BILLET D'ÉTAT

XXI
2007

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B I L L E T D' É T A T

TO THE MEMBERS OF THE STATES OF

THE ISLAND OF GUERNSEY

I have the honour to inform you that a Meeting of the States of Deliberation will be held at **THE ROYAL COURT HOUSE, on WEDNESDAY,** the **31st OCTOBER, 2007,** at 9.30am, to consider the items contained in this Billet d'État which have been submitted for debate by the Policy Council.

G. R. ROWLAND
Bailiff and Presiding Officer

The Royal Court House
Guernsey
28 September 2007

PUBLIC SERVICES DEPARTMENT

BELLEGREVE WASTEWATER DISPOSAL FACILITY INTERIM WORKS

The Chief Minister
Policy Council
Sir Charles Frossard House
La Charroterie
St Peter Port

22nd August 2007

Dear Sir

1.0 Executive Summary

1.1 Comprehensive refurbishment of the Belle Greve Wastewater Disposal Facility is one of the major capital projects prioritised by the States in October 2006. This report has been prepared to release funding for Phase I of the project: Interim Works.

1.2 The report sets the Interim Works in context by explaining that Guernsey is, at present, totally reliant upon this 36 year old facility for disposal of almost all wastewater throughout the Island and that, regardless of any future decisions in respect of wastewater treatment, the existing Belle Greve Facility is in need of refurbishment as soon as possible.

1.3 It also outlines the proposed future phases of the refurbishment project and explains what might happen after refurbishment has been completed, taking account of any decision to pursue wastewater treatment.

1.4 In short, the report explains that the Interim Works are urgently required to:

- Minimise existing risks until comprehensive refurbishment has been completed;
- Survey the existing outfall;
- Define the scope of the overall refurbishment project;
- Ensure business continuity during the refurbishment project.

1.5 The Public Services Department is recommending the States:

(a) To vote the Public Services Department an additional credit of £1,270,000 to complete the Phase I interim works as set out in this report, such sum to be charged to its capital allocation;

(b) To authorise the Treasury and Resources Department to transfer an appropriate sum from the Capital Reserve to the capital allocation of the Public Services Department in respect of these works;

(c) To delegate authority to the Treasury and Resources Department to approve acceptance of all tenders in connection with these works.

2.0 Introduction

2.1 The Belle Greve Wastewater Disposal Facility receives, treats and discharges 90% of the Island's foul wastewater. This vital facility comprises a Headworks located at Marais Rise off Les Banques near the 'Red Lion' road junction and a long sea outfall.

2.2 Wastewater currently receives preliminary treatment comprising maceration and grit removal and is then pumped through the outfall to discharge over a mile from shore in the Little Russel.

2.3 This vital facility was commissioned in 1971 and has operated continuously for 36 years without major refurbishment or upgrading.

2.4 The Belle Greve long sea outfall should not be confused with the short outfall visible on the foreshore near the 'Red Lion', one of several former outfalls that have been retained for infrequent auxiliary use. The Red Lion auxiliary outfall terminates near the low water mark of the lowest spring tide.

2.5 In addition to the two outfalls noted above, there is also a surface water outfall in the same area. The Red Lion Surface Water Pumping Station discharges onto the foreshore by the sea wall; this high level outfall is exposed at most stages of the tide.

3.0 Wastewater Strategy

3.1 In January 2006, the States noted a comprehensive joint report on Sewerage and Wastewater Treatment, prepared by the Public Services and Environment Departments [Billet I of 2006]. The Green Paper informed and stimulated a period of public debate about alternatives and priorities for development and financing of the sewerage network and wastewater treatment.

3.2 The issues concerning the Belle Greve Wastewater Disposal Facility were reported in Sections 4.18 to 4.35 of the Green Paper. The relevant key points are:

- Even if a decision to construct a treatment plant were made today, it would take time to plan, finance & procure;
- In the short to medium term there is no alternative to continued use of the Belle Greve Outfall;
- After 36 years continuous service, the Belle Greve Facility requires major refurbishment to ensure that reliable and effective wastewater disposal facilities can be maintained;
- The Public Services Department announced a comprehensive review to address known deficiencies in this vital strategic asset;
- Refurbishment of the Belle Greve Wastewater facility will ensure adequate capacity for future increases in wastewater flows.

3.3 The deficiencies of the existing Belle Greve Facility include:

- Storm flow exceeding discharge capacity, which is a priority;
- Odour nuisance;
- Operational resilience;
- Outfall maintenance;
- Risk analysis and contingency planning.

3.4 A second report on Sewerage and Wastewater Treatment from the Public Services Department has been prepared for consideration by the States. This may lead to further improvement and extensions of the sewerage network and wastewater treatment, if and when the necessary resources can be secured. Future strategy for the east coast of the Island is also under review.

3.5 The strategically vital wastewater disposal facilities at Belle Greve must be maintained in effective and reliable condition until any long-term alternative has been planned, financed, procured and commissioned. **If and when wastewater treatment is provided, the Belle Greve Headworks will still remain a vital part of the sewerage network.** The Belle Greve outfall would probably be retained to discharge treated effluent or as a storm overflow.

3.6 In October 2006 [Billet XVII] the following statement was included in the States Report on Capital Prioritisation: *"The Public Services Department has identified essential works in respect of the wastewater disposal facility at Belle Greve including new headworks, refurbishment of the pumping station and outfalls. The total cost of this facility is estimated to be nearly £10m, of which £6.0m will be incurred before the end of 2010."* The States agreed that the refurbishment of the Belle Greve Facility was one of the priorities for capital expenditure.

4.0 Comprehensive Refurbishment of Belle Greve Wastewater Disposal Facility

4.1 Consultants Black and Veatch Consulting Limited were appointed in January 2005 to undertake a strategic review of the Belle Greve Wastewater Disposal Facility. An interim report, including some potential solutions and recommendations for further investigation, was received in September 2005.

4.2 A provisional refurbishment and upgrading programme has been developed in conjunction with Black & Veatch to indicate the overall scope and order of cost involved in this project. The final scope of works, budget cost and programme depend on the outcome of outfall and flow surveys. In order to minimise risk, the outfall survey must be undertaken after completion of the Interim Phase I Business Continuity Measures.

4.3 The phased programme will provide an opportunity to reconsider and refine the scope and detail of the main refurbishment project taking into account the development of overall policy for wastewater treatment and any east coast strategy that might emerge.

4.4 It is emphasised that the Department is only seeking approval to complete Phases One and Two and is not at this stage seeking formal approval for the whole refurbishment programme shown in Appendix A.

5.0 Phases I & II - Strategic Review, Outfall Survey and Interim Business Continuity Measures

5.1 Most of the Belle Greve long sea outfall pipe is spun iron pipe of 686mm [27”] diameter installed within a 45 metre deep shaft and 1300 metre long tunnel under the sea. This tunnel was constructed in hard rock and is generally unlined, with metal arch supports installed where unsound rock was encountered. However, completion of the rock tunnel was prevented by adverse geological conditions encountered during construction.

5.2 The following major changes to the original design appear to have been implemented during construction:

- The final 500 metres of outfall pipe was laid directly on the sea bed using a flexible polyethylene plastic pipe of 600mm diameter [24”];

- The completed tunnel was allowed to flood instead of being pumped dry.

5.3 The length of plastic pipe on the seabed has been regularly inspected by divers and is known to be in poor condition. The diameter of this section is smaller than the pipe installed in the tunnel section and this limits the overall capacity of the outfall.

