without the introduction of legislation.

The PWD may not always remain the sole waste management service provider and if, for example, a system of charging to implement the Polluter Pays Principle were introduced, a private operator might decide to try and operate his own facilities. Also, it should be appreciated that the military at MPA operate waste management facilities and they have expressed a view that they wish to accord with UK principles of legislation, which include a site licensing process.

If all wastes in the Falkland Islands are to be deposited at high quality facilities, thus helping to implement objective (a), there is little doubt that a system of waste management facility licensing will ultimately need to be introduced, with penalties applicable for depositing wastes without such a licence. Such legislation could control not only the standard of waste management facilities but also stockpiles of wastes, thus assisting to implement objectives (e) and (f). This could be done through an Environmental Protection Ordinance.

Because of the scale of production of hazardous wastes, it is unlikely that the Falkland Islands could economically provide suitable facilities itself. It is therefore logical to export these to the UK or elsewhere. This would provide a solution for objective (e). A bilateral agreement with the UK, of the kind being negotiated will permit the Falkland Islands to export such wastes to the UK or elsewhere in the EU, without the need to become a party to the Basel Convention. This will also help to implement objective (a). It should be stressed, however, that at present the bilateral agreement being negotiated applies only to wastes from MPA. It is most important that it is extended to include wastes from the civilian sector.

Such an agreement, however, does not provide any protection against an unscrupulous individual who might wish to import hazardous wastes for disposal in the Falkland Islands. It may be considered that measures should be taken in this regard, and that becoming a party to the Basel Convention might be such a measure. It seems to us, however, that becoming a party to the Basel Convention would place a number of administrative requirements on the Falkland Islands that might otherwise be largely unnecessary. For example, parties are required to introduce relatively complex legislation and provide information and statistics to the Convention Secretariat. A Party is also required to "ensure the provision of adequate disposal facilities for the environmentally sound management of hazardous wastes and other wastes, that shall be located, to the extent possible within it, whatever the place of their disposal." We do not therefore recommend that the Falkland Islands should become a Party to the Convention in the near future unless specifically requested to do so by the UK Government.

Instead, if an Environmental Protection Ordinance is introduced, it would be possible to include a provision banning the import of hazardous wastes (perhaps with the exception of wastes for recovery) and to ensure that no licence may be issued for the reception of imported hazardous wastes (other than those produced from marine vessels). This would also help to implement objective (a).

Objective (b) will mainly best be implemented by the provision of the appropriate facilities. The segregation and composting of food and garden wastes is one possible option. One of the problems associated with composting - and also potentially with some other processes, such as incineration or even landfilling, is the presence of heavy metals in household waste. There are many sources of these heavy metals, but one particular source is batteries. A producer responsibility scheme, whereby the producer of such products is obliged to accept back used batteries could possibly improve this situation. In order to make such a scheme effective, importers of batteries to the Falkland Islands would need to offer a service for the collection of used batteries and their transport back to the UK for disposal or recycling. We have not recommended this, however, as we do not believe that retailers or importers (or FIG) would be interested in financing its cost, which would be substantial - for a very limited environmental amelioration. If it were to be implemented, legislation might be required - if a voluntary scheme could not be established. We have some doubt, however, as to whether such legislation would fit with the Falkland Islands culture and hesitate to recommend it.

Another possible aspect relating to objective (b) is the processing of oil wastes. This would almost certainly be costly, and small producers of such wastes might be unwilling to pay for the service. One option would be for FIG to fund the service but, if it were decided to recover the costs, one option would be to impose a tax on imported lubricating oils to pay for the facility.

Air pollution from burning wastes is a more difficult matter. Given the low quantity of wastes which arise and the large land area, there is probably little harm in burning wastes provided that this activity takes place away from where people live - be it for housing or recreation. The main problem with burning occurs in Stanley, where a number of people still burn their wastes and do not understand why this is harmful. It would be possible to introduce an Ordinance banning such activity, helping to implement objective (c), but it is likely that this would be a controversial move and might not be acceptable to the Legislative Council. We therefore recommend reducing the amount of burning by a public communications campaign rather than by legislation.

The Montreal Protocol requires that parties reduce their consumption of CFCs to 50% of their 1986 level and to maintain the consumption of halons at or below the 1986 level. In the EU, Regulation 3322/88 applies controls on CFC and halon producers in order to achieve the desired result. The UK is a party and has achieved these objectives by product and process changes. Since the Falkland Islands derives most of their imported goods from the UK, it is likely that the UK's actions will have ensured that the Falkland Islands also meets its obligations. There are also obligations on the production of these products, but this does not concern the Falkland Islands, since no such chemicals are produced. Thus, from a legislative point of view, we do not believe that the Falkland Islands needs to take any specific action.

The emission of ozone-depleting substances would be extremely difficult to control by means of legislation, because of the problems of monitoring such activity. This, we believe, can best be controlled by ensuring the provision of suitable facilities, which provides the most effective way of implementing

objective (d). If a simple method for the disposal of refrigerators and other equipment containing these materials is provided, there would be little or no incentive for people to do otherwise than to avail themselves of the service. Thus we do not recommend legislation on this topic.

There is little that can practically be done by means of legislation to achieve objective (f). The only possibility relates to scrap motor vehicles, where it would be possible to introduce a deposit on imported vehicles which would be refundable when they are processed for scrap recovery.

The Litter Ordinance 1986 provides legislation for the control of litter. It has been suggested that its wording implies that the litterer needs to be caught in the actual act of depositing the litter, although we can see little reason why such an interpretation is appropriate. Furthermore, the wording of the Ordinance is very close to that which is currently in force in the UK Environmental Protection Act 1990. We believe that, in order to implement objective (g), the solution lies in effective enforcement of the Ordinance. Enforcement is currently the duty of the police, and it is difficult to see any practical alternative. A few well publicised prosecutions, however, would probably have a significant effect. It may be possible also to encourage the general public to report litterers, who could then also be prosecuted. This, however, might be difficult in such a small and close community. Provision of more litter receptacles might also be effective.

In the UK, there is also a requirement for local authorities to prepare litter control plans, but this would be unnecessary in the Falkland Islands.

The control of wastes from fishing and other marine vessels operating in Falkland Islands waters presents a different kind of problem. States adopting MARPOL must provide facilities adequate in scale for the shipping handled and are encouraged, but not required, to ensure that wastes discharged to port facilities are included in the national planning of waste management and disposal. Adequate facilities are taken to include the provision of a mechanism for waste handling and registration which minimises delay to the vessel. Wastes generated by shipping, however, will not necessarily be landed in the Falkland Islands even if the facilities for its reception are provided.

The requirements of MARPOL are the provision of "port reception facilities" - which is not actually defined but relates to any system of receiving shipboard residues and mixtures containing oil, noxious liquids or garbage. Ships registered in the Falkland Islands may be required to use the port facilities under existing ordinances from 1988. There is, however, no direct method by which vessels registered outside the Falkland Islands can be obliged by law to use any port facilities which may be provided, although we understand that this position will change when the UK Merchant Shipping Act 1995 and the Merchant Shipping (Pollution by Garbage) Regulations are applied to the Falkland Islands.

We also understand that MARPOL will shortly be introducing regulations which require the preparation of Port Waste Management Plans. We believe that this study should enable this requirement to be fulfilled.

First of all, the necessary facilities need to be provided. If these are available, it is then necessary to encourage the fishing and other vessels to make use of them. Such a system would implement objective (g).

According to the Polluter Pays Principle, vessels should pay a charge for the service and, indeed, it would be unreasonable to expect FIG to pay for the cost of the service. On the other hand, if vessels have the accessibility of the ocean as a dump, many will be unlikely to pay for such a service. The objective should therefore be to cover the costs whilst making the service free at the point of delivery.

This could be achieved by increasing the charge for harbour dues by an appropriate amount and then providing the service "free of charge". The vessels, if their country of registration is a MARPOL signatory, will in theory be obliged to comply with the procedures and bring their wastes ashore. It might, however, be worth considering incorporating some conditions requiring vessels to make use of the facilities as part of the conditions incorporated into the harbour dues system. We doubt that such a system will ever control the real "cowboy" operators, but these will always be difficult to control. Consideration might be given to refusing fishing licences to companies suspected of flouting the regulations.

A similar approach could be taken with respect to offshore oil installations. The oil companies, however, are generally environmentally conscious. They could reasonably be expected to make use of facilities provided and make the necessary payment. We doubt that it will be necessary to recover costs through licence fees. In order to ensure that they conform with the procedures which the Falkland Islands requires, however, it would be logical to include a requirement to do so in the licences awarded - probably by means of a PON. This would implement objective (h).

In summary, it is recommended that:

- An Environmental Protection Ordinance is introduced requiring wastes to be deposited at licensed facilities, restricting or banning the import of hazardous wastes.
- Harbour dues incorporate a charge for using waste collection and reception facilities provided at FIG's expense, with a requirement to use such facilities incorporated into the conditions.
- Offshore oil installations are required to follow a code of practice which is incorporated into a PON.
- Optional additional measures include refundable deposits on imported oils and motor vehicles.
- A bilateral agreement needs to be signed with the UK to permit exports of hazardous wastes.

If an Environmental Protection Ordinance is introduced, it may be appropriate to give consideration to other environmental measures which should be incorporated, for example relating to statutory nuisances, waste water discharges or nature protection. Also, a number of other provisions with regard to waste management might be included, such as defining the duties of the PWD. This issue is addressed further in the next Section.

4.4 Recommended Structure and Content of Legislation

4.4.1 Introduction

We have based our proposals for an Environmental Protection Ordinance on the UK Environmental Protection Act 1990 (EPA90). Other models could be used but, given the fact that the Falkland Islands is a UK dependent territory, it seems best to follow UK legislation where appropriate.

4.4.2 Definitions

The definition of waste is clearly the first issue which needs to be addressed in any waste management legislation. We recommend that the current definition used within the EU and recently implemented in UK legislation is used. This defines waste as:

'Any substance or object in the categories set out in Schedule 2B to this [EPA90] Act which the holder discards or intends to discard; and for the purposes of this definition —

> "holder" means the producer of the waste or the person who is in possession of it; and
>
> "producer" means any person whose activities produce waste or any person who carries out pre-processing, mixing or other operations resulting in a change in the nature or composition of this waste.'

The new Schedule 2B reproduces Annex I to the EC Waste Framework Directive 91/156/EEC.

"Hazardous waste" may also need to be defined. We favour the definition provided in the Basel Convention, where it is done by means of broad categories and properties:

> 'Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III.'

A simpler alternative might be the definition proposed in the Terms of Reference. The problem we have with this definition is that it is so comprehensive that it could lead to virtually all wastes being included as hazardous. This definition will certainly include all the Basel Convention wastes. The problem is that it may include most other wastes as well. For example, normal household waste can certainly result in hazards to human

health or the environment if it is improperly handled, stored, transported, treated or disposed of.

Finally, "controlled waste", "household waste", "industrial waste" and "commercial waste" may require to be defined. It would be possible to include commercial waste either with household or industrial waste. The reason for their separate definition in UK law is unlikely to be required in Falkland Islands legislation. It may be simplest, however, to conform with UK legislation, because it is well understood by the UK legal profession. Suitable definitions are to be found in Section 75 of EPA90 - with the rider mentioned below.

4.4.3 Wastes to be Regulated

The wastes to be regulated should be those defined as Controlled Waste, as in EPA90. This comprises most waste materials, with the exception of most agricultural wastes. In many countries, radioactive wastes are excluded because they are covered by other legislation. In the Falkland Islands, we are not aware of any suitable existing legislation which regulates these wastes and therefore we recommend that they are not excluded.

4.4.3 Regulation of Waste Management

A central feature of the proposed legislation is the licensing of facilities used for waste management. Such licences will need to be granted by a Competent Authority. This should be a different Department from the PWD, which is the main executing Department. There are two options - the Department of Health and Social Services, through the Medical Department, or the Environmental Planning Department. We recommend the latter, which already has responsibility for requesting and evaluating EIAs.

The licensing process will require technical expertise, probably beyond that which is available in the Falkland Islands at present. For the number of facilities that will require licensing, however, we do not consider that such expertise should be obtained or developed. It can be "bought in" as required from the UK or elsewhere. Such a practice has recently been adopted by the States of Guernsey, for example.

The procedure recommended for the licensing process is described in section 4.4.6 below.

The fundamental principle which needs to be introduced is the offence of depositing controlled waste on land which is not licensed. Section 33 of EPA90 provides a suitable wording format.

4.4.5 Duty of Care

We believe that the licensing of transporters or Duty of Care legislation would be unnecessarily complex administratively for a small community such as the Falkland Islands. It should be noted, however, that such a system has been proposed by consultants for the Military.

We do however recommend a system of consignment notes should be incorporated in a code of practice covered by a PON for oil industry wastes. This will enable tracking of the arising, storage and disposal of the wastes to facilitate monitoring of oil industry related wastes.

4.4.6 Licensing Procedure

The purpose of licences for waste management facilities is to ensure that they are designed and operated to adequate environmental standards. They should therefore contain conditions, which would be imposed by the competent authority.

Broadly speaking, sections 35 to 44 of EPA90 could provide the framework for the licensing procedure. For the Falkland Islands, some of the details may not be appropriate. For example, the provisions on Fit and Proper Person in s. 36. There are also many references to departments and authorities which do not exist in the Falkland Islands. DoE Circular 11/94 provides some detail on the working of the system.

An additional section could be introduced to ensure that all waste management facility licences prohibit the acceptance of imported hazardous wastes (other than from shipping, marine and offshore sources). This would effectively introduce a ban on the importation of such wastes. An exclusion could possibly be provided where such wastes were to be used for the purpose of reclamation or recovery. Wastes are imported to many countries for recovery as a useful economic activity, although it is difficult to foresee this occurring in the Falkland Islands.

4.4.7 Responsibility for Ensuring Collection and Disposal of MSW

Currently there is no legislation in the Falkland Islands compelling the FIG or any particular department thereof to provide a collection and disposal service for household waste, although this takes place (in Stanley) by custom and practice. We believe that it is worthwhile to make this responsibility mandatory for Stanley and any other large settlements that may develop, for the avoidance of doubt.

4.4.8 Transfrontier Movements of Wastes

The proposed bilateral agreement with the UK under EU Council Regulation 259/93 requires that appropriate documentation is provided under Title V of this Regulation. The UK Transfrontier Shipment of Waste Regulations 1994 provides the necessary procedures, which will need to be incorporated into Falkland Islands law. A simpler alternative might be to insist that all waste exports are handled by a Government Department, but this might present problems with MPA, who ship more such wastes than are likely to be shipped by the civilian community.

It must be once more stressed that the bilateral agreement, as it is currently being negotiated, related only to wastes from the Military. It is important that it is extended to cover wastes arising from civilian sources.

4.4.9 Timing and Method of Introduction

One alternative which might be worth considering is to delay the introduction of a Environmental Protection Ordinance and operate a "shadow" waste management facility licensing system, whereby the two organisation which are actually likely to provide waste management facilities in the near future, namely the PWD and the military apply for a "notional" licence to the competent authority. This could be used to test the system in practice before the legislation is introduced.

The problem with taking this approach, which is being tested at present in, for example, Guernsey, is that it will not introduce the prohibition of depositing waste at other locations, nor the other provisions proposed for the Ordinance.

4.4.10 Oily Wastes

It has been suggested above that a relatively small tax on imported lubricating oils could fund the provision of a waste oil recovery facility, thus implementing the Polluter Pays Principle. The tax could be refunded when waste oils are delivered to the facility for recovery. This would require appropriate legislation.

4.4.11 Wastes from Shipping

We have recommended that a service for wastes from ships be provided and that the cost be incorporated into harbour dues. We suggest that the conditions attached to fishing licences should require that no wastes are discharged into Falkland Islands waters (except for domestic sewage) and that such vessels as are found to do so will have their licences revoked and not renewed. The same should apply to harbour dues for reefers mooring in Berkeley Sound.

4.4.12 Wastes from Offshore Oil Facilities

Offshore oil facilities should be obliged to comply with the procedures recommended in section 8.6.5. In addition, a consignment note system, whereby all wastes produced are recorded, showing a description of the waste, the quantity and the method and location of disposal, should be required, by means of a PON.

It also appears that some confusion exists over the role of the incineration of waste at sea. Under the London Convention the incineration of shore-derived hazardous waste at sea by purpose designed marine incinerator ships was banned some two years ago. Under MARPOL, there are regulations concerning the design and operation of on-board incinerators for wastes arising from shipping and offshore facilities but there is no ban on such activities, nor is any envisaged. Consequently, incineration of MSW and similar wastes on an offshore oil exploration platform will continue to be an acceptable method of disposal.

4.4.13 Scrap Vehicles

Consideration could be given to introducing a returnable deposit on imported vehicles. This could be levied by FIG on import and refunded when the vehicle is shipped as scrap to the UK (or elsewhere). Alternatively, it could be raised on a gradual basis through the annual motor vehicle licence fee. This type of legislation is being considered for implementation in the EU under the proposed end-of-life vehicles directive. When the deposit is refunded, two-thirds could go to the vehicle owner and one-third to the company handling the scrap metal, to cover the costs of shipping etc.

This would encourage the recycling of scrap vehicles, but might not be the type of legislation which would be acceptable within the Falkland Islands culture.

5 RECOMMENDED ORGANISATIONAL ARRANGEMENTS

5.1 Existing Situation

The PWD currently has, *de facto,* responsibility for ensuring the sound management of household waste collection and disposal and also the provision of landfill facilities in Stanley. In Camp, waste management is undertaken by each community, at its own expense. The Private Sector delivers all waste collection services in Stanley, under contract to the PWD.