5.4 The submerged tunnel, shaft and outfall pipe contained within them have never been inspected or maintained because there is no safe access. The main objective of the outfall survey is to assess the condition and residual life of the shaft, tunnel and outfall pipes. A secondary objective would be to consider whether and how access for future repairs or replacement might be secured.

5.5 The survey requires state of the art equipment and experience and can only be undertaken after completion of the Interim Works. It is proposed that a specialist company will undertake the survey using remote underwater vehicles and non-destructive testing of both the tunnel and outfall pipe. This survey is essential to:

- Assess risk and prepare contingency plans;
- Plan future maintenance or replacement;
- Incorporate the outfall in plans for wastewater treatment.

5.6 The Island's wastewater disposal depends on a single outfall, which is not unusual. However, it has not been practical to monitor the condition of the critical length enclosed in the tunnel. Furthermore, there is no access to undertake routine maintenance. Major civil engineering works may be required to seal and drain the tunnel to undertake any repairs that might eventually be required, which could take several months.

5.7 The long sea outfall has functioned well for over a third of a century. However, there is a need to refurbish the outfall and to prepare contingency plans, which might include a prolonged diversion of flows for major repairs or construction of a replacement outfall.

5.8 Drainage from combined sewers in urban areas includes drainage of surface water from roads, roofs and other paved surfaces. The volume of wastewater received at Belle Greve increases dramatically in wet weather such that maximum flow is more than 5 times the average dry weather flow and can exceed 1,000 litres per second. Wastewater storage capacity at Belle Greve is minimal; flows must be discharged when they are received.

5.9 Some new sewers have been constructed to divert surface water away from foul sewers, mainly by diverting road drainage. However the benefit of constructing new surface water sewers has been offset by a myriad of minor building developments, including construction of patios, drives and paths within existing premises. Such incremental development progressively increases the volume of surface water draining to existing foul sewers. This increases the maximum flow in combined foul sewers during storm rainfall.

5.10 The intensity of storm rainfall is expected to increase as a result of climate change and this will exacerbate the already high maximum flows in the combined foul and surface water sewers.

5.11 In addition to surface water, flows are also increased by infiltration of seawater during high spring tides. Critical conditions can arise if heavy rainfall coincides with a high spring tide when the wastewater pumps at Belle Greve have to deliver maximum pressure to discharge against the high tide.

5.12 Diverting more surface water to separate new sewers and eliminating infiltration of seawater are substantial medium to long-term projects.

5.13 In recent years, the flows received at Belle Greve under severe storm conditions have frequently exceeded pumping capacity, leading to surcharge of sewers in low lying areas of the east coast and localised foul water flooding. The combination of an old and frequently overloaded pumping station presents an unacceptable risk that more serious flooding may occur.

5.14 The capacity of the Belle Greve Wastewater Disposal Facility is limited by the size and risk to the integrity of the outfall pipe. In the medium term, flow capacity would be addressed by the comprehensive refurbishment project; an interim solution is urgently required to minimise flood risks until the main refurbishment project has been completed.

5.15 The Red Lion auxiliary outfall was constructed about 1900 to discharge foul wastewater from a substantial part of the Island. This manually controlled outfall is 900mm [36”] diameter, operates by gravity and is not at present connected to the Headworks pumping station. Emergency use of this outfall is severely restricted by tidal conditions and the location of the controlling valve in the busy road junction.

5.16 The Interim Works have therefore been devised to:

- Provide access for survey and briefly divert flows through the auxiliary ‘Red Lion’ outfall during survey of the main long sea outfall;
- Discharge flows in excess of outfall capacity;
- Provide a contingency for emergencies;
- Avoid discharge through the auxiliary outfall during routine maintenance of the pumping station;
- Provide auxiliary pumping capacity to facilitate temporary shut down of the existing pumping station during refurbishment.

5.17 The Interim Works include construction of:

- An auxiliary storm and standby pumping station;
- A bypass pipeline linking the auxiliary pumping station to the main outfall and the existing Red Lion auxiliary outfall;
- An emergency overflow to the foreshore;
- Improved access into the outfall pipe and shaft.

5.18 Most of the interim works will be underground or within the existing Headworks. Excavation to install the bypass pipeline in Les Banques adjacent to the Red Lion road junction would be very difficult because of the existing dense network of vital underground services and the heavy traffic on this strategic route. The proposed alternative route is along the foreshore buried adjacent to the sea wall, which will minimise cost and greatly reduce disruption to traffic and underground services. The route of the bypass pipeline is shown on the attached General Layout Plan Ref 6922/284A.

5.19 H. M. Receiver General has been consulted and has agreed in principle to the proposals in so far as these affect Crown land, subject to contract. A formal planning consultation has been submitted to the Environment Department which has raised no objection to these proposals, subject to conditions which have been accepted by Public Services.

5.20 Interim Works commenced prior to resurfacing of Les Banques Road early in 2006, undertaken by Geotrant Limited within the Term Contract for Sewer Rehabilitation. The initial work cost £411,764 including purchase of materials. Revenue budgets were insufficient to complete this bypass; further work was therefore suspended pending consideration of the options. The Public Services Department is now seeking States approval to complete the Interim Works as a capital project.

5.21 In view of the need to undertake work on the foreshore during summer weather, the Public Services Department intends to recommence this element of the Interim Works prior to debate in the States. In the event that capital funds were not released by the States for this priority project as indicated last October, the £400,000 cost of these advance works would be met by further postponing vital sewer rehabilitation projects.

5.22 In February 2006, the Treasury and Resources Department approved a capital vote of £200,000 to fund a comprehensive review and an outfall survey. The first stage of this review has been undertaken, leading to preparation of this report to the States and a decision to undertake Phase I: Interim Works.

6.0 Future Phase III: Refurbishment and Upgrading Outfalls

6.1 If and when full wastewater treatment is provided, a new outfall might then be constructed. Even then, it is likely that the existing outfalls will be retained as part of the long term solution. In the meantime it is essential to maintain the existing outfalls in effective working condition.

6.2 Phase III includes replacement of the seabed length of the main outfall which is known to be in poor condition. A replacement pipe for the length on the seabed would be of larger diameter so that the whole pipeline would then be of the same diameter. This would increase the maximum flow that could be discharged through the long sea outfall when this is required, during storm rainfall.

6.3 This Phase also includes refurbishment of the auxiliary outfall that will be connected to the bypass pipeline under Phase I: Interim Works.

6.4 Refurbishment and upgrading the existing outfalls has been programmed after full inspection of the existing outfall pipe during Phase II works, including the length constructed in submerged tunnel. Depending on the results of outfall and tunnel survey, it might be necessary to consider alternative solutions including, under the worst scenario, replacing the whole length of outfall pipe and abandoning the tunnel. The final scope of the overall refurbishment project will therefore be reviewed prior to commencing outfall refurbishment. Should there be any decisions on future strategy for wastewater treatment or the eastern seafront, these can be taken into account at this stage.

7.0 Future Phase IV: Refurbishment of Pumping Station

7.1 The existing pumping station will be retained with minor repairs to this major structure but, after 35 years continuous operation, the electrical and mechanical plant is obsolete and requires replacement.

7.2 It is envisaged that the pumping station will be taken out of service for several months to replace the mechanical and electrical plant. A complete shut down of the existing pumping station offers a safer and more cost effective approach to replacing power cables threaded through the pump inlet chamber, a hazardous confined space.

7.3 Although refurbishment of the pumping station is already overdue, it has been programmed after completion of the proposed new auxiliary pumping facilities because these Phase I Interim Works would be necessary to divert flows during refurbishment.

8.0 Future Phase V: Refurbishment and Upgrading of Preliminary Treatment

8.1 The Department is proposing to replace the present preliminary treatment unit because simple replacement of the obsolete plant would not adequately resolve current operating, storm capacity and business continuity issues.

8.2 The new preliminary treatment plant would be fully enclosed within a new building with effective odour control and treatment. Fine screens would replace obsolete maceration plant to remove non-biodegradable plastics and sewage related debris in accordance with current best practice. Grit removal and flow measurement facilities would also be included.

8.3 It may be appropriate to incorporate storm retention capacity to minimise discharges through the auxiliary outfall during routine maintenance and severe storms.

8.4 In addition to replacement and upgrading essential plant, this Phase would provide substantial environmental benefits for the marine environment and greatly improve the current environmental impact on neighbouring properties. This is in effect the first phase of wastewater treatment.

8.5 The cost of this work could achieve a commensurate reduction in the future cost of providing wastewater treatment.

9.0 Conclusions

9.1 After 36 years continuous service, the Belle Greve Wastewater Facility urgently requires major refurbishment. A decision to provide wastewater treatment would not avoid the need to refurbish the existing facilities, both as an interim measure until new facilities are commissioned and as an essential element in the final solution.

9.2 The staged refurbishment programme set out in this report would provide flexibility to accommodate future decisions about wastewater treatment and overall strategy for the east coast of Guernsey. Refurbishment would also extend the operational life of this vital facility by 20 years.

9.3 Although the overall refurbishment strategy is outlined in this report, the States are asked to approve only the first phase, Interim Works. The Interim Works are essential to ensure that all wastewater can be discharged without significant risk of foul water flooding. These works are also necessary to complete a survey of the outfall and plan the overall refurbishment.

10.0 Recommendations

10.1 The Public Services Department recommends the States:

i) To vote the Public Services Department an additional credit of £1,270,000 to complete the Phase I interim works as set out in this report, such sum to be charged to its capital allocation;

ii) To authorise the Treasury and Resources Department to transfer an appropriate sum from the Capital Reserve to the capital allocation of the Public Services Department in respect of these works;

iii) To delegate authority to the Treasury and Resources Department to approve acceptance of all tenders in connection with these works.

Yours faithfully

William M Bell
Minister

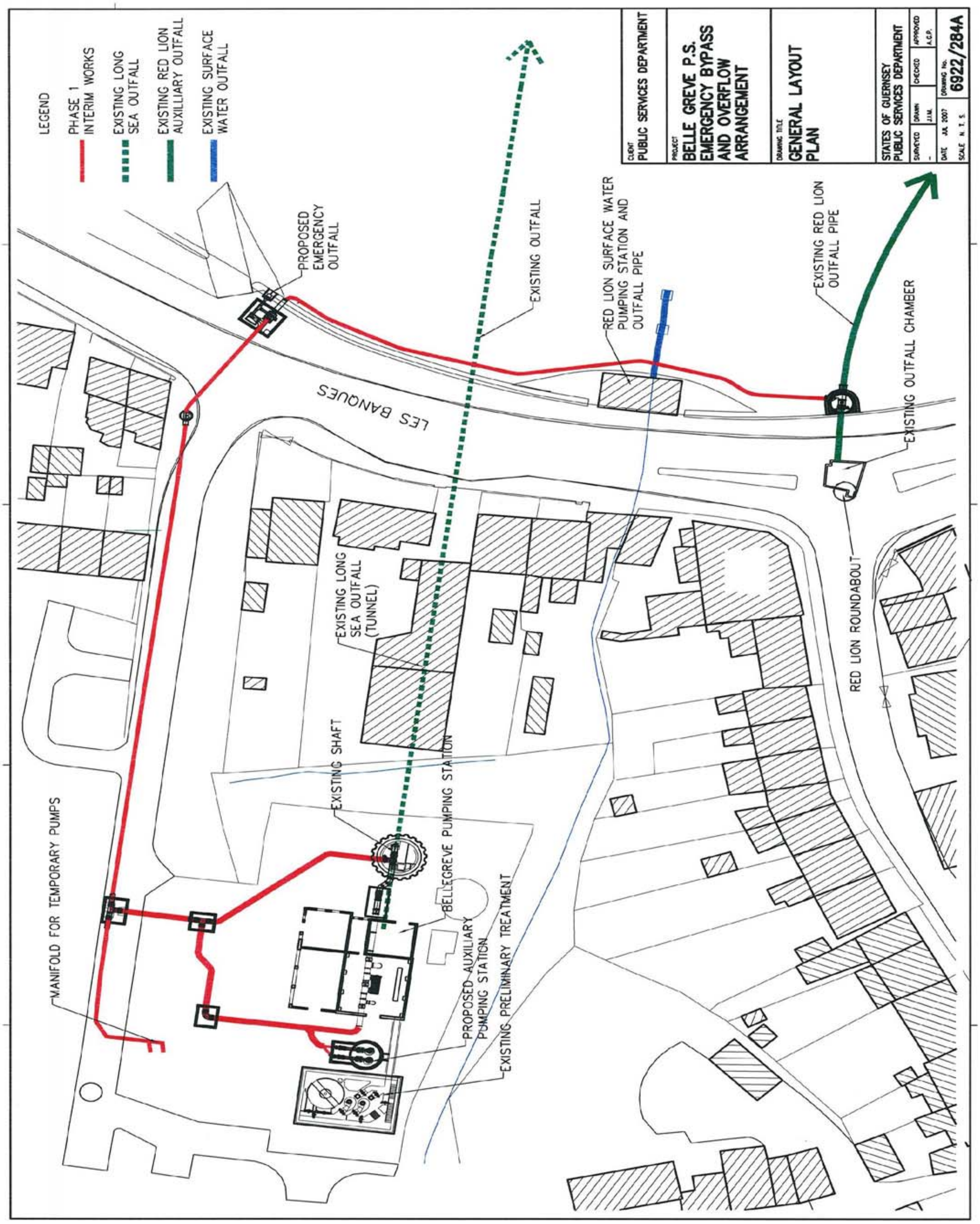
APPENDIX A

Provisional Programme for Refurbishment and Upgrading Belle Greve Wastewater Disposal Facility				
Phase	**Description**	**Budget Cost - £**		**Programme**
I	Complete Interim Business Continuity Measures	1,270,000		2007
II	Outfall Survey & Report	200,000		2007/8
Total Firm Programme		**1,470,000**		
Future Phases		**Minimum Cost**	**Maximum Cost**	**Provisional Programme**
III	Refurbish Outfalls	2,500,000	4,000,000[1]	2008/9
IV	Refurbish Pumping Station	1,000,000	2,000,000	2008/9
V	Preliminary Treatment Storm Water Retention[2]	3,000,000 Omit	4,500,000 4,000,000	2010/11
Project Total		**7,970,000**	**15,970,000**	

Notes:

[1] This estimate excludes replacement or refurbishment of outfall pipes in the submerged shaft & tunnel – a new outfall costing £10 Million might be required.

[2] It may be appropriate to incorporate stormwater retention with preliminary treatment.