There is currently no waste regulatory function.

5.2 Proposals

5.2.1 Role of PWD

It is logical for PWD to continue its existing role, since it possesses greater experience in the field than any other department of FIG. We believe, however, that its responsibilities and powers should be defined in law, as is done in the UK, for the avoidance of doubt.

PWD should be charged with ensuring the provision of all necessary waste management facilities for the Falkland Islands. It should then be permitted to do this with its own direct labour or by contracting to the private sector, at its discretion.

If waste management standards are to be raised in Camp, this could place an additional burden of cost on the residents, which is likely to be undesirable and potentially unpopular. It would be entirely justifiable for PWD to finance these improvements - by providing, or financing the provision of, the necessary plant, equipment and advisory services, as needed.

If services are to be provided to shipping, it has been suggested that these be financed by means of an increase in the cost of harbour dues and then funded by FIG. PWD should be given responsibility to ensure that such a service is provided - probably under contract by the private sector, at its discretion. A similar service should be provided to the offshore oil industry.

In our view, PWD should also be given a duty to prepare waste management plans at appropriate intervals. This Study might form the first such plan, but it should be updated at, say, five year intervals.

We propose that the following duties be assigned to the PWD:

- To ensure that a collection service is provided for MSW in Stanley
- To ensure that environmentally sound procedures are followed for the disposal of MSW in Camp.

To ensure that waste management facilities are provided to treat and dispose of all wastes generated on the Falkland Islands (excluding wastes from the

Military) and to ensure that they are managed in such a manner as to avoid harm to human health or the environment.

To ensure that a waste collection and disposal service is provided for all shipping which desires to make use of it, together with offshore oil facilities.

To prepare and publish a Waste Management Plan at five yearly intervals. Section 50 of EPA90 provides a suitable wording, even though it has now been repealed by the Environment Act 1995, because of a change to the structure of waste management organisation in the UK. It does, however, include a number of features which would not be necessary or would require adaptation - such as the licensing policy (3) (e) and most of sub-sections (5) onwards.

5.2.2 Role of Environmental Planning Department

We have already indicated that it is our view that the Environmental Planning Department should act as the waste regulation authority. Clearly, it would be inappropriate for the PWD to act in this role, even though it does have more knowledge and experience of waste management, because of its executive functions. If it were to be the regulation authority it would effectively be regulating its own activities.

The Environmental Planning Department would almost certainly need some external assistance in setting the technical conditions for waste management licences, since its strengths and experience lie in other directions. This could readily be provided by means of an external consultancy, as is done in, for example, Guernsey.

5.2.3 The Role of the Public and Private Sectors

It is generally accepted that competition is the key to ensuring the most efficient use of resources, whilst monopolies tend to lead to complacency, lack of innovation and inefficiency. If this were the only factor at work, it would be logical to ensure that all services were provided through competition between several organisations, be they public or private. On the other hand, economies of scale can offset the benefits of competition and it can be shown that the cost of providing certain services, particularly utilities, is substantially lower if they are provided by a monopolistic supplier. This is particularly true in smaller communities, such as the Falkland Islands. A typical example is the supply of electricity.

A function of the public sector is often to control (and usually own) "benign monopolies". The objective of the public sector in this regard is usually to ensure that a service is provided to the entire population on a fair and equitable basis, when it is not practical for it to be provided by the private sector in competition. The public sector also has a regulatory and controlling function, such as land use planning, public health and environmental protection. It is often possible for the public sector to take a longer term view of what is right for the population as a whole, whilst the private sector will generally only provide services in order to make a profit. If the two can

coincide and economies of scale do not dictate that a monopoly is necessary, then the private sector will normally provide the more cost effective service.

In the field of waste management, environmental protection and, to a lesser extent, public health are key aspects. In countries where the private sector is heavily involved in providing waste management services, the public sector is obliged to play a strong role in controlling activities by means of strict legislation and enforcement.

The Falkland Islands, by nature of its size, does not have extensive resources to devote to regulation and enforcement of waste management standards and therefore the view is likely to be taken that the best way to ensure environmental protection is for the FIG to operate waste management facilities and services in the role of, to all intents and purposes, a monopoly provider.

In many countries, monopolistic service providers, especially in the public sector, can display some of the following characteristics:

- Lack of innovation
- Lack of response to changing market needs and conditions
- Less incentive to control costs
- Misallocation of resources relative to market needs

The private sector frequently performs better in these areas. It also may be able to share overheads or physical resources with other activities already being performed to offer services at a lower cost than the public sector. On the other hand, the public sector frequently has access to relatively inexpensive sources of finance and, because it does not have a profit motive, is content with relatively low rates of return on its investments. The private sector, of course, is generally concerned primarily with profit and will not only seek higher returns on investment but may also have less regard for non-financial issues such as environmental protection, unless it can see that this will directly affect its future profitability.

From the foregoing, it is evident that both public and private sectors have a role to play in the provision of waste management services. The public sector, with its environmental protection role should be responsible for defining the quality, particularly environmental quality, of the service and ensuring its provision. The private sector may, in some cases, be better able to deliver the service at lower cost. In addition, where rapid response is required to changing market needs and conditions, the private sector may have something very positive to contribute. An example of this is in the field of recycling.

Since most of the important waste management facilities in the Falkland Islands are likely to be in a monopolistic position, the ownership of these facilities is likely to be better placed in public hands for two main reasons: the public sector will be better able to control their environmental impact and because it has access to lower cost finance.

The private sector may have a significant part to play in the future of waste management in the Falkland Islands. Waste collection and possibly recycling are two areas where it has much to contribute.

5.3 Implementation of Strategy

The above section sets out recommendations for the organisation appropriate for the ongoing operation of solid waste management in the Falkland Islands. It will become clear, however, that the implementation of the initial changes in methodology, especially as regards the technical options, will require substantial technical and organisational resources in excess of those which are currently, or likely to become, available.

If the proposed strategy is to be implemented within a reasonable time frame, additional resources will be required in the short term to undertake, *inter alia*, the following tasks:

- Technical decision making
- Final selection of technical options
- Selection of detailed location of facilities
- Detailed design and specification of facilities
- Purchasing and acquisition of equipment
- Preparation of tender documents
- Selection of contractors
- Overall supervision of contractors
- Definition of operational procedures
- Application for waste management licences
- Issuing waste management licences
- General administrative issues: budgets, authorisations etc.

It is recommended a Strategy Implementation Team is established, under the overall management and supervision management of PWD, and that most of the tasks shown above should be performed by short term project management and technical consultants providing the following support:

For PWD:

- Project management and coordination - 120 man-days
- Technical support and design (from UK/overseas) - 80 man-days
- Design and implementation of communications programme - 40 man-days

For Environmental Planning Department:

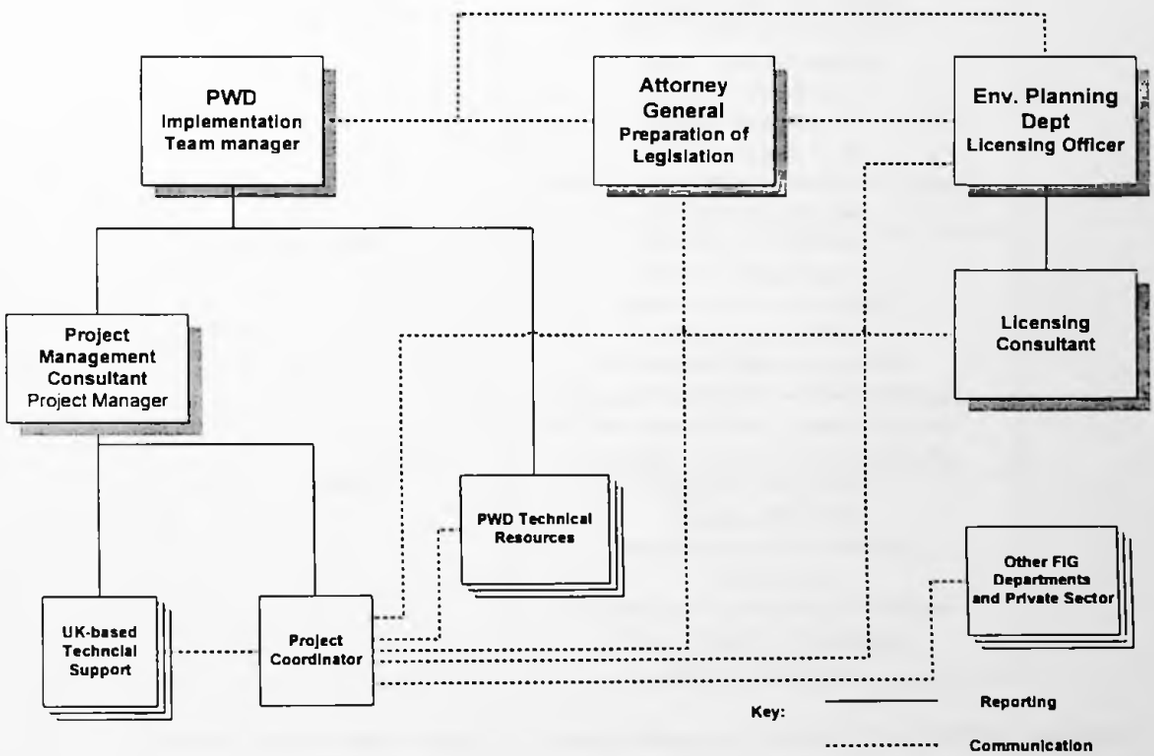
- Technical advice on licensing - 30 man days

The time estimates are approximate and reflect an initial assessment of the work needed. We would envisage that three consulting firms would be required: one as the main project management and technical consultant to PWD, a second, independent, firm to advise the Environmental Planning Department and a third, probably local, specialist to handle the

communications issues. In addition, some 15 man-days of technical assistance in the Falkland Islands would need to be provided by contractors for the safe packaging of the sheep dip and for the inspection and evaluation of the hospital incinerator. Additional resources would be required to undertake the licensing of facilities at MPA, which has not been included in the above estimates.

We estimate the total costs of providing this consultancy to be in the region of £100-125,000. Whilst this is a large sum, we do not believe that it will be possible to implement the Strategy without assistance of this kind. The proposed organisation of the implementation team is shown in Figure 5.1. The definition of the tasks to be performed is described in more detail in section 12.

Figure 5.1: Organisation of Strategy Implementation Team



6 REVIEW & COARSE SCREENING OF TECHNICAL OPTIONS

Selection of technical waste management options requires consideration of the various stages of the waste management process, namely Segregation, Recovery and Reuse, Recycling, Pre-treatment and Final Disposal. For some waste streams, it is necessary to consider a range of configurations whereby different options are selected at different stages. The entire range of technical waste management options has been reviewed in appendices A and B. Of these, the ones that might be reasonably practical in the Falkland Islands have been identified and described in section 12 of the Consultation Paper. These are summarised in Table 6.1.

Table 6.1: Process Options for Evaluation

Stage	Process
Segregation	CA site CA site with authorised scavenging Two bin system for dry recyclables Two bin system for bio-wastes "Bring" system Differential disposal pricing Encourage recycling by private sector Producer responsibility for battery segregation Stronger bags for healthcare waste Central sorting facility for hazardous wastes Facilities for shipping
Recovery	MRF - Hand sorting
Reuse	Schools resource centre
Recycling	Paper - thermal insulation Paper - animal bedding Metals - export to UK Glass - export to UK Tyres - export to UK Recovery/recycling of CFCs and halons Oil recovery for fuel
Pre-treatment	Anaerobic Digestion Aerobic composting Green waste composting Home composting Incineration/Waste-to-energy Upgrade healthcare waste incinerator Waste Derived Fuel - "energy loaves" Hazardous waste treatment in UK
Landfill	Upgrade Eliza Cove Develop Mary Hill Cooperation with the military Other sites Procedures for landfilling in Camp Special waste procedures Secure landfill cell

These options were then compared, using criteria as described in section 13 of the Consultation Paper, in order to produce a short list for more detailed examination. The results of the evaluation are shown in Tables 6.2 to 6.5.

Table 6.2: Assessment of Segregation Options

Option	Policy Compatibility	Minimise Policy change	Technical Suitability	Reliability	Environmental Performance	Public Acceptability	Cost	Sustainability	TOTAL SCORE
CA site	5	5	8	10	5	6	13	7	59
CA site/scavenging	5	5	10	10	6	8	13	8	65
Two bin - dry recyclables	5	5	10	10	9	8	9	10	66
Two bin - bio-waste	5	5	10	10	9	8	9	10	66
"Bring" system	5	4	10	10	8	6	12	10	65
Encourage private sector	5	5	5	7	8	10	15	10	65
Differential pricing	5	2	10	8	8	7	15	10	65
Battery segregation	5	2	5	5	7	5	15	10	54
Healthcare waste bags	5	4	10	10	9	9	7	10	64
Sorting for hazardous wastes	5	5	10	8	8	8	12	10	66
Facilities for shipping	5	4	10	9	8	10	15	10	71

Table 6.3: Assessment of Recovery, Reuse and Recycling Options

Option	Policy Compatibility	Minimise Policy change	Technical Suitability	Reliability	Environmental Performance	Public Acceptability	Cost	Sustainability	TOTAL SCORE
MRF - Hand Sorting	5	2	5	8	8	10	5	10	53
Schools Resource Centre	5	2	8	8	5	10	12	10	60
Paper - insulation	5	3	9	8	10	10	10	10	65
Paper - animal bedding	5	2	5	6	6	6	12	8	50
Metals - export to UK	5	2	10	10	9	9	10	10	65
Glass - export to UK	5	2	10	10	9	9	10	10	65
Tyres - export to UK	5	2	10	9	10	9	10	10	65
Recovery/recycling of CFCs and halons	5	4	10	10	8	10	12	10	69
Oil recovery	5	4	8	7	10	10	12	9	65

Table 6.4: Assessment of Pre-treatment Options

Option	Policy Compatibility	Minimise Policy change	Technical Suitability	Reliability	Environmental Performance	Public Acceptability	Cost	Sustainability	TOTAL SCORE
No pre-treatment	2	5	10	10	3	7	15	7	59
Anaerobic Digestion	5	2	3	5	10	9	5	7	46
Aerobic Composting	5	2	3	5	8	6	7	8	44
Bio-waste composting	5	3	9	9	9	9	11	10	65
Home Composting	5	4	9	10	7	9	13	10	67
Waste-to-energy	5	2	5	10	8	8	5	10	53
Upgrade hospital incinerator	5	5	10	10	7	10	13	7	67
Waste Derived Fuel - energy loaves	5	4	9	10	8	9	13	8	66
Hazardous waste to UK	5	5	10	10	10	10	10	10	70

Table 6.5: Assessment of Landfill Options

Option	Policy Compatibility	Minimise Policy change	Technical Suitability	Reliability	Environmental Performance	Public Acceptability	Cost	Sustainability	TOTAL SCORE
Eliza Cove	10	5	10	10	6	6	13	5	65
Mary Hill	10	5	10	10	8	8	13	10	74
Cooperation with military	10	3	10	9	9	10	15	10	76
Other sites	8	3	5	10	5	5	13	7	56
Landfilling in Camp	10	5	10	10	7	8	11	10	71
Special waste procedures	10	5	10	9	10	10	13	10	77
Secure landfill cell	10	5	10	8	10	8	10	7	68

Options achieving a score of 60 out of the possible 75 have been short listed and are shaded. An explanation of some aspects of the scoring is given in section 13 of the Consultation Paper. The short-listed options were:

Segregation Options

- CA site with authorised scavenging
- Two-bin systems for dry recyclables or bio-waste
- "Bring" system for recyclables
- Encouragement of private sector to enter recycling activities
- Stronger healthcare waste bags
- Sorting and storage of hazardous wastes
- Facilities for shipping

Recovery, Reuse and Recycling Options

- Paper for thermal insulation
- Metals, glass and tyres for export to the UK
- Recovery/recycling of CFCs and halons
- Oil recovery

Pre-treatment Options

- Bio-waste composting
- Home composting
- Upgrade Healthcare Waste Incinerator
- "Energy loaves"
- Hazardous waste for export to UK

Landfill Options

- Upgrade Eliza Cove
- Develop Mary Hill as a landfill for all wastes
- Develop Mary Hill as a landfill for inert wastes only
- Cooperate with military
- Procedures for landfilling in Camp
- Procedures for special wastes, e.g. carcases, asbestos etc.
- Secure cell for landfill of hazardous wastes

Of these options, further evaluation in section 14 of the Consultation Paper revealed that the following options would not, for the reasons given, be practical in the Falkland Islands:

- Paper for thermal insulation - requires newsprint grade paper, rather than office paper
- "Energy loaves" - economies of scale/lack of demand
- Upgrading Eliza Cove - small remaining airspace
- Secure landfill cell for hazardous wastes - very small volumes would give technical problems

7 EVALUATION AND RANKING OF SHORT LISTED TECHNICAL OPTIONS

Section 14 of the Consultation Paper shows the technical and preliminary financial evaluation of the short-listed options, after eliminating those deemed impractical as described in the preceding section. In this section, we select from these the preferred options, which are then described in detail in Section 8. Table 7.1 shows a summary of our evaluation of the short-listed options. It should be noted that, in some cases, the costs have been revised since the production of the Consultation Paper and now conform with the figures quoted in sections 8 and 11.