LEGEND
PHASE 1 INTERIM WORKS
EXISTING LONG SEA OUTFALL
EXISTING RED LION AUXILLIARY OUTFALL
EXISTING SURFACE WATER OUTFALL
PROPOSED EMERGENCY OUTFALL
EXISTING OUTFALL
RED LION SURFACE WATER PUMPING STATION AND OUTFALL PIPE
EXISTING RED LION OUTFALL PIPE
EXISTING OUTFALL CHAMBER
RED LION ROUNDABOUT
LES BANQUES
EXISTING LONG SEA OUTFALL (TUNNEL)
EXISTING SHAFT
BELLEGREVE PUMPING STATION
PROPOSED AUXILIARY PUMPING STATION
EXISTING PRELIMINARY TREATMENT
MANIFOLD FOR TEMPORARY PUMPS
CLIENT PUBLIC SERVICES DEPARTMENT
PROJECT BELLE GREVE P.S. EMERGENCY BYPASS AND OVERFLOW ARRANGEMENT
DRAWING TITLE GENERAL LAYOUT PLAN
STATES OF GUERNSEY PUBLIC SERVICES DEPARTMENT
SURVEYED -
DRAWN J.I.M.
CHECKED
APPROVED A.C.P.
DATE JUL 2007
SCALE N. T. S.
DRAWING No. 6922/284A

(NB The Policy Council supports the proposals.)

(NB The Treasury and Resources Department supports the proposals.)

The States are asked to decide:-

I.- Whether, after consideration of the Report dated 22nd August, 2007, of the Public Services Department, they are of the opinion:-

1. To vote the Public Services Department an additional credit of £1,270,000 to complete the Phase I interim works as set out in that Report, such sum to be charged to its capital allocation.

2. To authorise the Treasury and Resources Department to transfer an appropriate sum from the Capital Reserve to the capital allocation of the Public Services Department in respect of these works.

3. To delegate authority to the Treasury and Resources Department to approve acceptance of all tenders in connection with these works.

PUBLIC SERVICES DEPARTMENT

WASTEWATER CHARGES

The Chief Minister
Policy Council
Sir Charles Frossard House
La Charroterie
St Peter Port

22nd August 2007

Dear Sir

1.0 Executive Summary

1.1 This report reviews the current funding arrangements for sewerage services in Guernsey.

1.2 It notes the synergies between the management of the potable water (drinkable) and wastewater (sewage) systems. Potable water originates from the natural environment, is processed and then delivered to properties. Wastewater is removed from properties, processed and then returned to the natural environment.

1.3 The water inputs to properties are managed by the Public Services Department through its division Guernsey Water, which operates as a self funding business. The water outputs from a property are also managed by the Department, but the majority of the funding is provided through general revenue.

1.4 Both services of 'potable water in' and 'foul water out' are essential to public health.

1.5 The Report outlines the inconsistencies between the funding of the services and proposes a change to tie in with the revision of the current tax on rateable values. When the new Tax on Real Property is introduced there will no longer be a higher rate applied for those properties, which are connected to the public sewer. This change, combined with concerns over the equity of the current cesspit emptying charges, provides an opportunity to introduce a standard mechanism whereby all customers pay for the removal of wastewater.

1.6 In many countries the customers meet the full direct cost of the sewerage system. The Public Services Department does not consider this to be appropriate for Guernsey at this time. Instead it recommends that a wastewater charge be introduced which is sufficient to cover the operational costs of the sewerage network, but that capital expenditure such as extensions to the public sewerage network, replacement of pumping stations and any future wastewater treatment facilities should, at least for the time being, continue to be funded by the States of Guernsey.

1.7 The report recommends the States to agree in principle to the introduction of a wastewater charge, which, for the average property, could equate to £25 per quarter. The exact amount is, however, a matter for future consideration. Properties requiring cesspit emptying would still pay for this service, but at a reduced rate. The extent to which these charges are reduced will be considered at a later stage. The intention is that all properties should pay for wastewater (sewage) disposal. This will reduce the current disparity between those who are on a cesspit, therefore paying over £200 per annum and those on the main drain who only pay in the region of £30 per annum through a higher tax on rateable value.

1.8 It is intended that all the charges would be collected through the Guernsey Water billing system.

1.9 If approved in principle, the Public Services Department will develop the proposals and report back to the States with firm proposals.

2.0 History/Background

2.1 Following the review of the Machinery of Government, the Public Services Department (the "Department") was formed, the mandate of which includes inter alia the responsibilities of the former States Water Board (SWB) and Public Thoroughfares Committee (PTC).

2.2 The SWB was a business unit operating as a Trading Board and was totally self-contained, providing a full range of technical, operational and administrative services. The SWB was in a strong position, as a well established unit, able to plan its future activities because of the certainty and clarity of its funding.

2.3 The wastewater responsibilities inherited from PTC had no such guaranteed funding apart from that relating to the sewage tanker fees. It was reliant on receiving sufficient funds each year from General Revenue and Capital to cover the essential maintenance and operations of the existing sewerage network and pumping stations, as well as carrying out improvements and extensions. These funding arrangements can lead to uncertainty, particularly for capital projects, causing delays that can easily result in increased costs.

2.4 The formation of the Department saw the bringing together of a number of business disciplines and was seen as an opportunity to draw on the synergies of experienced, specialised teams to spread knowledge and skills across the Department as a whole.

2.5 At this stage, it is worth noting that the UK has moved towards shared control between the sewerage infrastructure and potable water supplies, with 10 of the 26 water companies incorporating both services. This enables the combination of expertise, administrative systems and buying power, leading to savings through economies of scale for the companies but ensuring that there is no overlap in areas where there would be the remotest risk of cross contamination.

2.6 Through an officer level working group, the Board has examined all options for the control of sewerage so that it operates within a properly structured and funded business unit. In the short term, the key objective is to establish a system of funding so that sewerage is no longer solely reliant on General Revenue or Capital Allocation for funding.

3.0 Sewerage – An Essential Service

3.1 Guernsey's sewerage network provides a service that serves every household and business on the Island and not just those properties with direct connections into it. The tanker fleet empties cesspits, discharges loads into the sewerage network for onward transmission through pipework and pumping stations (the sewerage network) for eventual discharge to the recognised outfalls. The sewerage infrastructure is an essential requirement for all civilised societies, especially in high-density population areas like Guernsey, which relies to a large extent on its surface waters for its potable water supplies.

3.2 The maintenance costs associated with the sewerage infrastructure offer very little or no flexibility and cannot withstand any cutbacks. Pumping stations have to be serviced and maintained, sewers have to be cleansed to avoid a build up of debris which could lead to flooding and surcharging of the sewers resulting in pollution to the Island's water supply. Maintenance and repair to any part of the network is essential as soon as the need is established; it cannot wait for additional funding to be made available. Any delay to repair work could be to the immediate and serious detriment of the health and well-being of the population, and also impact adversely upon the public perception of the service.

3.3 In a report dated 13 March 1998, submitting its Business Plan to the States (Billet d'État VII), the PTC advised that it had prepared a report on the Network Extension Plan updating the 1986 plan, setting priorities on the extension to the foul sewer network.