Of the options evaluated in Table 7.1, we believe that all should be selected as preferred options to form part of the strategy with the following exceptions:

- A two-bin system for separating bio-wastes is only viable if a process for treating the bio-waste is economically viable. It will be seen below that we do not consider this to be the case. We also believe, from our experience during the waste analysis, that the quality of separation likely to be achieved in Stanley would not be sufficient to ensure a good enough quality of product.

- A two-bin system for dry recyclables would be more expensive than a "bring" system. Also, from the results of the survey, we suspect that the response from the public would not be appreciably greater than if a "bring" system were introduced.

- Composting of bio-waste is practical but the collection of such material from MSW is likely to be relatively expensive. We also have doubts, as mentioned above, as to whether the degree of segregation achieved by householders would be sufficient to ensure a product of good enough quality to ensure a stable end-use market. Composting of green wastes arising from horticulture, however, would be worth pursuing and will be evaluated further in the next section.

- Because of the potential problem of attracting birds to a landfill accepting putrescible wastes, we do not favour the option of using Mary Hill for all wastes, in view of its proximity to the airport. It is also substantially more capital intensive than the option of cooperation with the Military. There may also be other land use planning objections to such a proposal. It is therefore recommended that FIG cooperates with the Military to make use of their existing and newly developed landfills.

Table 7.1: Comparison of Short-Listed Options

Option	Capital Cost (£'000)	Estimated Annual Operating Cost (£'000)	Environmental Impact	Technological Requirements	Additional Manpower	
					FIG	P'v't Sector
CA Site with scavenging	5	6	+	*	0.25	-
Two bin system for dry recyclables	-	15[1]	+	*	-	0.5
Two bin system for bio-waste	-	15[1]	+	*	-	0.5
"Bring" system for recyclables	1	7	+	*	-	0.2
Healthcare waste bags	-	0.3	++	*	-	-
Sort & store hazardous waste	-	1.4	++	**	0.05	-
Collection service for shipping	135	107[2]	+++	*	0.1	0.6
Recycle cans in UK	30	4[3]	+	*	0.15	-
Recycle scrap metal in UK	-	3.5[3]	++	*	0.1	-
Recycle glass in UK	-	1[3]	+	*	-	-
Extract CFCs	2	1	+	*	0.05	-
Recover oils	10	4.8	++	**	-	0.05
Compost from bio-waste	25	7.5[5]	+	**	-	0.25
Home composting	25	4	+	*	-	-
Upgrade healthcare waste incinerator:						
upgrade existing plant	60	4	++	*	-	-
new plant to medium standards	60	4	++	*	-	-
new plant to UK standards	300	30	+++	**	1	-
Hazardous waste to UK	15[4]	2	++	*	-	-
Upgrade landfilling standards in Camp	-	10	+	*	-	0.3
Upgrade Mary Hill:						
All wastes	195	70	++	**	2	-
Inert wastes only	10	10	+	*	0.2	-
Cooperate with Military	80	25	+++	*	0.5	0.4

Notes:

1 These systems are only practical if a use or market exists for the product collected. Also only one of these two options can be selected without the need to purchase additional bins at a substantial cost.

2 These costs are foreseen to be recovered from shipping operators and therefore the cost to FIG would be nil

3 Any costs incurred for shipping to the UK must be added to this figure.

4 One-off cost for sheep dip disposal - not a capital cost.

5 This cost would be offset by savings on purchase of topsoil for landscaping

8 DESCRIPTION OF PREFERRED TECHNICAL OPTIONS

8.1 Introduction

This section describes the preferred technical options identified in section 7. In addition, it addresses a number of specific waste streams and issues which have not been specifically identified in the list of technical options. These waste streams will be able to be managed by means of the selected options, but certain matters warrant further description.

8.2 Segregation Options

8.2.1 CA site with authorised scavenging

A Civic Amenity (CA) site should be constructed in Stanley in order to allow residents to dispose of bulky and other wastes without having to enter the landfill itself, with the consequent risk to health and safety. Allowing members of the public on the landfill also invites criticism as to the way it is managed. Whilst some of this may currently be justified, a landfill is never an attractive sight to the untrained eye and consequently public access should be minimised.

A location for a CA site has already been identified but we consider that this has several disadvantages:

- It is on soft ground, necessitating the placement of an expensive stone base which, itself, is likely to degrade with time and require maintenance.
- It is close to Eliza Cove, leading to the temptation to continue to visit the site.
- It is not in a location at which the provision of intermittent supervision is convenient.

Scavenging of waste materials is clearly part of the Falkland Islands culture and it provides a useful method of conserving resources and minimising the amount of waste requiring landfilling. It needs to be carried out under controlled conditions, to ensure public safety. A CA site could be established with this in mind.

We recommend that a portion of land is made available at the "Megabid" site, where hardstanding already exists and which is closer to Stanley and therefore more convenient. Containers could then be placed for different types of material, notably timber, metal, household appliances and other wastes. For the first three in this list, at least two containers should be provided, so that the materials can remain available for access by the public for, say, two weeks before being landfilled. The actual number of containers required will only be able to be determined by experience. Eight or ten will probably be more than sufficient. Some 600 m^2 of land should be adequate, which appears to be readily available at the Megabid site.

Containers for any recyclables that are to be collected via a "bring" scheme could also be provided at the site. In addition, a compound for the reception of lead-acid batteries should be provided.

The site should be supervised from time to time by a PWD employee, who can ensure that it is kept in a clean and tidy condition. If other waste management activities are also undertaken by PWD (see below), such as segregation and/or processing of recyclables, this employee would also be able to assist with these duties, so that supervision of the CA site would be a part-time occupation.

Assuming that sufficient hardstanding is already available at the Megabid site, the cost of providing the CA site would be about £5,000 for the containers. Emptying the containers would cost about £1,500 p.a. and a supervisor devoting 25% of his time another £4,000. It may be necessary to use a loader to clear the site of debris etc. from time to time, costing perhaps £1,500 p.a.. Allowing for depreciation of the containers, the annual cost would be about £6,000.

8.2.2 "Bring" system for dry recyclables

One outcome of the attitude survey undertaken in Stanley is the positive reaction of many householders to the principle of recycling. We discuss the actual benefits and costs of recycling in section 0 below. The most cost-effective method would be to introduce the "bring" system, whereby containers are placed at strategic points, such as near to shopping centres, the school etc. and householders bring their recyclable materials to the container. In addition, the pubs should be required to separate their cans and bottles from other waste materials and should, ideally, be persuaded to make use of can crushers, to increase the quantity of waste that can be contained in a bin. The existing 1100 litre containers, together perhaps with some of the smaller bins, depending on the location, would be ideal, although special lids would be preferable for the larger bins being used by the general public, with apertures for the bottles, cans etc.

The yield of materials would probably be less than a two-bin system, since fewer people would participate. We estimate that the yields achieved by a "bring" system would be about 75% of that for a two-bin household collection system. The two-bin system, however, would be appreciably more expensive and could be unpopular with a significant number of people, as revealed by the survey.

We estimate that the cost of collection for a "bring" system would be around £7,100 p.a. or possibly less.

8.2.3 Encouragement of private sector to enter recycling activities

In principle, encouragement of the private sector to engage in recovery and recycling activities should involve little cost on the part of FIG, and can only be beneficial. We do, however, have some doubt as to whether there is enough potential financial gain, given the small volumes of material, for any Falkland Islands company to take much interest in such activities. Whilst the FIG should certainly do everything it can to encourage such activities, we do not feel confident that anything significant is likely to be achieved.

8.2.4 Stronger healthcare waste bags

The physical handling processes for healthcare wastes present the greatest risk to public health. One of the main reasons for this is that they are contained in normal gauge plastic bags, which can easily rupture. The European ADR regulations are likely not to permit this in the future, unless the bags are of thicker gauge or are themselves contained in rigid plastic containers. The safest system is to use rigid sealable plastic containers - typically holding about 60 litres (about 18 kg)- which cost about £5 apiece. Alternatively, plastic lined cardboard boxes can be used, at about half the price. The least expensive solution, however, is to use a stronger gauge of plastic bag which, it is believed, will conform with the regulations. These cost about 15p each and hold about 5 kg - which equates to £30 per tonne. These bags need only be used for "risk" waste, which probably does not exceed 10 tonnes p.a., leading to an additional cost of £300 p.a.

We recommend that these bags are used. They can be obtained from: Griffiths & Nielsen Plastics, Billingshurst, Sussex (0044-1403-784881)

8.2.5 Sorting and storage of hazardous wastes

Hazardous wastes arise in the Falkland Islands in very small quantities. They can be shipped to the UK for disposal (when the bilateral agreement is finalised), but require to be accumulated into reasonably economic quantities to minimise transport and handling costs. It is recommended that the PWD establishes a secure storage container for these materials. This container should be well ventilated and possess a lip at the entrance to contain spillage. It should also be equipped with fire prevention apparatus, suitable for dealing with different types of fires. A qualified chemist (for example from the School or Department of Agriculture) should have overall responsibility for ensuring that incompatible materials, which might react together, are kept totally separate from each other and his (or her) advice sought whenever new wastes are brought to the storage container.

Within the container, the wastes should be enclosed in secure lidded drums and appropriately labelled identifying the source of the waste and, as far as possible, the principal hazardous constituents. If the wastes are contained in bottles or other small packages, these should be packed in vermiculite into the drums, with only materials of similar chemical composition being placed in any one drum. The cost of equipping the container would be about £1,000.

The cost of providing this service would be relatively low, involving no more than 2 hrs per week from a qualified chemist, say about £1,300 p.a., giving a total cost including depreciation of £1,400 p.a.

An alternative might be to make use of the secure compound that will be set up by Stanley Services to service the offshore exploration industry. In this case, it is likely that the supervision could be provided by Stanley Services, although the cost might be somewhat higher.

8.2.6 Services to Shipping

Solid Wastes

We recommend that a solid waste collection service is provided to shipping which is free of charge at the point of delivery and is funded by an increase in the cost of harbour dues. This view is supported by the Harbour Master. It is probably best that this service is provided by the private sector, which already provides supply services to shipping. This could be done by means of a contract with PWD.

Lidded skips, fitted with rings for securing on deck, should be provided to any vessels which require them. These could then be collected by the supply vessels when visiting the ships or could be exchanged at FIPASS when ships enter Stanley Harbour. For larger vessels, skips similar to those currently used on land - but with lids to prevent spillage in rough weather and high winds - could be used. Ideally, they should be constructed of galvanised steel. For smaller vessels, galvanised steel 1100 litre containers could be used, again with rings for securing on deck.

We assume that 50% or 150 of the vessels visiting Falkland Islands waters might potentially make use of the service. If each vessel using the service is equipped with a container, it may be that some 100 containers would be required, of which about 70 would be the smaller type. This takes account of the fact that not all vessels are in the area at the same time and that some can therefore share containers. It would be inadvisable to order this many in advance, however, until the likely response is more accurately gauged. If our assumptions are correct that about 600 tonnes would be brought ashore, then each container would need to be emptied about 8 times a year - leading to 560 small container movements and 240 skip movements. The shore based cost of handling these containers would be about £5,000, assuming similar rates to those currently quoted to PWD for providing skip and 1100 litre collection services. It is difficult to estimate the cost of delivering the containers to the ships but, following further discussions on our second visit, we estimate that about 50 vessel days would be required. Assuming a vessel such as the "Forrest" were used, the cost would be in the region of £75,000. It would be necessary to obtain quotations from possible suppliers to confirm these figures.

Allowing a five year life for the containers, because of the adverse conditions at sea, the depreciation on the containers, which would cost about £60,000 to purchase, together with an allowance for maintenance would be £15,000 p.a., so that the total cost of providing the service might be as much as £95,000 p.a., depending on the number of vessels which make use of the service. This amounts to an average annual charge per vessel of about £650. Naturally, the charges for the reefers moored in Berkeley Sound would need to be higher than those for the smaller fishing vessels.

An alternative system could be introduced, whereby the reefers undertake responsibility for the waste from all the fishing vessels servicing them. It would then only be necessary to collect the waste from the reefers, in which case larger skips could be used exclusively. This might enable the cost of collection to be reduced by about £15,000.

Liquid Wastes

Sewage

Annex IV of the MARPOL regulations requires that facilities be provided for the reception of sewage effluent from ships visiting port. We do not believe that the Falkland Islands should provide such a service, since there is no sewage treatment works and the existing sewage from Stanley is discharged into Stanley Harbour. Accepting sewage from shipping, which would otherwise be discharged to the open sea would simply increase the pollution load on Stanley Harbour. If the sewage system were to be improved, it is likely that this would be done by means of a long sea outfall, rather than a treatment works, so that even then there would be absolutely no positive environmental benefit, whilst any reception facilities would introduce a significant cost.

Waste Oils and Oily Water

Similarly to sewage, the MARPOL regulations, Annex I, requires that facilities be provided for the reception of oily wastes from ships visiting port. Additionally the existing regulations require Falkland registered vessels to use such facilities.

We estimate the annual arisings of oily waste at 650t and of oily water at 350t, based on the volume of shipping currently using Falkland Island waters and assuming the ratio of oily waste to oily water is similar to that landed at reception facilities at UK fishing ports. At present the capacity of reception facilities to be provided remains an estimate and should be based on a modular system which can be developed stepwise as demand is demonstrated. At a minimum, the reception facilities should consist of a bunded storage area at the dockside capable of storing an average of one weeks arising of up to 80 drums of used oil. Small oil spills can be cleaned up by absorption in sand or clay which may be landfilled. Larger spills would need re-drumming. The drums may be transported to the oil recovery centre by any vehicle or trailer onto which they can be manhandled or lifted by an on vehicle hoist

Based on the proportions of oily water to oil waste landed at reception facilities at fishing ports in the UK, the quantity of oily water being produced will be around half that of the oily waste, that is the equivalent of 40 drums per week or nominally 10,000l. The prevalence of onboard oil/water separators in Falkland waters on all but the smallest vessels indicates that landings of oily water will generally be much less.

It is a requirement of the MARPOL regulations that the reception facilities provided do not seriously impede the turn round time of docked vessels. We therefore recommend the provision of a small road tanker or trailer mounted tank with onboard pump unit. The tanker should have a minimum capacity of 5000l to shuttle between the dockside and the oily water treatment facility.

The operation of the dockside reception facilities for waste oil/oily water and of the oily water treatment unit should be contracted out by PWD. The service should be provided on a demand basis with prenotification.

There is no requirement under MARPOL to provide a disposal service for the oily wastes landed and the costs of the service and capital requirements should be wholly borne by the vessel operators.

8.2 Recovery, Reuse and Recycling Options

8.3.1 Introduction

We have already explained that there is unlikely to be a useful market for recovered paper. The materials for recycling would therefore be limited to glass bottles and cans.

From our approximate analysis of the composition of MSW in Stanley, the potential for recovery of recyclables from household waste is as follows:

Glass	183 tonnes
Cans - steel	33 tonnes
Cans- aluminium	3 tonnes

Practically, the participation rate by householders is unlikely to be better than 50%[1]. The capture rate - which measures the amount of materials actually recovered by the householder - may be as high as 90%, leading to a gross recovery rate of 45%. It can be expected, however, that the proportion collected from pubs and clubs would be 100%. The net potential yield of materials is therefore projected to be:

Glass	93 tonnes
Cans - steel	17.5 tonnes
Cans - aluminium	1.5 tonnes

[1] In a study by the European Recovery & Recycling Association, a participation rate of 68% was recorded in Adur DC on the South Coast of England using a two-bin system. We suspect that achieving 50% in Stanley using a "bring" system is optimistic.

In addition to the materials recovered from the MSW stream, there may be an opportunity to recover vehicle tyres.

8.3.2 Metals, Glass and Tyres for Export to the UK

The economics of shipping materials to the UK will ultimately depend on the price that can be negotiated between the FIG, the military and possibly ultimately Stanley Services. We do not believe that, as Consultants, we should become involved in such negotiations for fear of inadvertently compromising the FIG's position. We have therefore confined this section to examining the practical aspects and the prices achievable for materials delivered cif the UK.

Metals

There are three types of metals which might be shipped to the UK: beverage cans, larger ferrous metal items, such as cars and items of plant, together with lead-acid batteries from vehicles and electricity supply systems.

Beverage cans

If a segregation and recovery service were offered in Stanley, it might be expected that some 35 tonnes of cans could be collected each year. Although it is difficult to predict the aluminium proportion, this might amount to about 1.5 tonnes.

A small magnetic separator and baler or flattener could be used to process cans into two types - Aluminium and tin-plate. A plant would cost about £30,000 and should be operated by two men (for health & safety reasons). The quantity arising in the Falkland Islands could probably be processed in 2 or 3 hours a week, so that the ongoing operating costs would not be high - probably around £7,000 a year, including depreciation.

The aluminium cans could be shipped to the British Alcan plant at Warrington, where the current price offered is £750/tonne. The net revenue to FIG might be about £1,000, after allowing for transport and handling.

Tin-plate can scrap may fetch about £15/tonne, but transport and handling costs within the UK would probably offset this price. Provided the shipping cost is little or nothing, recycling of this material could be justified on environmental grounds - although there would no consequent saving at the landfill except for a small amount of airspace, which is not in short supply.

The net cost of operating the processing and recycling of beverage cans can be projected to be around £6,000 p.a. before shipping costs.

It should be noted that if the Military were to install a magnetic separator and baler, it might be more economic to share their facilities.

Large items of ferrous scrap

Provided that shipping costs were low, this material may be able to be recycled in the UK at a break-even cost. There may also be a market in Chile, to which it is understood a vessel (the "Tamar") travels largely empty twice a year. Scrap motor vehicles and other equipment has the potential to fetch about £25/tonne or more, depending on the material purity. Like the tin-plate scrap, however, most of this price would probably be absorbed by the costs of transport and handling in the country receiving the material. It is very likely, however, that the material could find a market.