3.4 In a further report to the States dated 21 September 2000, the PTC declared its long term target that by the year 2020 95% of the Island's residential properties should be connected to the sewer. In this report, the PTC outlined its plan to extend the network in three phases:-

Phase 1	2001-2005
Phase 2	2006-2010
Phase 3	2011-2020

3.5 Funding restrictions and the identification of extensive upgrading work at Belle Greve will result in the original network completion targets not being met. It is likely that upon reaching Creux Mahie in 2008 other large scale works to extend the foul sewer network will be placed on hold.

3.6 Approximately 90% of the Island's sewage flows to the Belle Greve outfall, which was commissioned in 1971. Capital funds must be set aside for the upgrading of this outfall and other related trunk sewers, the costs of which could be spread over a period of time, by writing a planned refurbishment programme.

4.0 Public Perception of Current Situation

4.1 At present, approximately 76% of the Island's properties are connected to the foul sewer network. The revenue generated for the States of Guernsey as a result of the current, marginally higher enhanced tax on rateable value obtained from these properties is approximately £0.5million.

4.2 The remaining 24% of properties, which must continue to use cesspits, contribute approximately £1.4 million.

4.3 The Board regularly receives representations from people who desire their properties to be connected to the foul sewer network but are unable to because the foul sewer network has not yet reached their vicinity. The core complaint is that as home owners, they have no control over where the network extension will be installed and so they must continue with the relatively archaic process of storing septic sewage on their domestic property and paying for its subsequent removal at an average annual cost in excess of £200, whereas it may be that a nearby property, which has been able to connect to the foul sewer, is charged the relatively low sum of £30 per year owing to the higher rateable value. Even this extra charge will disappear when the new Tax on Real Property comes into force. The Board is professionally advised that the capital value of properties connected to the foul sewer network is on average £15,000 higher than a similar property with a cesspit, so when these facts are combined it is understandable why people would like to be connected to the main sewer network.

4.4 The Department is aware that properties continue to be built requiring the use of cesspits, which only serves to exacerbate the situation faced by the Department at a time when it is attempting to reduce the number of properties connected to cesspits.

4.5 It should be noted that both cesspit and main drain customers use the sewerage network. The only extra service used by cesspit customers is the tanker fleet.

5.0 Principles of Future Funding

5.1 In a report issued to the States for discussion on 25 January 2006 (Billet d'État I) the Board suggested that all properties that generate foul water should be making a contribution to the sewerage infrastructure.

5.2 The Board fully accepts that in the very near future, the States of Guernsey will receive less direct tax revenues and believes that the time is now right to consider the introduction of charging its customers (all Island households and business units) for the provision of sewage disposal facilities. This proposal will levy a waste water charge directly from the customers and remove the reliance on General Revenue.

5.3 It is intended that in the long term, a 'user pays' method could be adopted where the waste water charge will fund the capital infrastructure and the full operating costs of sewage disposal.

6.0 Comparisons to Other Jurisdictions

6.1 In Guernsey, the majority of costs of sewage disposal are funded through general taxation. The only direct costs borne by householders connected to the public sewer network are their initial branch connections to the public sewer, for which financial assistance has been available through the Grants and Loan scheme. Householders who are not connected to a public foul sewer are charged for the cesspit emptying service, on the basis that it is currently a subsidised service.

6.2 In Jersey, water is supplied by Jersey Water, a Limited Company of which the States of Jersey are the majority shareholders. Sewerage services are provided by the States of Jersey. Liquid waste services are funded by public funds. A comprehensive sewerage charge was proposed to be introduced in Jersey from 2004 with the hope of raising approximately £2.3 million, however, this was not considered appropriate at that time as the States of Jersey were looking at introducing a Goods and Services Tax.

6.3 In the Isle of Man, water is supplied by the 'Water Authority,' a statutory Board operating under the Isle of Man Government. Sewage disposal is operated and funded by the Isle of Man Government.

6.4 It should be noted that the 'user pays' principle has been widely adopted in the UK, France and some States in the US.

6.5 The Water Services Regulation Authority in England and Wales (Commonly known as OFWAT) regulates the charges set in the UK for both water provision and sewage disposal. Charges for water and sewerage services are distinguishable.

6.6 Sewerage customers are charged a standing charge plus either, if the water entering the property is measured, a charge per cubic metre or, if the water is unmeasured, a charge based on either the Rateable Value or surface area of the property. These charges are set to recover the cost of receiving, treating and disposing of foul sewage, surface water and highway drainage.

6.7 Infrastructure charges are fixed charges made for each new connection to water mains and sewers. Maximum water/sewerage infrastructure charges are set by the Water Services Regulation Authority and such charges fund improvements to the relevant company's local infrastructure to take account of new demand placed upon the public system.

7.0 Establishment of Charges

7.1 Based upon the 2007 budget, the revenue cost of operating Guernsey's wastewater services for the year will be £3,419,500. Sewage tanker income will be £1,377,000. A breakdown of these costs is shown in Appendix A.

7.2 Capital expenditure of £3,572,500 has also been budgeted. The shortfall is currently funded by general revenue. A breakdown of these costs is shown in Appendix A.

7.3 It is proposed that an average charge of £100 per household per annum is levied. This will reduce the reliance on General Revenue for funding of provision of sewage disposal services. The Department has approximately 24,000 customers; therefore the proposed charge would generate about £2.4m per annum. This new source of revenue would be partially offset by the proposed reduction in cesspit emptying charges.

8.0 Calculation of Charges

8.1 There is a direct relationship between the amount of inflowing potable water into a property and the amount of waste water then produced and in need of disposal. Therefore, for those properties charged for water by meter, it would be appropriate to estimate the waste water produced as at least 90% of the volume of clean water supplied, which would be multiplied by a rate to be assessed dependent on the financial models to be produced.

8.2 For those properties without a water meter, the calculation of the property's waste water charge would be the same as that used by Guernsey Water (GW) ie. based on a multiplying factor of the property's rateable value. Following the introduction of Tax on Real Property (TRP) in January 2008, charges will then be based on the new rates using the TRP System. The multiplying factor to calculate the waste water charge has yet to be agreed but will be dependent upon the financial models to be produced.

8.3 Properties which are not on mains water are not currently subject to any water charges. However, if these properties are connected to the sewerage network, they will be subject to a waste water charge, calculated using the same method as those properties without a water meter. Consideration will also be given to those properties not on mains water and without connection to the sewerage system.

9.0 Introduction and Collection of the Charge

9.1 The Board would wish to ensure that all consumers were aware of the charge and exactly what it is composed of prior to being billed for it. The Department would need to incorporate publicity in the media and probably an explanatory leaflet issued to each consumer in a selected quarter with their quarterly water bill. Consumers would be directed to the Public Services Department who would be briefed to field any queries.

9.2 The Board recognises the progress that has been made with the Corporate Anti-Poverty Programme, and acknowledges that the safeguarding of vulnerable users must be taken into account in establishing a waste water charge.

9.3 The Board recognises that the timing of the introduction of TRP is critical to the establishment of the waste water charge as disputed TRP rates could filter through to disputed TRP-based water and waste water rates. The Board therefore suggests that some time is given following the introduction of TRP to allow for the settling of any disputes in rates prior to the introduction of the waste water charge with the aim of reducing the amount of queries that Guernsey Water will have about the new charges. Therefore, it is expected that the waste water charge will be introduced in January 2009.

9.4 GW already has an established income collection system, which, if the waste water charge is approved, could be utilised for the collection of the additional waste water charge. This takes advantage of the synergies between the ‘clean’ and ‘waste’ sides of the water business bringing together the benefits of commonality with such elements as customer database, records and billing. The charge could be added to each consumer’s water bill as a separate line item.