There is currently a substantial stockpile of scrap metal which has accumulated over many years. Some is deposited at Mary Hill Quarry, some remains on site and there are a number of large oil tanks, notably on the North side of Stanley harbour and at Albermarle. A project to recover ferrous scrap from South Georgia is being evaluated at the present time. If this proves viable, a ship will come to collect it. This ship could also make a collection in the Falkland Islands. This could make the recovery of existing ferrous scrap economically viable without the need for organising separate shipment to the UK.

It is recommended that close liaison takes place between the FIG and the Governor's office, which is responsible for the South Georgia project, so that, if the project goes ahead, suitable preparations may be made for the collection of other scrap metal from the Islands. It is unlikely that this will earn any positive revenue for FIG or the owners of the metals, but it would contribute to cleaning the Falkland Islands environment.

If this venture does not take place, an alternative might be to cooperate with the military in acquiring mobile plant suitable for processing scrap metal - either by purchasing or by hiring for a period of time.

The type of equipment required would be a mobile hydraulic guillotine shear. This reduces the volume of the scrap in its charging box by means of side-compression wings, and then projects this "log" of metal against the vertical shear blade which cuts it into chunks of predetermined size. The output still contains whatever dirt or other contamination was present in the raw material, and is no longer generally acceptable to most steelworks outside the former Soviet bloc. Such material is now normally fed into a fragmentiser which maximises density, separates ferrous and non-ferrous metals, and removes the dirt. Sheared scrap produced in the Falklands would have to be shipped to the UK, Brazil or Chile, where a price of around £25/tonne could be expected.

There is a considerable choice of shear capacities based on the cutting force. If military scrap were to be included, a machine of 500 tonnes cutting force would probably be required and would deal with a wide range of material.

The Belgian manufacturer Lefort has particularly wide experience of mobile shears and almost certainly has the major share of the European market. It has machines operating in South America. This type of plant would cost about £250,000.

Without cooperation with the military, the quantity of metal wastes arising in the Falkland Islands could not economically justify the use of a mobile shear, except perhaps on a one-off hire basis. We believe that, for the ongoing production of scrap metal, it should be flattened as much as possible using a bulldozer or landfill compactor and then shipped "as is" to the UK or Chile. The net cost of providing the service would be the cost of handling and transport in the Falkland Islands - about £3,500 - plus whatever is paid for shipping to the UK.

Lead-acid batteries

Lead-acid batteries could be accepted at the CA site for recycling. The value of the lead for recycling purposes is significant and should cover the cost of handling and shipping back to the UK. Handling methods are discussed under Hazardous Wastes below. They are estimated to cost about £500 p.a. Again, it might be better to share facilities with the Military.

Glass

Segregation and recovery of glass bottles in Stanley might yield about 90 tonnes p.a. If this were shipped to the UK, an average price of about £30/tonne could be obtained - provided it is sorted by colour. After transport and handling in the UK, the net price would probably be about £20/tonne. This should more than cover the cost of handling in the Falkland Islands - leading to a potential break-even position or even profit, apart from any shipping costs.

Tyres

Tyres present a greater problem. A market does exist in the UK for good quality used tyres - which can be retreaded. The quality, however, is crucial and the cost of disposal of rejects is now substantial. Consequently, we believe that this is only worth pursuing if the Military also make use of such a route, so that an existing market is established. In any event, many of the tyres which are disposed of will not be of suitable quality.

We understand that a second hand market for tyres - particularly from 4 wheel drive vehicles - exists in several South American countries. The company JFB Trading in Brazil has been mentioned to us as a possible purchaser, or at least outlet for, tyres.

If this outlet does not prove fruitful, tyres unsuitable for re-treading may need to be landfilled. In the proposed EU landfill directive, landfilling of tyres will be prohibited in any form. We believe, however, that the justification for this is that, as a material, tyres have significant energy recovery potential. Such an approach, however, would not be appropriate for the Falkland Islands, because of the low volumes and high transport costs to a suitable market.

Tyre shredding is a possibility, but a shredder would cost at least £85,000, which is hardly justifiable for the 10 tonnes or so of tyres produced annually by the civilian population. It might, however, be viable in conjunction with the military. If it is not, tyres should be landfilled as described in section 8.5.6.

One other possibility exists. If the MPA incinerator is installed at the abattoir for the incineration of SBM, it could also be used for the incineration of tyres. This could possibly be achieved without the emission of black smoke provided that the afterburner is raised to operating temperature before introducing tyres to the main combustion chamber. However trials would be needed to establish optimum combustion conditions and demonstrate performance. The tyres would have a substantial energy value and would mean that the amount of support fuel required for combustion of carcases would be significantly reduced.

8.3.3 Recovery/Recycling of CFCs and Halons

The main uses of CFCs are as an aerosol propellant, for blowing plastic foams and as a refrigerant gas. Halons are used mainly in certain types of fire extinguisher.

The actions which can be taken by FIG to minimise emissions of CFCs to atmosphere are somewhat limited. They are described below for each different application.

Aerosols

The use of CFCs as a propellant in aerosols has been reduced over the past few years. The CFC is emitted during the use of the aerosol, and consequently it is the *use* of the aerosol which causes CFC emissions rather than its disposal. The only action that can be taken is to discourage the use of such products through a communications campaign. For some products, notably medical aerosols, there currently appears to be no practical alternative.

Plastic foams

CFCs are used as a blowing agent for many polyurethane and polystyrene foams, particularly for use as insulation. In "closed cell" foams, of the kind used as insulation, the CFC remains present in the foam. It is technically possible to recover a large proportion of the CFC by crushing and capturing the gas. We are not aware that this is yet being undertaken on a commercial scale and it would certainly be prohibitively expensive in the Falkland Islands. The low density of plastic foams would render transport to a plant in the Northern hemisphere extremely expensive.

The amount of CFC present in foams in the Falkland Islands is extremely small in global terms and we do not recommend any action in this regard.

Refrigerant gases

Whilst CFC-based foams are present in refrigerators, by far the greatest amount of CFC is to be found in the refrigerant gas. A typical domestic refrigerator contains about 650g of CFC. Equipment is readily available for "degassing" refrigerators and collecting the gas and costs about £2,000.

Such equipment could be purchased and operated by FIG or a contract awarded to a private sector refrigeration specialist to undertake the degassing of refrigerators delivered or collected for disposal. Such a step would be a positive contribution to the reduction of CFC emissions. We estimate that the cost of providing this service would be no more than £1,000 per year. In Section 4, we have concluded that about 80 refrigerators a year will require degassing - a cost of about £12 per unit.

Halon fire extinguishers

Halon fire extinguishers emit halons as part of their function. There is no way to reduce halon emissions other than to cease to use such products. There are, however, certain applications for which they are the most effective or safest - such as for electrical equipment. In the Falkland Islands, it is recommended that a review be undertaken of all fire extinguishers on FIG premises to ensure that halon filed extinguishers are only used where absolutely necessary. Surplus equipment can then be returned to the manufacturers, who will accept it for recycling.

8.3.4 Oil recovery

Oils form shore-based activity

Some oil recovery may be achieved by gravity separation in any suitable vessel and skimming off the supernatant oil. Such oils are generally only suitable for fuel purposes but testing of the flash point and remaining water content should be carried out on a regular basis. The source of any oil recovered by such means needs careful assessment or additional chemical testing to ensure hazardous materials have not been entrained during use. In the event that contaminants are found or the flash point is low, the material would need to be considered as hazardous waste and shipped to the UK for treatment.

This process could be carried out at Stanley Growers - the main point of use, or possibly on the PWD's Megabid site. A burner capable of combusting a range of oil viscosities and some additional tankage would be necessary, with access for desludging, together with a bunded area for storage of drums prior to transfer into the tanks. We estimate that this would cost no more than £10,000.

This process should be encouraged, with drummed oil wastes being delivered directly to Stanley Growers. It is, however, a process which should be licensed, if a waste management facility licensing system is introduced. If unacceptable materials are discovered, the question will arise as to who would be responsible for their correct disposal. We recommend that PWD should bear the cost of this, possibly making a charge to the waste producer if identifiable, in order not to discourage Stanley Growers from operating the service.

From time to time, the tanks will require desludging. The sludges may be landfilled (see below), provided that they do not contain low flash point or other contaminants, when they would require to be shipped to the UK for disposal. Small oil spills can be cleaned up by absorption in sand or clay which may be landfilled. Larger spills would need re-drumming. The drums may be transported to the oil recovery centre by any vehicle or trailer onto which they can be manhandled or lifted by an on vehicle hoist

The annual operating cost of providing this service would be the cost of regular testing - probably about £2,000 p.a., together with the cost of handling and disposal of sludges, additional labour and depreciation, say £2,800 p.a., making a total of £4,800 p.a. The waste oil supplied could supply about 50% of Stanley Growers energy requirements, so that such costs could readily be absorbed by them - so that the net cost to FIG would be zero. The costs of disposal of hazardous materials delivered is difficult to identify. Ideally, no such cost should be incurred and, in any event, we believe that such costs would be low. We have not included them in our analysis.

Oil recovery from waste oils for specific purposes such as re-refined lubricants requires complex equipment and a chain of processes of dewatering, filtration and grading. The bulk oil is first blended then heated before coarse water removal by gravitation. Chemical additives are then mixed into the warm oil to sequester particulate matter and chemical contaminants. The product is then filtered to remove particulates and again gravity settled or centrifuged. The oil produced may need distillation for fractional separation into saleable products. Such a system is likely to involve capital expenditure of a minimum of £2,500,000; there would also be the requirement for laboratory facilities for testing of incoming oils and products. The minimum scale of operation of several tonnes per hour would preclude such an operation in the Falkland Islands.

Should the current bids for removal and disposal of the heavy oil stocks at Albermarle not proceed the waste oil facility at Stanley Growers offers a potential, although rather slow, solution to the problem. Without the use of specialist equipment the Albermale oil could be continuously decanted into drums when ambient temperature was sufficiently high to reduce the viscosity.

The Albermarle oil could shipped to Stanley Growers for blending with lower viscosity waste oil to form a pumpable mixture capable of being combusted through the purpose built waste oil burners which would be installed. The Albermarle oil could be combusted alone if a second specialist burner was purchased together with an oil heating circuit. This would probably be uneconomic due to the limited use of the equipment after combusting the Albermarle stockpile.

Oils from offshore exploration

Oily waste

It is believed that the arisings of oily waste noted in Table 2.2, which include arisings from the supply vessels, are an upper limit and that generally most oily waste will be landed outside the Falklands. To comply with the MARPOL requirements for provision of reception facilities, however, the new waste management plan proposes an oil recovery facility at Stanley Growers together with storage facilities for the dirty oil on the dockside and at Stanley Growers. These facilities would need to be expanded should there be a demand for this service from the offshore operators and the additional cost should be recovered from them.

It is estimated that all the oil recovered by this route could be disposed of by Stanley Growers through their oil recovery facility. In the event that supply exceeds demand, however, the excess oily waste could be separated by Stanley Growers and the combustible fraction disposed of through the incinerator currently at MPA (which is likely to be closed shortly) or exported. In either case the acceptance of the oil at Stanley should be on the basis of full cost reimbursement.

Oily water

It is believed that the arisings of oily water waste noted above is an upper limit and that generally most oily water will be treated offshore to remove water, for disposal to sea, and the oil recovered added to the oily waste stream. Any additional oily waste produced by this route would not alter the scenario for recovery by Stanley Growers and the need for full cost recovery from the offshore operators.

Oily water may also be produced by the supply vessels. It is not believed that large supply vessels would off-load oily water in Stanley unless access to a jetty with reception facilities was available. This is because the time delays and logistics of piping the waste ashore normally ensure this option is economically unattractive.

Any oily water landed at Stanley should be treated by the facilities which may be developed under the new waste management plan. The facilities proposed would be sized according to expected demand and be modular to allow for expansion as may be the case if the offshore industry develops. The offshore operators should be charged a proportion of any capital costs for expansion of the oil/ water treatment facility as well as to fully reimburse the additional running costs.

The oily water treatment facility should comprise at a minimum a storage tank of 20,000l capacity and an oil/water separator with a maximum discharge concentration of 15 ppm oil. As the sizing of the treatment facility is unsure the facility should be located at the Megabid site where room for expansion is available. If possible, the treatment facility should be located adjacent to the proposed sewage disposal pipeline such that the de-oiled water may be disposed offshore. If the pipeline is not operational prior to the commissioning of the oily water treatment facility the deoiled water will need to be tankered to a coastal site for disposal to sea. Such a disposal route should be approved by the Planning Department. The use of the same tanker for both oily and deoiled water suggests the tanker needs to be rigorously cleaned prior to filling with deoiled water. To minimise sea contamination the disposal of de-oiled water offshore should be undertaken as infrequently as possible so that the tanker requires cleaning a minimum number of times. In turn this suggests the storage facility for deoiled water is as large as possible.

Oils from shipping

The oil waste derived from shipping described above in Section 8.2.6 represents a second source of fuel for potential use by Stanley Growers. At present a very limited amount of oil waste is landed in Stanley and by implication most is disposed of outside the Falkland Islands. Whilst a proportion of the oil waste produced offshore could be used by Stanley Growers this may be at most 20% of the potential arisings.

Although there is no requirement under MARPOL to provide a disposal service for the oily wastes landed, it is recommended that all oil wastes landed be processed by Stanley Growers with the costs of the service and capital requirements wholly borne by the vessel operators. This means that should Stanley Growers recover clean oil in excess of their requirements the cost of disposal to the UK, or by arrangement with the MPA authorities in their incinerator, would also have to be borne by the vessel operators.

8.4 Pre-treatment Options

8.4.1 Composting

It has been explained that we do not favour the composting of separately collected bio-wastes from MSW. There is, however, a shortage of topsoil for landscaping in Stanley and we estimate that a value of about £30-50/tonne could be attributed to this material.

Stanley Growers produces some 200 tonnes a year of green wastes, which are currently used as pig food or dumped on site. If these were composted under controlled conditions, a useful and saleable product could be produced. Much of the green waste currently disposed of by Stanley Growers contains plastic contamination however we are informed that a more careful approach to picking the produce would prevent significant plastic contamination of the green waste for a small additional effort.

Compost processes require close control over air circulation and moisture content to achieve rapid decomposition and minimise odour. In the environment around Stanley it is likely that windrow composting would be impractical due to windblow and possibly odour. It is therefore concluded that the composting process (but not the maturation process) would need to be enclosed.

The minimum scale of enclosed composter commercially available which allows mechanical turning of the compost for aeration has a capacity of some 30 cubic yards. Such a composter requires occasional supervision on a daily basis and would be loaded and unloaded at least once a month dependent on ambient temperature. Following retention in the composer the material would need a period of several weeks maturation in the open air, although its condition after processing renders it odourless. Approximately 75 tonnes of compost would be produced annually.

A 30 cubic yard composter has a capital cost of £25,000 and annual costs for operators and fuel are estimated at £5,000. Depreciated over 10 years the cost of compost production is estimated at £7.500 or around £100/tonne, which is similar to imported composts and within the range of price which might be acceptable to PWD for landscaping projects.

The delivery of extra garden wastes and of bulking agents such as clean non plasticised paper to the composter from members of the public either directly or through the CA site would considerably improve the economics of use of the compost plant but maybe at the expense of a deterioration in product quality. A commercial tender may elicit a smaller, more cost effective composting unit as this area of processing equipment is currently undergoing significant development and expansion. However trials of any unit, perhaps supervised by the Department of Agriculture, would be required to demonstrate the optimum process conditions and method of operation with the materials available.

8.4.2 Home composting

Home composting can reduce the amount of putrescible material in household waste. This has the advantage of reducing its leachate generation potential and attractiveness to vermin and wildlife as well as reducing the quantity requiring disposal.

From comments in the returned questionnaires, it is clear that normal garden composting in the Falkland Islands climate presents problems. A well designed product, such as the "Green Cone", which has a double skin and allows solar heating to enhance the composting process, can improve the quality and speed of composting. Whether it would be successful in the Falkland Islands climate, however, remains to be tested. Section 3.3 of Appendix B describes home composting in more detail.

This product has achieved as much as a 17% reduction by weight of waste collected in the UK. Because of the smaller proportion of food waste arising in the Falkland Islands, we project that about 80 tonnes of waste would be diverted from the normal collection round. The cost of providing Green Cones would be about £25,000, which would equate to about £4,000 p.a.

It is unlikely that the provision of Green Cones would have any appreciable impact on the cost of disposing of the remainder of the MSW collected, because of the small quantities involved and the high fixed costs of a disposal system. It is therefore questionable whether their provision to householders by PWD could be justified on cost or environmental grounds. There are, however, some residents who may wish to use such a product. It is proposed that a few, say a dozen, Green Cones are purchased by PWD and introduced on a trial basis with householders which have an interest in trying them. If they work effectively, they could then be marketed by, for example, Stanley Growers. Alternatively the green waste producers may be persuaded to take their excess material to a centralised compost facility.

8.4.3 Upgrade Healthcare Waste Incinerator

The existing healthcare waste incinerator does not and is not capable of conforming to the emission standards currently in force in the UK and EU. There are four options for the future:

- Construct a new plant to conform with UK/EU standards.
- Upgrade the existing plant to meet better combustion standards such that the absolute environmental impact will be insignificant.
- Replace the existing plant to meet similar better combustion standards.
- Continue with the unmodified existing plant.

New plant to UK/EU standards

A plant to meet the current UK/EU standards would require a full gas cleaning system and would cost at least £300,000. This is about the smallest such plant which is manufactured, although it has a capacity of 70 kg/hour, which as about fifty times larger than would be needed for KEMH - or fifteen times if it were only operated on one shift.

The UK regulations were designed for plants with a capacity of up to 8,000 tonnes p.a. - almost one thousand times more than the healthcare waste arising in the Falkland Islands. As a result, the absolute amounts of the pollutants which would be emitted if a plant at KEMH did not have emission controls would be one thousandth of the amounts which the emission standards shown above were designed to control. Consequently, we believe that the high expense of installing the emission controls is not justified. Instead, we consider that a plant for KEMH should be:

- Operated to the best of its capability, and
- Upgraded to meet minimum acceptable standards.

Upgrade existing plant

A similar plant at Gatwick Airport was upgraded to interim standards some five years ago. The improvements were;

- Increase size of afterburner chamber to permit a 1 second residence time
- Ensure a constant afterburner temperature of 850°C
- Install a chart recorder to record combustion conditions
- Install and audible and visual alarm for drop in temperature

We believe that such modifications should be the minimum that should be applied. We estimate that the cost would be about £50,000 plus an allowance for transportation and installation. We have allowed a total cost of £60,000 in our financial projections but suspect that a lower price may be able to be negotiated.

Replace existing plant

A simple incinerator with a 1 second residence time and 850°C afterburner could be obtained for about £20,000. This may not have the level of instrumentation described in the figure given for the upgrading shown above. The plant for which we obtained a budget quotation would also not fit in the existing incinerator house. By the time it is delivered, installed and housed, we doubt that the costs will be very different from the upgrade option.

Either would, in our view, be acceptable - although the upgrade might involve less disturbance and the construction of new buildings. We recommend that firm quotations and comparable specifications are obtained from the manufacturers.

Continue with existing plant

The current instructions on the plant state that waste should be placed in the incinerator when cold and heated to 400°C, whereupon "self-combustion will take place and the fuel supply should be turned off". This is not acceptable. In order to minimise or eliminate the production of dark smoke, the afterburner should be heated to its full operating temperature before waste in introduced and the temperature should be maintained until combustion is complete. Waste should be introduced in small batches and a guard may need to be fitted to protect the loader from flames, sparks and explosion risks during the loading process.

The plant should also be de-ashed after every combustion cycle, to ensure that a build up of ash does not inhibit the combustion conditions.

This plant, however, does not have a large enough afterburner to achieve a 1 second residence time, nor does it have any suitable instrumentation.

We favour upgrading or replacing it, depending which is most cost-effective and convenient.

Confidential paper waste

The system whereby confidential paper waste from FIG is incinerated at KEMH should be continued, as we cannot see any viable alternative. There would be no adverse environmental impacts from continuing to do this. However as with the incineration of healthwaste loading should be in small batches to ensure proper burnout and a guard should be fitted.

8.4.4 Hazardous Waste for Export to UK

General

The processes for the treatment of hazardous wastes are described in Appendix B. It will be seen that such processes are all capital intensive and subject to significant economies of scale. Apart from the recovery of oils as fuel and lead from lead-acid batteries, there is no way in which hazardous wastes could be practically processed in the Falkland Islands. There are a few hazardous wastes which could be landfilled, however, with suitable precautions. These include asbestos and beryllium oxide.

The UK has treatment and disposal facilities for the complete range of hazardous wastes and is clearly the most suitable location for their treatment. What is required in the Falkland Islands is a secure storage location to accumulate economic quantities of the materials, as described in Section 8.1.5. Treatment and disposal can then be arranged with one of the two main specialist UK companies: Cleanaway Limited, of Brentwood, Essex, (tel: 0044-1277-234567) and Rechem Limited, of Fawley, Hants (tel: 0044-1703-898915).

Disposal costs could be as high as £1,000/tonne, especially for mixed wastes, but we suspect that a figure of £500/tonne, including shipping will be closer to the achievable figure.

Sheep dip

We estimate that there may be some 5 tonnes of various sheep dip and other pesticide chemicals stored at various points on the Islands. From our inspections, we believe that none of these are stored in safe conditions and they represent a significant health hazard. These materials should be removed and sent for disposal as soon as possible.

The materials are currently stored in deteriorating containers which are far from secure. What will be required will be that a qualified and experienced chemist should visit all locations where these materials are stored in order to identify and record the quantities of each material and to package them safely into secure drums conforming with international standards. These drums can then be safely transported to the central storage location in Stanley and shipped in a single load to the UK.

One of the hazardous waste management contractors mentioned in the previous section could be contacted to provide the necessary experienced personnel to undertake this task. Alternatively, they could provide training to a Falkland Islands scientist (e.g. from the Department of Agriculture or FIDC), who could then carry out the task over a more extended period. This would be a less expensive procedure, since these companies charge a high rate for the provision of specialists.

As a bare minimum, if a specialist contractor is not used, the following precautions should be observed:

- For products which are known to exist, such as Dieldrin and Gammatox, supplier's or manufacturer's safety instructions and Material Safety Data Sheets should be sought and complied with.

- Protective clothing should be worn when inspecting and handling the suspect materials, including:
  - Nitrile or neoprene gloves
  - Nitrile or PVC apron
  - Rubber boots
  - Cotton overalls
  - Face shield
  - Dust mask (for powders)
  - Half face respirator with organic vapour cartridges (for liquids)

- A fire extinguisher suitable for chemical fires should be carried.

- A comprehensive first aid kit should be carried, including an eye wash and any appropriate antidotes or therapeutic drugs recommended by the manufacturer/supplier.

- Access should be available to a shower with soap and hot water in case of contamination.

- A shovel and broom should be carried for cleanup of spilled and contaminated material.

- Sodium hydroxide should be carried and used for hydrolysis of spilled organophosphates before cleanup.

- Heavy duty polyethylene bags should be carried for bagging of contaminated material.

- Sawdust, or similar absorbent material should be carried and used to absorb any spillage of non-oxidising materials generated. This sawdust should then be drummed or bagged in heavy duty polyethylene bags for disposal.

- Ventilation in the storage area should be maximised by opening all doors and windows.

- The number, quantity and, where known, the chemical contents of all packages should be recorded.

- The packages should be placed carefully into sealable removable head drums packed with vermiculite. Drums should conform with UN standards.

- Different materials should be placed in separate drums, to reduce the risk of inter-reaction.

- All drums should be sealed when the operation is completed.

- If any material is found to be in 200 litre drums (we did not observe any), these should be packed into overdrums of the UN standard design, since they will almost certainly be corroded and show signs of reduced strength.

- Drums or other containers should be labelled in accordance with UN standards.

- Packaging and transport should conform with the standards outlined in the UN publication *Recommendations on the Transport of Dangerous Goods*.

- In the event that significant spillage has occurred, any contaminated soil should also be collected and placed into drums or heavy duty polyethylene bags for disposal.

The cost of disposal of these materials in the UK is likely to be at least £1,000 per tonne and maybe more given the comparatively small consignment size. The packaging operation is likely to cost about £5,000, because of the time which will be required and the remoteness of the locations. The total cost, including shipping is likely to be at least £15,000.

Lead-acid Batteries

Lead-acid batteries contain metallic lead, which has significant recycling value. These may be collected at the CA site. They also contain strong sulphuric acid, which will require treatment and disposal. The quantity of batteries generated in a year would produce about 250 litres of acid. This may be treated once a year, before shipment.

The treatment should be supervised by the chemist recommended to oversee hazardous waste storage. The acid could be neutralised in plastic 200 litre drums, using lime.

The lime should be slurried with water and the acid added slowly and carefully with stirring, using a non-metallic stirrer. Batches of about 100 batteries should be processed, maintaining the pH at 10 or above .

The resulting sludge and liquor can transported to the landfill in the drum, where it may be safely disposed, since any lead present will be precipitated in a non-soluble hydroxide form. It should be noted that landfilling of this waste is likely to be contrary to the proposed EU landfill directive, which forbids liquids to be landfilled and also the mixing of "hazardous" waste with non-hazardous waste. We believe, however, that the environmental consequences of such small quantities of waste will be insignificant.

8.5 Landfill

8.5.1 Introduction

It is clear that most of the processes for pre-treating biodegradable wastes are not going to be practical in the Falkland Islands, largely because of the poor economies of scale. Consequently, we recommend that biodegradable wastes continue to be landfilled for the foreseeable future. This is contrary to the proposals in the draft EU landfill directive but we strongly believe that it would not lead to significant adverse environmental impact because of the very small scale of the operation in global terms.

It has already been explained that we do not favour upgrading of Eliza Cove or using Mary Hill for all wastes and that, instead we recommend that FIG cooperates with the Military in using their existing landfill and subsequently the new one that they develop for all but inert wastes. Eliza Cove, however, will require closure, remediation and restoration.

8.5.2 Restoration of Eliza Cove

As soon as a decision is taken to develop a new site, two options emerge: the site can be progressively restored or it can be restored after it is closed. We believe that progressive restoration is the more desirable since it will demonstrate positive action to the public as well as having a favourable environmental impact.

Restoration should be accomplished by profiling the surface to an agreed landform. The surface so formed should be covered by a non woven polypropylene geotextile. In turn this should be covered with 500-750mm of 100mm rock fill compacted by the site bulldozer. Alternatively construction and excavation waste from the East Stanley development could be stockpiled at Eliza Cove as used for capping when available, which would be a less expensive option.

If progressive restoration is to be contemplated, the capping layer should be designed to be able to support traffic by waste collection trucks. The landform should be designed with a tipping face such that tipping could continue progressively until the substitute disposal system was in place. The cap should be permeable, to preclude build up of methane and also to allow penetration by rain thus diluting the leachate as far as possible. The final landform would be expected to vegetate naturally imitating the background scree found elsewhere on the Islands. Use of some more clay-like construction waste for capping may be less appropriate for transit by trucks or for visual appearance following completion

The landform should allow for a waste face slope of approximately 1:4 tipped from the top and the bulldozer should be used to run up and down the face to spread and compact the waste in a traditional landfill pattern. Each face should be capped with geotextile and rock blanket at the earliest opportunity.

During the capping process, burning on the site should be discouraged as this is poor practice on both environmental and health & safety grounds. Ensuring such fires are fully extinguished also presents problems.

Restoration costs would be approximately £35,000 for geotextile, £5,000 for labour and a similar amount for plant, making a total of £45,000. It is assumed that the cover material can be supplied free of charge from the East Stanley development.

8.5.3 Mary Hill Quarry

Mary Hill Quarry currently accepts inert and other non-putrescible wastes. A full operational plan for the chosen option will be produced by the waste strategy implementation team based on conditions pertaining at the time. Meanwhile some development is required if Mary Hill is to be operated to an acceptable environmental standard and this is described below.

Site access

Wastes should not under any circumstances be tipped over the quarry edge. Notices should be provided to this effect and earth banks erected to prevent such activities.

Site preparation

The preparatory phase for this development of Mary Hill involves the sorting of the existing waste and extraction of scrap for export with its storage at the front of the site. Any putrescible materials should be removed to the transfer station and any drums tested for contents, with oily waste being sent for local recovery, export for recovery or to the transfer station for transport to MPA and disposal. Drums of known or suspected hazardous waste should be repackaged for disposal in UK using the techniques discussed elsewhere in this report. Following development of a cleaned base the remaining waste should be placed and compacted in small amounts to ensure thorough densification. The cost of this is likely to be around £10,000.

Site operation

As soon as the base area has been cleared the site may accept waste from commerce and the public on a routine basis. It is not anticipated that a daily presence of a site operator will be required due to the small amount and irregular timing of the arisings. The public should be requested to bring materials only on one particular day of the week so that order may be maintained in progressively filling the quarry. All waste arriving at the site should be placed in a holding area or at the tip face under the direction of a site operator, if present. Notices at the entrance to the site and adjacent to any previously used positions along the quarry edge should inform depositors of the need to ensure that putrescible materials are not deposited and are returned to the transfer station.

The operator should ensure that any potentially hazardous waste or waste of unknown composition delivered to the site is repackaged for disposal in the UK. The operator should also remove potentially recyclable metal and wood to the Civic Amenity site.

On a weekly basis the site operator should move materials from the holding area and place them at the tip face; these should then be compacted and levelled. Any waste potentially attracting vermin or containing visible amounts of cloth, paper or other biodegradable materials should be covered with inert material or construction waste to a depth of at least 0.5 m

Costs

As the site will be used for non-putrescible materials only, there will be no site preparatory works and consequently no significant capital costs.

Following an initial intensive campaign on extraction of scrap and removal of putrescible and hazardous materials from the existing waste the annual costs are limited to those associated with an operator maintaining the site for a half day per week. It is estimated that an allowance of £10,000 would cover staff costs, hire of bulldozer and fuel, testing and repackaging of potentially hazardous materials and of transport of recyclables to the Civic Amenity site.

8.5.4 Cooperation with Military for Landfilling of Non-Inert Wastes

The Military at MPA have invited Consultants to propose recommendations for management of their wastes in parallel with this Study. We understand that they have recommended the construction of a single new landfill, to accept mixed wastes of a non-hazardous nature.

One option for Stanley would be to make use of this site rather than construct a new site or upgrade an existing one. In view of the availability of Mary Hill for inert materials, there would be little point in landfilling inert wastes at MPA, but using such a site at MPA for biodegradable materials would mean that the cost of upgrading Mary Hill would be minimised, as can be seen from the preceding section. It would also eliminate any problems which might be associated with birds and vermin being attracted to the site and any other adverse land use planning issues.

We understand from the Military's consultants that an increase in the quantity of waste deposited would make the environmentally acceptable management of the site easier - or at least no more difficult. They have recommended that wastes from Stanley should be accepted at both the existing site until it is completed and also at any new site which is constructed. It is not easy, however, to estimate the marginal cost of accepting waste from Stanley. The only fair and reasonable way in which costs could be allocated between the Military and Stanley would be to divide them proportionally to the quantity of waste disposed. The wastes suitable for delivery to MPA would consist of MSW, together with non-inert trade, commercial and industrial wastes.

It is currently difficult to estimate the future costs of landfilling at MPA. The MoD have identified a location for a new site but we understand that their consultants recommend that other sites are also evaluated, as the proposed site may present engineering problems and will, in any event, be very expensive to engineer. The full costs, including depreciation of the engineering costs of the new site are currently estimated by us to be about £250,000 p.a. If a different site were identified, as we are sure it could be, we expect that the costs would be somewhat lower. For the purposes of the Study, we assume that the costs for both the remaining life of the existing site and also for the new site will be about £200,000 p.a. for about 6,500 tonnes p.a. (excluding any waste from Stanley). If the Military were to make a proportional charge for disposal of these wastes, we would expect it to be around £25/tonne.

If wastes were to be transported to MPA for disposal, a transfer station would be required. Transfer Stations are described in Appendix B, section 4.2.

A transfer station for Stanley would require the installation of a waste compactor with hopper and ramp. The tipping hopper should be in an enclosed building of some 50 m², to minimise wind scatter. The building would need to constructed on a raised level about 2 m above the surrounding ground, to allow the waste to fall into the compactor hopper. We estimate the cost of construction of the transfer station would be as follows:

Construction of ramp, retaining wall and land raising	£20,000
Enclosed building - 6 m height to eaves	£15,000
Electricity and services	£5,000
Compactor and hopper - installed	£22,000
Contingencies	£10,500
11 m³ compaction containers (3)	£7,500
11 m³ Bulky waste containers (5)	£7,500
TOTAL	**£87,500**

The compactor should have a throughput of around 110 m³/hour and be fitted with a security cage, to prevent external interference, an auto-start facility and an indicator to show when the container is full. It should also be provided with a full set of spares. The budget price shown above includes shipping and an engineer from the UK to perform the installation, commissioning and maintenance training for the compactor. There are several UK manufacturers of compactors. One suitable supplier would be Thetford Compactors, tel: 0044-1842-762861.

Some bulky household wastes, such as furniture, white goods etc., and also some of the industry wastes, such as pallets, would not be suitable for compaction, as they can jam in the hopper. An open skip should be provided for these wastes, which, when full, can be transported directly to MPA. Some of them, no doubt, will be collected by scavengers visiting the CA site before they are removed.

The containers proposed could be handled by a skip vehicle and we are aware that spare capacity exists on the existing skip vehicles. There would therefore initially be no requirement to purchase additional vehicles, although a replacement programme would obviously be required.

The running cost for the vehicle will depend on the throughput of the transfer station which, in turn, will depend on whether the offshore oil facilities or BAS use the facility and also whether the wastes forecast to be delivered from shipping actually materialises.

We understand that BAS tend to deliver their wastes to Stanley and therefore would presumably want to use the transfer station. It is not yet known whether the offshore platform will bring waste ashore for MPA or incinerate it on board. If they bring it ashore, we assume they will use the transfer station. The amount of wastes from shipping is much more uncertain. Our forecast is that it will build up to 650 tonnes p.a. in ten years. In 1998, it is likely to be negligible.

We have therefore produced the following estimate of annual throughput:

Household waste	800 tonnes
Commercial/industrial	400 tonnes
BAS	280 tonnes
Minimum total	**1,480 tonnes**
Offshore oil	420 tonnes
Possible maximum total	**1,900 tonnes**

Using the minimum figure, we estimate that 8 - 10 loads a week (including bulky wastes) would need to be transported to MPA. This represents about 40-50% of a single skip vehicle's capacity and is likely to cost about £13,000 p.a. For the maximum, 10 - 12 loads would be required, being 50-60% and costing about £16,000.