9.5 As the infrastructure for charging is already in place, additional charges could be collected without the need for additional staffing resources. There would, therefore, be no additional costs in this respect.

9.6 The impact on customers in terms of administration will be minimal, as they will receive only one account, as at present, and will be able to pay the full amount for “clean” and “waste” water charges in one transaction.

9.7 There would be a need for legislation to be introduced before the charges could be implemented. At present, this would not have an adverse impact on the target date for implementation of the charges with effect from 1 January 2009.

9.8 Clearly the need for legislative measures means that there will be a cost to the States in terms of staff time, etc. in researching and drafting the legislation. However, such costs will not be ongoing, as the intention is to ensure that future charges can be amended by Regulation, thereby minimising future administration in this respect.

10.0 Long Term Charging Policy

10.1 The long term objective is for wastewater services to be self-funding using the 'user pays' principle. In order to achieve this objective, it will be necessary for charges to be reviewed regularly to ensure that the principle is still being observed and adjustments made to the level of charges as necessary. It is probable that charges would be reviewed annually, in common with the Board's other fees and charges levied, although it may not always prove necessary to amend them.

11.0 Impact on Inflation

11.1 The Board is aware that the Treasury & Resources Department is anxious to ensure that any adverse effect on inflation brought about through the introduction of new fees and charges should be minimised.

11.2 At this stage it is difficult to quantify with any certainty what the impact of the proposed charges will be. At present, the cost of sewage emptying for one load is included in the household section of the RPI, together with the rateable value per £ of a property's Rateable Value. The weight for each of these factors is determined by the Household Expenditure Survey (HES).

11.3 The effect of the proposed new charge would be to reduce the rateable value weight by a small amount, whilst at the same time effectively replacing the sewage emptying charge with a new one. However, until a new HES is conducted – and the next one is not scheduled to take place for another 5 years – it is not possible to determine the weight for the new charge within the index. Notwithstanding this, once the charge was introduced and monitored in the RPI, then after a year it would be possible to tell what the effect of increasing the charge would be on the index.

11.4 Given that sewage charges are already included in the RPI calculations, it is not anticipated that the proposals would have a significant adverse effect on inflation locally, although the possibility of a slight rise cannot be ruled out.

12.0 Summary

12.1 If the introduction of a waste water charge is approved in principle, further work will be undertaken to establish how exactly the introductory charge is calculated and administered. Further discussions and liaison will be needed with the Treasury and Resources Department with regard to continued funding whilst the waste water charge is phased in, and consideration should be given to other stakeholders. Nonetheless, the Public Services Department considers it essential that the States be asked for its view on the introduction of a waste water charge so that the necessary discussions can commence with the Treasury and Resources Department and the Law Officers of the Crown to assess what legislation is required to bring this into effect.

13.0 Recommendations

13.1 The Public Services Department therefore recommends that the States:

(i) Agree in principle to the introduction of Wastewater Charges as outlined in the above report;

(ii) Direct the Public Services Department to consult with the Treasury and Resources Department and the Law Officers of the Crown with regard to the introduction of the necessary legislation;

(iii) Direct the Public Services Department to undertake the additional work needed so as to report back to the States with firm proposals;

(iv) Direct the Treasury and Resources Department to take account of the fees raised from Wastewater Charges when recommending to the States, Cash Limits for the Public Services Department for 2009 and subsequent years.

Yours faithfully

William M Bell
Minister

APPENDIX A

PUBLIC SERVICES DEPARTMENT

WASTE WATER REMOVAL COSTS BUDGET 2007

INCOME		EXPENDITURE	
Sewage Tanker Income	1,377,000	General Revenue:	
		Sewage Tanker Service Contracts	1,629,000
		Pumping Station - Maintenance	680,000
		Sewer Maintenance Costs	268,500
		Sewer Rehabilitation	800,000
		Consultants	42,000
			3,419,500
		Capital Costs:	
		Network Extension Plan	3,017,500
		Sewage Tanker Replacement Programme	165,000
		Miscellaneous Capital Works	390,000
			3,572,500
Total Income	1,377,000	Total Expenditure	6,992,000
Shortfall to Fund Expenditure	5,615,000		
	6,992,000		6,992,000

(NB The Policy Council supports the proposals. The Policy Council stresses that whenever Departments consider new or increased charges it will wish to ensure that full account is taken of the Corporate Anti-Poverty Programme. The Council has always considered those on low incomes when formulating policy on social security contributions and other charges, including the costs of social housing for example. In respect of the proposals in this States Report, the Policy Council strongly endorses the comment made in paragraph 2.9 that the safeguarding of vulnerable users must be taken into account in establishing a wastewater charge against the approved fees and charges criteria.)

(NB The Treasury and Resources Department supports the proposals.)

The States are asked to decide:-

II.- Whether, after consideration of the Report dated 22nd August, 2007, of the Public Services Department, they are of the opinion:-

1. To agree in principle to the introduction of Wastewater Charges as outlined in that Report.

2. To direct the Public Services Department to consult with the Treasury and Resources Department and the Law Officers of the Crown with regard to the introduction of the necessary legislation.

3. To direct the Public Services Department to undertake the additional work needed so as to report back to the States with firm proposals.

4. To direct the Treasury and Resources Department to take account of the fees raised from Wastewater Charges when recommending to the States, Cash Limits for the Public Services Department for 2009 and subsequent years.

PUBLIC SERVICES DEPARTMENT

SEWERAGE AND WASTEWATER TREATMENT

The Chief Minister
Policy Council
Sir Charles Frossard House
La Charroterie
St Peter Port

29th August 2007

Dear Sir

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Appendices

1. Executive Summary

1.1 This report follows an extensive consultation process, including publication of a Green Paper [Billet I of 2006]. Reference is made in this report to the contents of the Green Paper; for brevity not all the Green Paper has been repeated or appended to this report. Copies of the Green Paper are available for reference.

1.2 The history and development of current liquid waste strategy was fully reported in the Green Paper; for ease of reference the relevant sections have been attached as Appendix I.

1.3 After a brief introduction in Section 2, this report summarises and comments on the current arrangements for sewerage and wastewater disposal in Section 3.

1.4 The report then explains the consultation process and summarises responses received in Section 4. Since publication of the Green Paper, there have been some international and local policy developments relevant to sewerage and wastewater treatment; these are reported in Section 5.

1.5 In response to points raised in the States and by the public, the Public Services Department has made further inquiries about health risks, environmental issues and alternative treatment processes. Further investigations are reported in Section 6.

1.6 The objectives, main tasks and potential costs of two alternative forms of Environmental Impact Assessment [EIA] have been clarified [Section 6.29]; these alternatives would be required to:

a) Assess the impact of current methods of wastewater disposal [Marine EIA];

b) Establish the environmental impact of detailed proposals for treatment plant located on specific sites [Full EIA].

1.7 Section 6 also reports progress on plans to refurbish and upgrade the existing Belle Greve Wastewater Disposal Facility. This remains vital to ensure reliable disposal facilities are available during the period until any alternative treatment and disposal facility may be brought into service. Thereafter, the existing facility would still be required as a permanent component of the sewerage network, probably as a long-term outfall incorporating upgraded preliminary treatment and storm retention capacity.

1.8 The Department has visited modern examples of all the wastewater treatment processes described in this report. These include some proprietary variations of the main generic treatment processes that were previously reported in the Green Paper. This has been followed up with additional research into alternative processes including evaluation of the alternative processes considered.