The operating costs for the transfer station, including labour, maintenance and depreciation is likely to be about £15,500, making a total of £28,500-31,500, depending on throughput - £16.60-19.25 per tonne.

The total cost, including a £25/tonne tipping fee at MPA would then be:

At 1,480 tonnes p.a. £65,500 or £44.25/tonne
At 1,900 tonnes p.a. £79,000 or £41.60/tonne

8.5.5 Procedures for Landfilling in Camp

This section contains some recommendations for upgrading the method of landfilling of wastes in Camp. We have suggested that FIG should contribute towards the additional costs. This would probably consist of paying the local farmers for the use of their mobile plant to undertake the proposed excavation and covering activities, which we estimate might cost about £10,000 p.a.

Recommendations for the procedures to be followed for the landfill sites to be used in Camp are contained in Appendix J.

What will be required, in addition, is some training and advice to the individual communities. We suggest that this could be provided by the energy advisory officer from FIDC, who has the necessary technical understanding and makes frequent visits to camp.

8.5.6 Procedures for Difficult Wastes at the Landfill

Difficult wastes are those wastes which, whilst acceptable for disposal at a landfill on the basis of their overall properties, have some characteristics which require a particular method of handling which is not part of the general site operating procedure. Individual procedures are appropriate for these types of materials. If all wastes from Stanley are landfilled, a number "difficult" wastes may require landfill from time to time. We recognise that, if the MPA option is selected, this will be a problem for the military but, for the sake of completeness we show the procedures below. The difficult wastes include:

- Tyres
- Bulky waste and empty containers
- Finely divided material (e.g. powders and dusts)
- Very light materials which may be easily windblown (e.g. expanded polystyrene)
- Animal carcases and other putrescible and potentially malodorous materials
- Asbestos and other solid hazardous wastes
- Small quantities of acid neutralisation sludges from lead-acid batteries
- Small quantities of oil sludges from the oil recovery process

the method in which each should be handled is discussed below.

Tyres

Tyres, if deposited whole in a landfill can rise and cause void spaces which break the surface and encourage vermin. They also contribute to surface instability and represent a fire risk. It is not advisable to store tyres in large quantities, as this can present a fire risk with the potential for excessive black smoke. Ideally, they should be shredded or quartered before landfilling.

If they are to be landfilled in their whole state, this should be done in a controlled fashion, with individual tyres being placed flat and separate from one another on the base of the landfill before being covered with waste or, preferably, cover material. Each single layer should be covered before further tyres are added.

Bulky waste and empty containers

Bulky waste and empty containers should be crushed where possible before being covered with further material, in order to avoid the creation of void spaces, which may harbour vermin.

Finely divided material (e.g. powders and dusts)

Materials which may give rise to excessive dust when tipped should ideally be wetted before discharge and covered with other waste as soon as possible.

Very light materials which may be easily windblown (e.g. expanded polystyrene)

Light materials should ideally not be deposited during periods of high winds. They should be covered rapidly to prevent wind scatter.

Animal carcases and other putrescible and potentially malodorous materials

Such materials should be placed into excavations in the waste body and be covered as soon as possible to minimise odour impacts.

Asbestos and other solid hazardous wastes

Asbestos and other solid hazardous wastes, such as beryllium oxide, should be double bagged in sealed heavy gauge plastic bags and immediately buried into excavations, which are then covered and carefully marked. An area should be set aside for such materials, together with the sludges discussed below, at the outset of the landfill planning stage. It should be noted that co-disposal with these wastes with MSW is contrary to the EU landfill directive and, consequently, it is possible that the Military may be unwilling to accept them at their landfill. In this case, these wastes should be landfilled at Mary Hill, using procedures similar to those outlined above. The same is true for the next two categories of wastes. However should deposits be needed to be made at Mary Hill it will be necessary to construct the trenches with granular construction or quarry waste to provide the absorbency not present in the quarry rock base or highly porous inert waste.

Small quantities of acid neutralisation sludges from lead-acid batteries

Acid neutralisation sludges should also be deposited into an excavated trench in the waste body sone 1.5 metres deep. After they have largely dried by evaporation, the excavation should be backfilled and marked.

Small quantities of oil sludges from the oil recovery process

Oil sludges can also be treated in a similar way to acid neutralisation sludges, but they should be covered immediately, since evaporation will be slow or negligible.

8.6 Specific Waste Streams and Issues

8.6.1 Abattoir Wastes

There is currently no evidence that any of the wastes from the abattoir will present any significant health risk. The UK has introduced stringent regulations because of the political pressure from the EU. Since BSE and scrapie are believed to be absent from the Falkland Islands, the only reason for introducing some of the more stringent UK-style regulations is if they are required for political/marketing reasons in order to ensure a market for the products of the abattoir in the EU.

For these reasons, it may be desirable to incinerate SBM - Specified Bovine Material (heads and spinal columns). If it is decided to do this, there are two options. The first is to combine the incineration of SBM with the incineration of healthcare wastes. Since a new or upgraded incinerator is required for KEMH, it would be possible to locate it at the abattoir, although this would involve significant extra cost to the hospital because of the need for specialised transport.

A better opportunity exists, however. The consultants for MPA have recommended that their existing incinerator be closed and sold. They have suggested that the likely market will lie in the UK but, no doubt, were unaware of the potential needs of the abattoir. It is recommended that FIG expand the current abattoir EIA to include this incinerator option and if environmentally acceptable negotiate with the Military to acquire this plant, which in engineering terms is suitable for the incineration of animal by-products. We have assumed that the plant could be acquired and re-installed for £10,000. The total cost of operating would then be around £4,000 pa including labour, fuel and maintenance.

8.6.2 Food Wastes from Shipping

Existing regulations cover the importation into the Falkland Islands of a number of foodstuffs which may also form part of any municipal type waste landed from shipping. Should there be any evidence of such prohibited waste being landed the matter will be handled by Customs and the Department of Agriculture which may require the vessel owner to remove the waste or specify a manner of destruction.

In general food waste imports into the UK are governed by the Importation of Animal Products and Poultry Products Order (1980). This Order is regulated by MAFF which has produced guidance notes on the treatment and handling of food waste imports.
In principle such wastes must be off loaded into drip proof containers to which scavenging animals and birds have no access. For transport purposes the waste container must be fully enclosed in an outer container, usually the vehicle body. Both incineration and landfill are acceptable methods of disposal for solid wastes. Semi solid wastes may be macerated and disposed to a sewer connected to a sewage treatment works. Any food waste disposed to landfill must be covered immediately to a depth (taken to be 9 inches) below the reach of burrowing animals. All containers in contact with food waste must be disinfected before the container is reused.

The use of heavyguage plastic bags subsequently transported by skip would conform to these requirements and the skips would not need to be disinfected (which should be carried out at the landfill site) unless the waste bags were punctured or leaked during transit.

8.6.3 Waste in Skips

We note that most of the skips in use in the Falklands are of the open topped variety. With the prevalent high winds, this undoubtedly contributes to the litter problem. Whilst lidded skips are normally unsuitable for construction and demolition wastes, it is recommended that most other wastes should be placed in lidded skips.

The existing skips could readily be converted, for example by Mr Mike Butcher, who specialises in such work.

8.6.4 Collection Service for Commercial Waste Producers

It is notable that a waste collection service is provided free of charge by PWD to pubs and hotels but that most commercial premises do not receive such a service. Some but not all of them use a service provided by FIC or Paul Bonner for which they pay a charge. Others burn their waste or transport it themselves to Eliza Cove. We believe that, in the interests of equity, all commercial premises should receive the same service. It is questionable, though, whether it should be provided free of charge. We suggest that a fee should be introduced, even if somewhat nominal - to encourage all premises to take advantage of it, and that the service should then be offered to all.

9 IMPORTANCE OF COOPERATION WITH THE MILITARY

There are substantial economies of scale in all waste management processes. There is little published data on costs at the volume levels appropriate for the Falkland Islands, because very few facilities of this small size exist anywhere in the world. Even in much more populous countries, regional cooperation is encouraged to maximise the opportunities for economies of scale. This is even more true in the Falkland Islands. One notable example is that if the landfill at MPA were to accept Stanley's wastes, it is unlikely that the operating costs would increase at all, so that the unit cost of disposal would fall appreciably. From an environmental point of view, the site might even be easier to manage. This is to everyone's benefit.

In the foregoing section, we have mentioned a number of opportunities for cooperation with the Military. Given the very small quantities of waste produced and the fact that the Military is comparable in size with the civilian community, we believe that cooperation is the key to achieving the maximum economies of scale.

Cooperation on the landfill is going to be vital, not only to achieve economies of scale but also to optimise the overall environmental impact of solid waste management in the Falkland Islands. There are, however, a number of other areas where cooperation could lead to the economic viability of processes which would otherwise not be suitable, or to better economics and the avoidance of duplication of facilities.

These might include:

- Tyre retreading
- Tyre shredding/cutting
- Sorting of aluminium cans
- Baling of cans
- Scrap processing
- Processing of lead-acid batteries for recycling
- Hazardous waste storage
- Healthcare waste incineration
- Oil recovery
- CFC recovery

It is recommended that, before any firm decisions are taken on the installation of any of the above mentioned facilities, a waste management liaison committee is established to ensure that there is no unnecessary duplication of facilities between the two communities. The respective strategies could then be harmonised to the mutual benefit of both parties.

In addition to the sharing of facilities, there are also other opportunities for cooperation, notably:

- The sharing of transport facilities to the UK for materials for recycling

- Sharing of purchasing power and markets for recyclables (e.g. glass, cans, scrap metal)

- Acquiring the soon to be redundant incinerator for use at the abattoir

We therefore believe that it would be incorrect to finalise FIG's waste management strategy without the establishment of the liaison committee mentioned above.

10 COMMUNICATIONS AND EDUCATION NEEDS

10.1 Introduction

A strategy of any kind involves the achievement of goals. In the real world, the objectives of different groups of individuals, be they formal such as organisations or informal such as neighbours or special interest groups, do not always coincide. As a consequence, it is usually necessary to cross many human barriers if the goals are to be achieved. The purpose of a communications programme is to make the crossing of these barriers easier.

Implementing a waste management strategy involves implementing several types of change:

- Legislative change
- Organisational change
- The introduction of new physical facilities
- A change in public behaviour (e.g. attitude to recycling and segregation)

All these types of change require cooperation from other organisations and/or the general public. In many countries, the most significant and difficult issue is the obtaining of permits for the construction of new waste management facilities. There is always a body of opinion which will oppose such changes, even if they can be shown to be providing environmental improvement for the common good. This may not be such a serious problem in the Falkland Islands, but will still undoubtedly be relevant.

The fundamental purpose of a communications strategy is therefore to manage people's expectations in such a way as to prevent extreme situations from occurring.

10.2 Communications Objectives and Needs

The main objectives of a structured communications programme would be to:

- Inform, educate and generate support for the waste management strategy from the general public, especially the young, who will be the opinion formers of the future.

- Inform, educate and gain support for the strategy from specific target audiences, including the media, government departments, environmental pressure and interest groups, industrial and commercial waste producers and local private waste management companies.

- Generate a response and feedback from the public and key groups regarding the strategy, which can be used to adjust and refine the final strategy prior to adoption and implementation.

- Facilitate implementation of the strategy by winning the commitment of, and building cooperation with, key interest groups.

- Establish permanent channels for communication and dialogue with key interest groups, thereby facilitating the on-going task of information gathering and updating of the strategy.

The communications programme would need to:

- Be designed and conducted as a consultative and participative exercise to gain public acceptance, involvement and participation in the final strategy and master plan.

- Present the FIG, in terms of public opinion, as caring, responsible and committed to meeting their obligations to the public and the environment.

- Reflect the professionalism of FIG through the quality of its communication.

- Identify target groups and audiences, and use a range of communications tools and methods, to create an on-going dialogue with each in order to address particular concerns and issues.

10.3 Development and Implementation of a Communications Strategy

10.3.1 Main Elements of a Structured Communications Strategy

Based on the Consultants' experience of meeting a wide variety of Falkland Islanders both inside and outside Government, in Stanley and Camp, through media interviews and through the widely distributed attitude questionnaires as well as previous experience gained elsewhere it is suggested that the integrated communications strategy should be developed and implemented along the following lines:

Phase 1 - Development of Strategy

- Establish programme management team
- Agree scope, broad content and overall timing of programme
- Identify key issues for communication
- Identify target audiences
- Preliminary data gathering and analysis
- Prepare/carry out initial opinion and attitude survey of key target groups
- Prepare detailed plan, specification, schedule and budget for integrated communications programme

Phase II - Development of Programme

- Familiarisation of communications specialists with waste management issues
- Determine campaign strategy
- Statement of objectives with regard to each audience
- Determine communications methods
- Identify strategy for reactive communications in the event of an incident or unforeseen development

Phase III - Implementation

- Prepare statements and fact sheets relating to key issues
- Develop programmes for, *inter alia*, the following:
  - Internal communication within government departments
  - An education programme for schools
  - A media relations programme
  - A programme for relations with environmental pressure and interest groups
  - A programme for communication with waste producers

10.3.2 Development of Strategy

It is assumed that PWD would have the overall responsibility for the communications programme. A local communications specialist will probably be required to assist. It should be noted, however, that environmental communications is a somewhat specialised and sophisticated branch of the art, involving as it does the interpretation of technical issues to non-technical audiences.

The major objectives should be determined. These may be translated into particular key issues for communication to particular audiences. The survey already carried out by PWD will give some background information on current public perceptions. We list below some suggestions for the development of the communications strategy.

Existing Public Attitudes

The detailed results of the survey have been outlined in section 3.2.8. About one third of the households in Stanley responded and showed a strong interest in the environment and in improving the quality of waste management. They also showed willingness to participate in the segregation of wastes for recovery and recycling. It must be assumed, however, that the two-thirds who did not respond had less interest and would also probably be less keen to participate in change. There is therefore much to be achieved through a communications strategy.

Key Issues to be Communicated

Some the issues which will require communication and education are:

- The overall content of the FIG waste management strategy, its benefits, costs and the changes required
- The provisions and implications of the new legislation
- The importance and approach to waste minimisation and avoidance
- The desirability of all commercial waste producers using a collection service
- The reasons for and benefits of the "bring" system for recycling
- Encouragement of public houses and hotels to use can crushers
- The benefits of and procedures for the new CA site
- The reasons for and benefits of the transportation of wastes to MPA
- The benefits of and procedures for the new transfer station
- The benefits of and procedures for CFC extraction from refrigerators
- The benefits of and procedures for the recovery and recycling of car batteries
- The dangers of stocks of sheep dip and the methodology for their safe handling and storage
- The reasons for not storing or dumping scrap metal, vehicles and tyres
- The benefits of and procedures for the collection of scrap metal
- The problems caused by litter, the benefits of reducing it and the prevention measures which will be taken
- The benefits of and procedures for the facilities being provided to shipping

Target Audiences

The target audiences are likely to be:

- Householders
- Commercial and industrial waste producers
- Schools
- Environmental and conservation groups
- The media
- FIG departments
- The Military

10.3.3 Development of Programme

The development of the programme is likely to be carried out largely by the local communications specialist. Input from PWD will be devoted mostly to identifying and articulating the messages to be conveyed to each audience.

The above may be regarded as the "pro-active" strategy. It is also necessary to plan for the necessary "reactive" strategy in response to incidents or unforseen developments. This will require clearly defined channels of communication, especially with the media, and can be managed more easily if such circumstances are considered and anticipated so that a predetermined response may be given.

10.3.4 Implementation

It is frequently found that one of the most useful first stages is the preparation of fact sheets or policy papers on the key issues. This has the benefit of ensuring that FIG has clarified its view and policy on matters which are likely to be discussed within the public domain. These can be especially valuable in reactive communications of the kind described in the above section. They are also of value in providing information to most of the target audiences.

Other features in the implementation of the communication programme are:

Newsletters

Within FIG, there will be an ongoing need to inform various departments about actions, concepts and opinions. A newsletter is a useful tool in this regard and it may also have value to a wider audience - although mainly to specialists rather than the general public.

Schools Programme

The environment is an issue that appeals strongly to the young, who often have a significant influence on their parents' behaviour and attitudes. As the future generation, it is important that their attitude to and understanding of environmental issues is influenced in a positive direction. Waste management can be made into an educational topic of interest to schoolchildren and the preparation of study books and wall charts is a relatively inexpensive way of explaining to them the importance and realities of waste management.

Media Relations

The communications media represent both a threat and an opportunity. Antagonistic investigative journalism is not highly developed in the Falkland Islands, but the risk still exists. A good personal relationship, involving trust on both sides, can produce a very positive result and an opportunity to convey the required message in the most effective way to target audiences and the general public. Good media relations requires personal contact and the opportunity for discussion. It also requires a creative approach to finding ways of gaining and holding the media's interest. This can best be achieved by a local specialist.

Environmental Pressure and Interest Groups

Some of these groups may be actively hostile to some practical initiatives, even those which are actually in the positive interest of the environment. Again, in the Falkland Islands, their attitude appears to be comparatively positive but, once agin, a risk exists, especially if oil is found. Although some of such activity may be politically motivated and therefore difficult to influence, the majority of such groups oppose new projects because of lack of or incorrect information.

It is important to communicate with these groups and to develop a trusting relationship by the provision of information and the operation of an "open door" policy, whereby they may be given access to, and information about, waste management facilities.

Waste Producers

In larger countries, waste exchanges, conferences, training seminars and training literature will all play a part, in the education of waste producers. In the Falkland Islands, however, the size of the sector and the resources available mean that these are unlikely to be practical. Advertising, newsletters and influence through the media will have a role to play for general communication, but for specific issues, such as sheep dip and the services to shipping and the oil industry, direct communication by letter will be the most effective method.

10.4 Key Recommendation

It is the Consultants' firm belief that the PWD should adopt and implement a structured communications programme to facilitate the achievement of the implementation of the Strategy.

11 FINANCIAL IMPLICATIONS OF THE PREFERRED OPTIONS

The financial implications of the preferred options are shown in Table 11.2 based on the projected waste flows and disposal method summarised in Table 11.1. Table 11.2 shows the estimated capital expenditure and breakdown of annual costs together with the manpower requirements for each definite and for three likely options. It also shows the estimated one-off costs associated with the project management of strategy implementation, restoring Eliza Cove and disposing of the sheep-dip stockpile.

It will be seen that the initial outlay would amount to £229,000 of capital expenditure and £170,000 of one-off costs, amounting to a total of, say, £400,000. A further £145,000 may be required to provide the collection services for shipping and to install the probably redundant MPA incinerator at the abattoir. The costs for the shipping services would be recovered from the shipping operators.

The additional annual operating costs, including depreciation and net of revenue recovered, would amount to £105,200.

The assumptions used in calculating these figures are shown below:

- One additional employee would be required by PWD to supervise the transfer station, CA site and recycling.
- A chemist would be required for an average of 2 hours a week to supervise the hazardous waste storage.
- Transport for recyclables to the UK can be negotiated free of charge via MPA.
- Oils are used as fuel by Stanley Growers, which will bear the cost of the facilities necessary.
- A landfill price of £25/tonne can be negotiated with MPA.
- PWD will pay £50/tonne for 150 tonnes of compost p.a. for landscaping.
- The offshore oil companies and BAS will use the transfer station and will pay a pro rata fee.
- The costs above have been calculated on the basis that only BAS use the transfer station. If the offshore oil companies also use it, the amount of cost recovered will increase and the net cost to FIG will fall to £102,000.
- The collection service for shipping will be introduced gradually, as demand is established.

Table 11.1: Falkland Islands Government - Projected Waste Flows					
Waste arisings		Tonnes (forecasts based on "most likely" scenario)			Disposal method
		1997	2007	2017	
Non-inert:					
	Household - Stanley	800	800	800	To MPA
	Household - camp	200	200	200	Local Landfill
	Trade & Commerce	400	600	900	To MPA
	Shipping		650	650	To MPA
	Offshore Oil	420			To MPA (50% probability)
	BAS	280	280	280	To MPA
Inert	C&D	2650	3900	5800	Mary Hill
Scrap Metal:	Onshore	200	300	450	To UK at breakeven
	BAS	100	100	100	To UK at breakeven (via MPA)
	Offshore	50			To UK at oil companie's expense
Tyres		40	60	90	Retread or landfill (also possibility for export to South America)
Oily Wastes:	Onshore	60	90	135	Use as fuel
	Stockpile	100			Drum, blend and use as fuel
	Shipping		1000	1000	Use as fuel
	Offshore oil				Own reuse
Other Hazardous:	Healthcare	10	10	10	Incineration
	Other Onshore	7	3	4	Export
	Offshore	50			Make own arrangements
Drilling Muds		10000			Make own arrangements
Drill Cuttings		?			To sea bed
Abbattoir		75	75	75	Rendering Plant. Possible incineration of SBM
Horticultural		200	200	200	Composting

Table 11.2:	Falkland Islands Government - Projected Waste Management Costs												
Costs to FIG	Capital Expenditure		Annual Operating Cost 1998								Manpower	
Item	Amount	Life - yrs	Lab'r	Mtce	Dep'n	Transp't	Other	TOTAL	Revenue	Net Cost	FIG	Private
Definite projects												
CA Site	5,000	10	4,000		500		1,500	6,000		6,000	0.25	
"Bring" system	1,000	10			100	7,000		7,100		7,100		0.20
Healthcare waste bags					0		300	300		300		
Hazwaste sorting & storage	1,000	10	1,300		100			1,400		1,400	0.05	
Lead/acid battery recycling			300		0			300		300	0.01	
Recycling - sorting/tpt to MPA	30,000	10	2,500	500	3,000	1,000		7,000	1,000	6,000	0.15	
Scrap recovery			1,500		0	2,000		3,500		3,500	0.10	0.05
CFC extraction	2,000	10	800		200			1,000		1,000	0.05	
Oil recovery	10,000	10	800		1,000		3,000	4,800	4,800	0		0.05
Composting	25,000	10	4,000		2,500		1,000	7,500	7,500	0		0.25
Healthcare waste incinerator	60,000	20		1,000	3,000			4,000		4,000		
Hazardous waste to UK							2,000	2,000		2,000		
Transfer station - buildings	50,000	20			2,500			2,500		2,500		
Transfer station - plant	35,000	10	7,500	2,000	3,500	13,000		26,000	5,390	20,610	0.50	0.40
Landfill at MPA							37,000	37,000	7,000	30,000		
Mary Hill Landfill	10,000	20	3,000		5,000		7,000	10,500		10,500	0.20	
Upgrade landfill in Camp							10,000	10,000		10,000		0.30
SUB-TOTAL	**229,000**		**25,700**	**3,500**	**16,900**	**23,000**	**61,800**	**130,900**	**25,690**	**105,210**	**1.31**	**1.25**
Collection service for shipping	60,000	5		3,000	12,000	80,000		95,000	95,000	0		0.50
Oily water treatment - plant	35,000	20	1,500	500	1,750			3,750	3,750	0	0.10	
Oily water treatment - vehicle	40,000	7			5,714	2,500		8,214	8,214	0		0.10
Abattoir incinerator	10,000	10	800	1,200	1,000		1,000	4,000		4,000	0.05	
SUB-TOTAL	**145,000**		**2,300**	**4,700**	**20,464**	**82,500**	**1,000**	**110,964**	**106,964**	**4,000**	**0.15**	**0.60**
GRAND TOTAL	**374,000**		**28,000**	**8,200**	**37,364**	**105,500**	**62,800**	**241,864**	**132,654**	**109,210**	**1.46**	**1.85**
Additional 1998 one-off costs												
Project management	110,000											
Sheep dip export	15,000											
Restoration of Eliza Cove	45,000											
TOTAL ONE-OFF COSTS	**170,000**											

12 PROPOSED IMPLEMENTATION PLAN

Section 5.3 has discussed the resources necessary to implement the proposed strategy. This section shows in Table 12.2 the 172 sub-tasks that will need to be performed, their timescale and interrelationship.

The Gantt charts comprising Table 12.2 will be provided to the PWD and the project implementation team on disc as an aid to project planning.

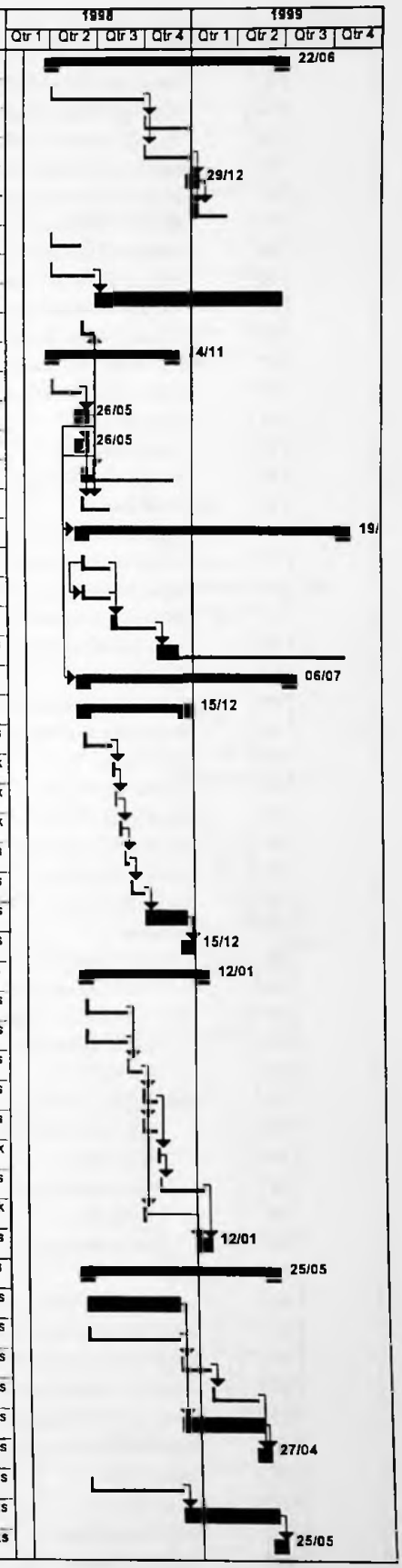
It has also been proposed that consultants are employed to cover the peak workload in the initial implementation phase. The estimated workload in man-days, both for the consultants and for FIG departments is shown in Table 12.1.

Table 12.1: Workload for Strategy Implementation

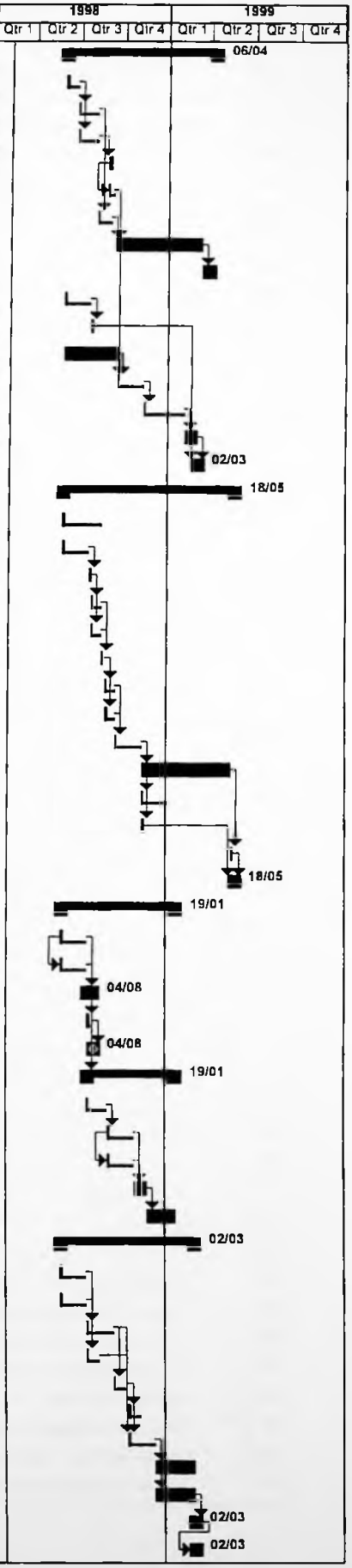
Resource	Man-days
PWD (management and technical)	55
Consultant Project Manager	20
Project Coordinator	100
UK-based Technical Support	80
Local Communications Specialist	40
Environmental Planning Department	30
Planning Consultant	30

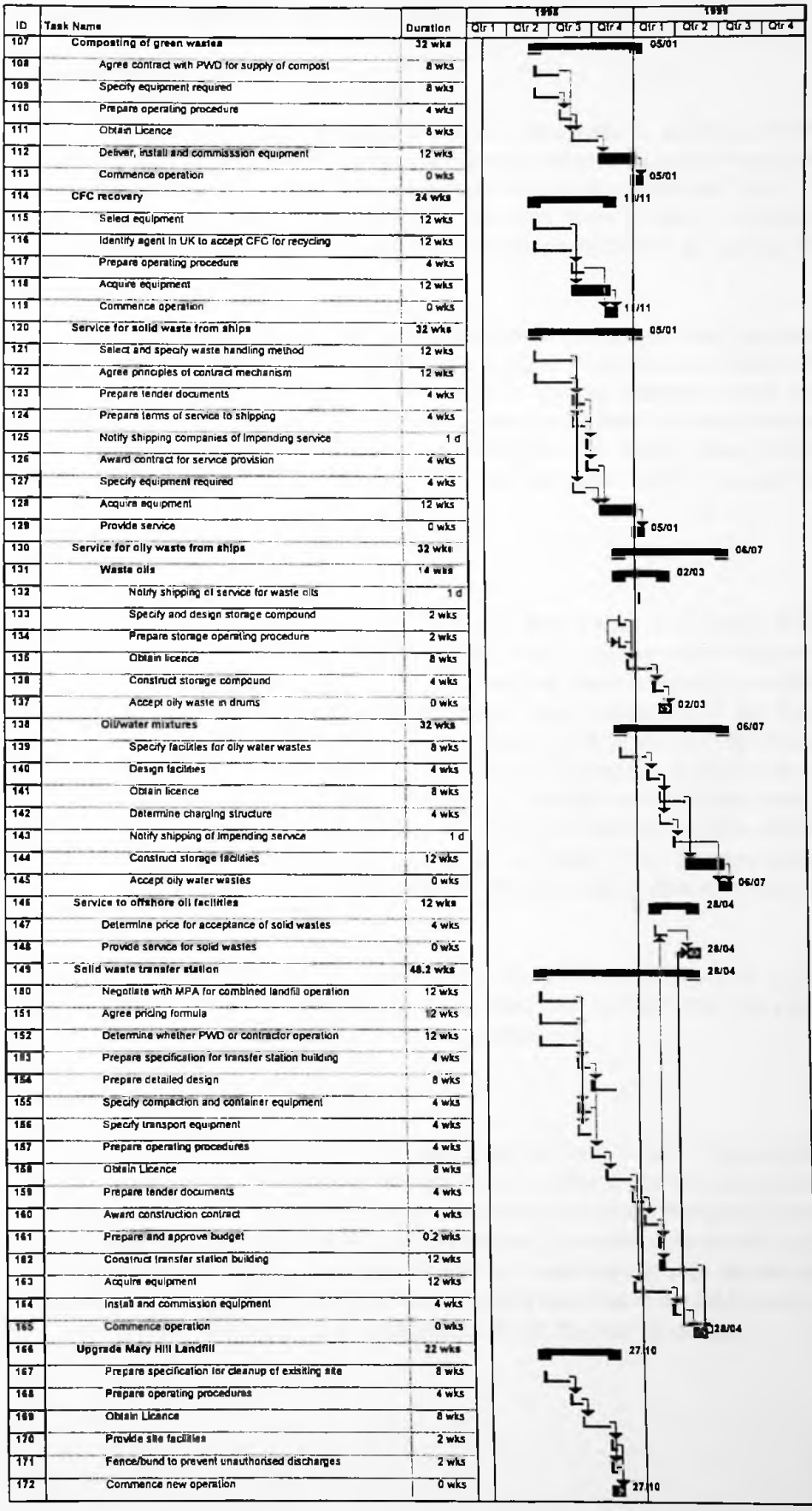
Table 12.2 Sub-tasks for Strategy Implementation

ID	Task Name	Duration
1	Introduce necessary legislation	64 wks
2	Draft Waste Management Ordinance	26 wks
3	Consult with local business and FIG depts	13 wks
4	Allocate resources for implementation	13 wks
5	Implement Waste Management Ordinance	0 wks
6	Implement Licensing Procedure (inc.training)	10 wks
7	Finalise bilateral agreement with UK	8 wks
8	Discuss Basel Convention with UK DETR	12 wks
9	Ratify Basel Convention if required	52 wks
10	Prepare PON for offshore waste management	4 wks
11	Set up organisation for strategy implementation	34 wks
12	Decide organisation	8 wks
13	Establish strategy implementation team	0 wks
14	Allocate departmental responsibilities	0 wks
15	General duties (contingency)	26 wks
16	Determine split between public and private sector	8 wks
17	Prepare/implement communications strategy	73 wks
18	Identify target audiences and messages	8 wks
19	Appoint local communications specialist	8 wks
20	Prepare programme	13 wks
21	implement programme	52 wks
22	Develop and implement physical facilities	58 wks
23	CA site	29 wks
24	Confirm location	8 wks
25	Prepare detailed design	1 wk
26	Specify equipment	1 wk
27	Prepare and approve budget	1 wk
28	Prepare operating procedure	2 wks
29	Obtain Licence	4 wks
30	Order equipment and construct	12 wks
31	Commence operation	0 wks
32	Recycling	33 wks
33	Negotiate rates for shipping of materials to UK	12 wks
34	Identify purchasers of materials/negotiate rates	12 wks
35	Decide materials to be recycled, if any	4 wks
36	Decide on collection method	4 wks
37	Confirm location of collection points	4 wks
38	Specify equipment	1 wk
39	Order equipment, if necessary	12 wks
40	Prepare and approve budget	1 wk
41	Commence operation	0 wks
42	Scrap metal	52 wks
43	Evaluate practicality of S. Georgia project	26 wks
44	Assess practicality of collecting from Falklands	26 wks
45	Determine and obtain approval for cost to FIG	8 wks
46	Transport scrap to appropriate collection points	13 wks
47	Contractor prepares for mission	22 wks
48	Despatch scrap to UK	0 wks
49	Determine acceptability of vehicle deposit scheme	26 wks
50	Prepare necessary legislation	26 wks
51	Introduce scheme if acceptable	0 wks