Treatment of biosolid wastes generated by wastewater treatment and integration of solid and liquid waste treatment has also been addressed. A supplementary report from WRc plc is attached as Appendix VII.

1.9 Previous estimates of resource requirements have been reviewed; a revised summary of the site area required for wastewater treatment is provided in Table A [Section 6.90] and estimated capital cost in Table B [Section 6.92]. The recommended area of land required has been substantially increased to 20,000 square metres to avoid committing the States to a complex and expensive design and reflect practical examples of modern treatment plants seen in the UK.

1.10 Section 6 concludes with consideration of options to minimise capital cost including the following key observations:

- The cost of the main process plant may be only 20% of overall scheme costs;

- The difference in capital cost between alternative processes is less than 10% of overall scheme cost;

- Reduced standards of treatment may offer savings of only 10% of overall scheme costs;

- Site related factors represent more than 50% of overall capital cost: capital costs are largely dependent on the site selected, sludge disposal route and potential to incorporate the previously refurbished Belle Greve Wastewater Disposal Facility;

- A smaller more compact plant is generally more expensive to construct and operate, with higher energy requirement than a plant of similar capacity on a more generous site;

- Estimated total project costs remain unchanged at £50 million but upper and lower cost estimates have been added to demonstrate that potential costs could range from £30 million to £85 million;

- Reliable estimates for budget purposes can only be prepared after investigation of specific sites and preparation of outline designs based on the constraints of that site;

- Further investigations should now focus upon selection of a suitable treatment site – the choice of treatment process may best be determined later in the procurement process when site, outfall location and discharge standards have been agreed.

1.11 The following Sections [7 to 10] of this report assume that a decision to treat wastewater has been made and address the key decisions for project definition and delivery.

1.12 Potential environmental objectives and standards of treatment are considered in Section 7, including options for staged construction. The Department notes that upgrading preliminary treatment and provision of storm retention capacity could be completed in conjunction with refurbishment of the existing Belle Greve Wastewater Disposal Facility. The report explains why it would be advantageous, if and when further treatment is required, for the whole plant to be constructed as a single project.

1.13 The report points out that wastewater treatment alone would not be sufficient to protect water quality and achieve potential environmental objectives and standards. Run-off from land and surface water quality affects the quality of bathing water. Further improvements to surface water quality, reducing the frequency of overflows from the sewerage network and other sources of contamination should not be forgotten. Completion of the Network Extension Plan to reduce the number of cesspits would also contribute towards water quality objectives. A balanced programme addressing all sources of pollution and supported by extensive monitoring and investigation would be required.

1.14 Section 8 briefly comments on the existing outfall and the value of a long sea outfall. Feasibility studies would be needed to investigate Longue Hougue and any other potential alternative site for an outfall.

1.15 The report then considers criteria for selection of sites for wastewater treatment and explains why the existing site would be unsuitable. Section 9 of this report suggests and briefly explores the suitability of five potential alternative sites for wastewater treatment. It is suggested that the open land adjacent to the existing Belle Greve plant be reserved for preliminary treatment and stormwater retention.

1.16 The potential construction of a third golf course on the previously designated area of search north of St Peter Port, appears to offer an opportunity to incorporate landscaped modern wastewater treatment facilities at minimum cost and impact on the environment. Full evaluation of potential alternative sites would require investment of substantial resources.

1.17 Existing and potential wastewater costs are reviewed in Section 10. The approximate annual cost to the community of providing wastewater services, whether paid directly by a wastewater charge, through general taxation or a combination of both wastewater charge and general taxation, is summarised in the following table:

TABLE C: Cost of Wastewater Service Options		
Option	**Cost of Service £ Per Annum**	**Average Cost Per Property £ Per Annum**
To sustain current sewerage network without treatment	6,000,000	250
Extra to extend 'main drain' to connect 95% of dwellings within 20 years	2,500,000	105
Extra for wastewater treatment	5,000,000	210
Total to complete sewerage network over 20 years and provide wastewater treatment	13,500,000	565

1.18 The typical cost of providing sewerage services in recent years has been approximately £5 million per annum, including capital maintenance and upgrading projects; this would need to be increased to about £6 million per annum to sustain the current sewerage network.

1.19 The Network Extension Plan has progressed for several years utilising a separate capital allocation of £3 million per annum: the annual budget for network extension is likely to be reduced to approximately £1 million in 2008 and may be further reduced until the Island's fiscal revenues are sufficient.

1.20 **The overall cost of wastewater services has been in the region of £8 million per annum, approximately £335 per property. The additional cost to the community to complete the sewerage network over the next 20 years and provide wastewater treatment would be approximately £5.5 million per annum or £230 per property.**

1.21 Alternative sources of funding and procurement strategy are briefly reviewed. The report observes that the wastewater treatment process should be based on a combination of commercial and technical factors, including the site selected, environmental constraints and standard of effluent required. Although the States would determine the site and environmental standards, competitive tender will probably determine the appropriate treatment process.

1.22 The conclusions of these investigations are summarised in the 28 paragraphs comprising Section 11; some important conclusions are set out in the following paragraphs.

1.23 There is no evidence of significant environmental degradation as a result of wastewater disposal into the Little Russel through the long sea outfall.

1.24 The primary objective and benefit of wastewater treatment would be disinfection to minimise risks to human health.

1.25 The pattern of bathing water quality results over the past 15 years shows general compliance with the Mandatory standard of the 1976 Bathing Water Directive [Appendix II]. However, Island beaches have not consistently met the higher Guideline standard and some beaches may fail to meet the requirements of the 2006 Bathing Water Directive. The results of wastewater dispersion modelling, read with the pattern of bathing water quality reported over the past 15 years indicate that;

- Treating wastewater discharged through the Belle Greve outfall is unlikely to significantly improve the overall pattern of bathing water quality;
- Bathing water quality appears to be adversely affected by other sources of pollution such as surface water discharges and direct contamination;
- Further investigation of bathing water quality would be required to comply with the new Bathing Water Directive.

1.26 Priority for wastewater treatment should be considered in the broadest policy context, taking into account risks to human health, the environment and public perception. The benefits of wastewater treatment should be assessed in comparison to the benefits of investing similar sums in other health and environmental projects. Within the wastewater function, the other priorities include;

- Improving the existing sewerage network;
- Transferring flows from short outfalls at Creux Mahie and Fort George;
- Extension of the sewerage network to remove most of the 5,000 existing cesspits;
- Constructing separate surface water sewers, to reduce the frequency of overflows from foul sewers on the east coast during storm rainfall.

1.27 In October 2006 the States agreed to allocate priority to funding refurbishment of the Belle Greve Facility. The Public Services Department is planning a phased refurbishment and upgrading of the Belle Greve Facility as a five-year programme. Subject to necessary approvals, this project will commence in 2007 with enabling and interim works, including inspection of the existing outfalls.

1.28 The Public Services Department is recommending preparation of an environmental impact assessment [Marine EIA as set out in sections 6.30 – 6.32

of this report] at a budget cost of £600,000, to establish:

- the impact of current methods of wastewater disposal on the marine environment;
- the causes of poor bathing water quality;
- the potential effect of wastewater treatment on the Island's carbon footprint.

1.29 The Department is also recommending that, within the limited financial resources available for wastewater services, priority be allocated to those measures necessary to sustain and develop the existing sewerage network, including measures to reduce ingress of saline and surface water.