ID	Task Name	Duration
52	**Hazardous wastes**	**45 wks**
53	Specify task to be performed by contractor	4 wks
54	Select UK contractor for pesticide disposal	6 wks
55	Identify personnel for packaging of pesticides	6 wks
56	Undertake training procedures	1 wk
57	Specify safe working procedure	2 wks
58	Specify and prepare storage facility	4 wks
59	Package and store all pesticide wastes	26 wks
60	Ship pesticides to UK for disposal	4 wks
61	Investigate cooperation with offshore operations	8 wks
62	Prepare and approve budget	1 wk
63	Appoint supervisory chemist	16 wks
64	Specify operating procedure	8 wks
65	Obtain Licence	12 wks
66	Equip storage facility	4 wks
67	Operate hazwaste storage facility	0 wks
68	**Healthcare wastes**	**51 wks**
69	Introduce new waste storage bags	12 wks
70	Arrange inspection of existing incinerator	8 wks
71	Inspect plant/obtain information for preparing spec	1 wk
72	Obtain quote for upgrading existing plant	3 wks
73	Obtain quote for new plant	3 wks
74	Select best option	1 wk
75	Specify plant operating procedures	3 wks
76	Specify shutdown procedures for disposal/storage	3 wks
77	Obtain Licence	8 wks
78	Construct/upgrade plant	26 wks
79	Specify transport procedures, if any	8 wks
80	Prepare and approve budget	1 wk
81	Commission new plant	1 wk
82	Commence operation	0 wks
83	**Abattoir wastes**	**34 wks**
84	Determine acceptability of cooperation with KEMH	8 wks
85	Evaluate and negotiate for MPA incinerator	8 wks
86	**If KEMH cooperation agreed**	**2 wks**
87	Agree apportionment of costs	2 wks
88	Go to task 74	0 wks
89	**If MPA incinerator to be used**	**26 wks**
90	Prepare spec for re-installation/upgrading	6 wks
91	Obtain licence	8 wks
92	Prepare tender documents	8 wks
93	Award contract	4 wks
94	Install MPA incinerator	8 wks
95	**Waste oils**	**40 wks**
96	Agree arrangement with Stanley Services	8 wks
97	Agree financing and charging policy with FIG	8 wks
98	Select combustion technhnology	8 wks
99	Specify new storage requirements	4 wks
100	Specify plant operating procedures	4 wks
101	Notify waste producers of future intentions	4 wks
102	Obtain Licence	8 wks
103	Install new burners	12 wks
104	Install storage facilities	12 wks
105	Commence operation	0 wks
106	Prohibit deposit of oils other than at facility	0 wks





ID	Task Name	Duration
107	**Composting of green wastes**	**32 wks**
108	Agree contract with PWD for supply of compost	8 wks
109	Specify equipment required	8 wks
110	Prepare operating procedure	4 wks
111	Obtain Licence	8 wks
112	Deliver, install and commisssion equipment	12 wks
113	Commence operation	0 wks
114	**CFC recovery**	**24 wks**
115	Select equipment	12 wks
116	Identify agent in UK to accept CFC for recycling	12 wks
117	Prepare operating procedure	4 wks
118	Acquire equipment	12 wks
119	Commence operation	0 wks
120	**Service for solid waste from ships**	**32 wks**
121	Select and specify waste handling method	12 wks
122	Agree principles of contract mechanism	12 wks
123	Prepare tender documents	4 wks
124	Prepare terms of service to shipping	4 wks
125	Notify shipping companies of impending service	1 d
126	Award contract for service provision	4 wks
127	Specify equipment required	4 wks
128	Acquire equipment	12 wks
129	Provide service	0 wks
130	**Service for oily waste from ships**	**32 wks**
131	**Waste oils**	**14 wks**
132	Notify shipping of service for waste oils	1 d
133	Specify and design storage compound	2 wks
134	Prepare storage operating procedure	2 wks
135	Obtain licence	8 wks
136	Construct storage compound	4 wks
137	Accept oily waste in drums	0 wks
138	**Oil/water mixtures**	**32 wks**
139	Specify facilities for oily water wastes	8 wks
140	Design facilities	4 wks
141	Obtain licence	8 wks
142	Determine charging structure	4 wks
143	Notify shipping of impending service	1 d
144	Construct storage facilities	12 wks
145	Accept oily water wastes	0 wks
146	**Service to offshore oil facilities**	**12 wks**
147	Determine price for acceptance of solid wastes	4 wks
148	Provide service for solid wastes	0 wks
149	**Solid waste transfer station**	**48.2 wks**
150	Negotiate with MPA for combined landfill operation	12 wks
151	Agree pricing formula	12 wks
152	Determine whether PWD or contractor operation	12 wks
153	Prepare specification for transfer station building	4 wks
154	Prepare detailed design	8 wks
155	Specify compaction and container equipment	4 wks
156	Specify transport equipment	4 wks
157	Prepare operating procedures	4 wks
158	Obtain Licence	8 wks
159	Prepare tender documents	4 wks
160	Award construction contract	4 wks
161	Prepare and approve budget	0.2 wks
162	Construct transfer station building	12 wks
163	Acquire equipment	12 wks
164	Install and commission equipment	4 wks
165	Commence operation	0 wks
166	**Upgrade Mary Hill Landfill**	**22 wks**
167	Prepare specification for cleanup of exisiting site	8 wks
168	Prepare operating procedures	4 wks
169	Obtain Licence	8 wks
170	Provide site facilities	2 wks
171	Fence/bund to prevent unauthorised discharges	2 wks
172	Commence new operation	0 wks

13 STANLEY HARBOUR WATER QUALITY

13.1 Introduction

The Consultation Paper included a section, Appendix K, on assessment of water quality issues related to Stanley Harbour which had been requested as an addition to the Terms of Reference of the Waste Management Study. The Appendix contains a costed proposal for long term studies necessary to address the monitoring required for compliance with the European Union Bathing Water Directive.

The Fisheries Department have suggested that the proposal relied excessively on expatriate inputs and that the issue to be tackled could be more simply defined as a general check on the quality of Stanley Harbour water quality together with an assessment of trends to determine if there was any impending concerns regarding water quality deterioration. To meet these redefined objectives the previous proposal has been amended and is presented in Section 13.2.

13.1.1 Background to amended proposal

Although there has been some concern that there may have been a deterioration of water quality within Stanley Harbour during recent years there is no analytical evidence to support this. However there is anecdotal evidence relating to odours emanating from around certain stretches of the harbour perimeter and also video evidence produced from a diving survey indicating proliferation of algae on parts of the sea bed. The above suggests that the possible problems may be associated with increased nutrient levels within the harbour. There are a number of small domestic sewage outfalls within the harbour and there may possibly be a discharge from Stanley Growers (horticultural establishment). These are the only known potential sources of pollution in the harbour.

In order to assess the current water quality status the most practical approach would be to focus on parameters associated with sewage derived pollution including nutrients and microbiological parameters.

13.2 Approach to Amended Proposal

It is proposed that an intensive tide related survey, to take place sometime during the months October to March. This represents the period of greatest biological activity in the water. Faecal coliforms and faecal streptococci should be assessed as the appropriate microbiological parameters. In addition a range of physico-chemical parameters should be measured in-situ to assess the general water quality. Results of analysis and monitoring would be compared with relevant standards and background levels for marine waters.

The full list of parameters for the tide-related survey would therefore be as follows:

Microbiological:

Faecal coliforms
Faecal streptococci

Physico-chemical:

pH
temperature
turbidity
dissolved oxygen

The survey work and analysis would be undertaken by an experienced water quality scientist (the trainer) together with designated personnel from the Fisheries Department. The objective , in addition to the assessment of water quality would be to train personnel from Fisheries Department, KEMH, Department of Agriculture or others in order that they can assume responsibility for future monitoring and analysis activities, and make assessments of trends in water quality.

13.3 Methodology

It is proposed that samples should be taken from the existing 14 stations, as used by the Fisheries Department with one additional sampling station on the shoreline adjacent to Stanley Growers. Sample positions will be fixed using GPS equipment.

Samples will be taken from each station at low, mid and high tides, thus a total of 45 samples will be taken in one day. Observational and olfactory assessments and in-situ water quality measurements will be taken at each station for each state of the tide. The survey will be repeated once, as part of the initial intensive study, i.e. there will be two separate survey days.

Microbiological analysis will need to be undertaken in a suitably equipped building. There will be a requirement for a room with electricity and water supply and a work surface that can be disinfected e.g. melamine. The sampling and analysis for the initial intensive study will be undertaken by an experienced water quality scientist. Approved methodologies for microbiological and chemical analysis will be used. The trainer will set up the facilities required for undertaking the microbiological analysis and arrange for the necessary purchase and transport of new equipment required.

Observational and olfactory assessments will be recorded on proforma data sheets (example included in Annex C of Appendix K) and in-situ water quality measurements will be undertaken using a multi-parameter water quality sensor. This sensor will be used for dissolved oxygen, turbidity, temperature, pH, depth and salinity measurements, which will be recorded at surface, mid and bottom depths in the water column. The water quality sensor will be purchased in the UK by the trainer, on behalf of the Fisheries Department.

Taking into account certain anecdotal information regarding water quality in Stanley Harbour and video evidence from a survey undertaken by local divers in 1994, it is also proposed to undertake analysis of nutrient concentrations, i.e. nitrate and phosphate, from one set of samples , on each of the survey days (i.e. 30 samples in total). This would enable some assessment to be made of whether the harbour may be becoming hypernutrified. An area is considered to be adversely affected if it is hypernutrified. Hypernutrification exists when winter values of nutrient concentrations, out with any area of local effect, significantly exceed 12 mmol dissolved available inorganic nitrogen/m^3 (DAIN) in the presence of at least 0.2 mmol dissolved available inorganic phosphorous/m^3 (DAIP). Samples would be analysed by the Department of Agriculture.

Based on the results of the survey the trainer would produce a report covering the following:

- assessment of the current water quality status;
- recommendations for future monitoring programme; and
- recommendations on any further training or equipment purchases required.

A summary of estimated costs to undertake the survey work is given below in Tables 13.1 and 13.2. These costs assume the trainer is contracted in the UK and spends one week in the Falklands.

Survey Costs

Table 13.1 Stanley Harbour Water Quality Survey - Staff Costs

TASK	WATER QUALITY SCIENTIST		DAILY	TOTAL
	No days UK	No. days OS	£	£
Project Management	1		350	350
Survey work and training		7	450	3150
Analysis of results	1		350	350
Assessment Report	3		350	1050
TOTAL				**4900**

Table 13.2 Stanley Harbour Water Quality Survey-Reimbursable Costs

ITEM	PER PERSON OR UNIT	TOTAL
	£	£
Air fares	968	968
Transport UK		86
Accommodation	100	700
Microbiological testing equipment		5000
Purchase of multi-parameter probe		4200
Sampling device	28	56
Small boat hire	150/day	300
Total		**11310**

Notes.

Some of these costs may be considerably reduced if facilities are made available on the island e.g. incubators and filtration equipment for microbiological analysis. Costs for transport of testing equipment are not included. Prices quoted for microbiological and chemical testing equipment are catalogue prices. Formal quotations should be requested if the work is to proceed.

14 SUMMARY AND CONCLUSIONS

An integrated strategy for waste management comprises the introduction and enforcement of legislation, the establishment of a suitable organisation for its implementation, the development and implementation of a communications strategy and a financing plan. The strategy should also be planned and implemented working closely with the Military.

The key proposals for legislation are:

- An Environmental Protection Ordinance should be introduced requiring wastes to be deposited at licensed facilities, restricting or banning the import of hazardous wastes.
- Harbour dues should incorporate a charge for using waste collection and reception facilities provided at FIG's expense, with a requirement to use such facilities incorporated into the conditions.
- Offshore oil installations should be required to follow a code of practice which is incorporated into a PON.
- Optional additional measures could be introduced, including refundable deposits on imported oils and motor vehicles.
- A bilateral agreement needs to be signed with the UK to permit exports of hazardous wastes.

PWD should be charged with ensuring the provision of all necessary waste management facilities for the Falkland Islands. It should then be permitted to do this with its own direct labour or by contracting to the private sector, at its discretion.

The Environmental Planning Department should act as the waste regulation authority, supported by technical consultants.

A Strategy Implementation Team should be established, under the overall management and supervision management of PWD. Most of the tasks should be performed by short term project management and technical consultants. We estimate the total costs of providing this consultancy to be in the region of £100-125,000. Whilst this is a large sum, we do not believe that it will be possible to implement the Strategy without assistance of this kind.

Communication and education is an important element, if the necessary behaviour changes are to be achieved and the public is to accept the new waste management systems. The communications strategy should be developed and implemented by a local specialist, working closely with PWD.

Some the issues which will require communication and education are:

- The overall content of the FIG waste management strategy, its benefits, costs and the changes required
- The provisions and implications of the new legislation
- The importance and approach to waste minimisation and avoidance
- The desirability of all commercial waste producers using a collection service
- The reasons for and benefits of the "bring" system for recycling
- Encouragement of pubs and hotels to use can crushers
- The benefits of and procedures for the new CA site
- The reasons for and benefits of the transportation of wastes to MPA
- The benefits of and procedures for the new transfer station
- The benefits of and procedures for CFC extraction from refrigerators
- The benefits of and procedures for the recovery and recycling of car batteries
- The dangers of stocks of sheep dip and the methodology for their safe handling and storage
- The reasons for not storing or dumping scrap metal, vehicles and tyres
- The benefits of and procedures for the collection of scrap metal
- The problems caused by litter, the benefits of reducing it and the prevention measures which will be taken
- The benefits of and procedures for the facilities being provided to shipping

The incremental cost of the proposals will require capital expenditure of some £¼ million. With the cost of project management and certain one-off costs for restoring Eliza Cove and packaging and exporting the sheep dip stockpiles, the total outlay would be about £400,000. Operating costs to FIG, including depreciation, would be just over £100,000 p.a.

The waste management processes to be introduced should be:

- Develop a "CA" Site with authorised scavenging at Megabid
- Introduce a "bring" system for cans and bottles
- Use stronger healthcare waste bags
- Sort & store hazardous waste
- Provide a collection service for solid wastes from shipping, to be paid for via Harbour Dues
- Accept waste oils from shipping at FIPASS
- Recycle cans in UK
- Recycle scrap metal in UK
- Recycle glass in UK
- Recover lead from lead/acid batteries for recycling in UK
- Extract CFCs from refrigerators for recycling in UK
- Recover oils for use as fuel at Stanley Growers

- Oil waste from Albermarle can be blended with other waste oils and used at Stanley Growers, if no contractor volunteers to accept it under the current invitation to tender
- Produce compost from green waste produced at Stanley Growers for PWD's landscaping needs
- Upgrade healthcare waste incinerator
- Acquire redundant MPA incinerator for certain abattoir wastes and possibly tyres unsuitable for retreading in UK
- Export hazardous waste to UK
- Package sheep dip safely before shipment to UK
- Upgrade landfilling standards in Camp
- Close and restore Eliza Cove as soon as other landfill facilities are established
- Develop Mary Hill as a controlled landfill for Inert wastes only
- Non-inert wastes to be landfilled at MPA and transported via a transfer station constructed at Megabid
- Provide a collection service for all commercial wastes and charge a fee

A number of opportunities for beneficial cooperation with the Military at MPA have been identified, in addition to the joint use of the MPA landfill. It is recommended that, before any firm decisions are taken on the installation of any of the above mentioned facilities, a waste management liaison committee is established between FIG and the Military, to ensure that there is no unnecessary duplication of facilities between the two communities. The respective strategies could then be harmonised to the mutual benefit of both parties.

STANLEY REFUSE COLLECTION SERVICE

WHEELED REFUSE BINS INFORMATION SHEET

Dear Householder,

As previously notified in the local press and radio the upgrading of the existing refuse collection system to one using more attractive and vermin resistant, lidded bins is imminent. **The new system will begin on March 1st 1997.** Old drums should not be used after 28 February, and will be removed after this date on a progressive basis. **Only the new bins should be used after the end of February.**

Delivery of Bins

New bins are being delivered to all premises in Stanley by Bonner's Haulage. Initially one 240 litre plastic wheeled bin and one 25 litre metal bin will be delivered to domestic premises. A second wheeled bin can be delivered if required. 120 litre wheeled bins will be delivered to premises occupied by older residents if these are preferred due to their lower height and greater ease of use. These additional or smaller bins should be requested from Bonner's Haulage.

Collection of Refuse

Collection from your property will be on the same day each week, once the initial settling in period has passed. This day will be made known to you by Bonner's Haulage. On collection day you will need to place your bin(s) just inside the entrance or gateway to your property. If this is a problem for reasons of infirmity or age then please make this known to Bonner's Haulage who will if possible accommodate your needs. Only the wheeled bins will be emptied.

Benefits

The new bins will enable a better, cleaner service to be provided as the lids will keep out animals, birds and other vermin and reduce the amount of waste which blows away. The more frequent collections will reduce build-up in bins and should remove the need for burning.

Responsibilities

When the bins are delivered you will be asked to sign for them. The bins will remain the property of the Falkland Islands Government but you are asked to take care of these during use. It is requested that you keep the bins inside your property, as part of the reason for the new system is to improve the appearance of Stanley. This will also assist in reducing the risk of damage. If the bins are damaged by misuse, then repair or replacement will be at the householder's expense. If a bin is stolen a free replacement will be issued, provided that there is no negligence on your part. It is suggested that you make some identifying mark (which does not cause damage) on the base of the bins for easy identification.

Care of the Bins

The plastic bins are not however suitable for hot materials such as ashes. These should be placed in the metal bin provided, or some other container until they are cool, when they can be placed in the plastic bin. Corrosive materials or objects (such as old vehicle batteries) should also not be placed in the bins.

Cleaning

If you wish to clean your bin, this can be done with warm soapy water, but abrasives should not be used. The expected life of the bins, given reasonable use, is 20 years.

Costs

The replacement cost of the bins is as follows: 25 litre metal £12.20, 120 litre wheeled £22.50 and 240 litre wheeled £28.70.

For further information, contact Bonner's Haulage on telephone number: 22726.

February 1997