1.30 Further progress would require significant additional resources.

1.31 **This report provides a comprehensive basis for the States and the community to decide whether the provision of a wastewater treatment is just desirable or absolutely essential. If treatment is essential, then there are three main questions that need to be answered:**

- **Where will the wastewater treatment plant be sited?**
- **What method of disposal should be used in respect of the resulting bio solid sludge or residue?**
- **How will the financial requirements be funded?**

2. Introduction

2.1 The Public Services and Environment Departments [The Departments] were established in May 2004. The Environment Department has political responsibility for overall environmental policy, including land use planning. The role of the Public Services Department is to procure, commission and maintain the associated infrastructure.

2.2 During 2004/5 The Departments prepared a comprehensive joint report on Sewerage and Wastewater Treatment with the objective of informing and encouraging public debate. The joint report was published on 16 December 2005 in the form of a 'Green Paper' [Billet d' Etat I of 2006]. As a consultation document, the Green Paper did not make any substantive recommendations.

2.3 The joint report outlined the development of current strategy for sewerage and sewage disposal, reported progress and set out options for the future with resources required to deliver each alternative.

2.4 The Green Paper also reviewed current wastewater disposal arrangements, natural marine processes, the sewerage network and the procedures that would need to be followed should further sewage treatment be deemed necessary. Emphasis was placed on assessment of environmental impact and the need for a full Environmental Impact Assessment before any decisions are taken on wastewater treatment.

2.5 The States noted the joint report after a debate on 25 January 2006. The period of public consultation continued after the States Debate until 28 February 2006 to provide a further opportunity for submission of written representations. As promised, the Public Services Department has listened very carefully to the discussion and reflected upon the various issues and concerns raised.

2.6 There have been some material policy developments since the consultation period, both local and international. Issues reviewed in Section 5 of this report are:

- Decisions on prioritisation of capital expenditure;
- The proposed development of a Waterfront Strategy for the East Coast;
- Update on introduction of the Environmental Pollution Law;
- Update on solid Waste Strategy;
- Adoption of Private Sewers;
- Implications of the new EU Bathing Water Directive;
- The proposed new EU Marine Strategy Directive.

2.7 The Public Services Department has undertaken some further investigations in response to the issues raised during the consultation period. These investigations are reported in Section 6 of this report.

2.8 The first joint report included a comprehensive history of the development of Liquid Waste Strategy [Section 3] and a progress report on the implementation of that strategy [Section 4], which remain valid and relevant. For brevity, these sections have not been repeated in the body of this report; for ease of reference the development of Liquid Waste Strategy is attached as Appendix I.

2.9 This report summarises the existing sewage collection and disposal arrangements, reviews the consultation response, and reports on further investigations and recent developments. The report then continues to address and progress the practical issues associated with further sewage treatment. These issues include consideration of finance and procurement strategy, standards of treatment required and selection of an appropriate site.

3. Summary of Existing Wastewater Collection & Disposal Arrangements

3.1 The following summary of the existing wastewater collection and disposal arrangements provides background context for the following sections of this report.

Sewerage Network History

3.2 Provision of public foul drainage and water supply networks commenced in the late 19th century in response to epidemics of cholera and other waterborne diseases. An effective drainage system remains fundamental to protect public health.

3.3 During the first half of the 20th century, foul and surface water drainage was extended to most urban areas of the island and to the hospitals. These combined sewers discharged through several short outfalls on the east coast of the Island, discharging on the foreshore near to the low tide mark. Drainage from the combined sewers in urban areas includes drainage of surface water from roads, roofs and other paved surfaces.

3.4 After the Second World War, suburban development extended rapidly across the Island. The States agreed the first comprehensive Island Drainage Plan in 1966. New trunk sewers were constructed to drain residential development in the west and northern areas of the Island. It was intended that surface water would be excluded from these sewers but in practice the volume of wastewater does increase during wet weather. It has proved difficult to prevent drainage of surface water through foul sewer connections on private property and by underground infiltration.

3.5 A new long sea outfall was completed at Belle Greve Bay near the Red Lion in 1971. Over the following 20 years pumping stations and pipelines were progressively constructed to transfer flows from the original short sea outfalls in central St Peter Port and St Sampsons to the new long sea outfall at Belle Greve Bay. This long sea outfall currently discharges wastewater from 90% of properties throughout the Island. The outfall discharges approximately one mile offshore and is rapidly diluted and dispersed by the fast tidal currents of the Little Russel.

3.6 The Airport and properties in adjacent areas were connected to a new short sea outfall at Creux Mahie. A short sea outfall was also constructed to serve new development at Fort George.

3.7 The Belle Greve and Creux Mahie wastewater disposal facilities originally included disinfection with chlorine. However, this was found to be only partially effective and subsequently discontinued due to high operating and maintenance costs. The application of chlorine to untreated wastewater is now considered environmentally unacceptable because the resulting chemicals damage the marine environment.

3.8 Sewer construction in suburban areas of Guernsey is relatively expensive due to the dispersed pattern of ribbon development, undulating topography and difficult ground conditions. Consequently, sewer construction fell behind the rate of residential development in the second half of the 20th century.

Network Extension Plan

3.9 A Network Extension Plan was prepared during 2000 with the objective of extending main drain to 95% of homes throughout the Island by 2020. Work commenced in 2001 with a capital budget of £3 million per annum. By the end of 2006, the project had provided new public sewers to connect 1,375 properties at a total cost in the region of £20 million, less than £15,000 per property.

3.10 Currently about 75% of properties are connected to main drain whereas more than 95% of properties in the UK are connected. A limited number of first time sewerage schemes are still being implemented in the UK at costs of up to £30,000 per property.

Cess Pit Drainage

3.11 Properties without the benefit of direct connection to a public foul sewer drain to cess pits, some of which act as septic tanks [septic tanks are designed to retain only solids whereas cess pits should retain all wastewater]. Wastewater is collected by road tanker from approximately 5,000 cesspits and discharged at designated emptying points on the sewerage network. Over 170,000 tanker loads were collected during 2005. The standard tanker load is 3,600 litres [800 gallons].

3.12 Cesspit drainage systems may overflow or develop undetected leaks; leakage from cesspit drainage systems is difficult to detect and quantify. At the time of the 1997 waste strategy assessment it was estimated from tanker records that approximately 22% of cesspits drainage systems might be leaking. This situation has been improved by investment in new sewers and some replacement cesspits installed during the past decade. However, the number and concentration of cesspits in suburban areas remains a risk to the surface and underground water resources, bathing water quality and the natural environment.

3.13 Fresh water contains dissolved oxygen that is consumed during natural decomposition of organic material present in wastewater. In the confined still conditions inside a cesspit there is less opportunity for oxygen to be absorbed from the air. When available oxygen has been exhausted the biological process changes and wastewater becomes anaerobic or septic. Septic wastewater generates toxic gases, foul odours and strong acid is created where the gases are in contact with the exposed wet surfaces of sewers and manholes.

3.14 Septic wastewater creates odour nuisance, health and safety risks and damages unprotected sewerage infrastructure. Managing the impact of cesspit drainage systems adds to the cost of operating sewerage infrastructure. At present wastewater from cesspits is conditioned by addition of two chemicals after collection between collection and discharge by tanker. The Public Services Department has tested alternative conditioning products and will continue to investigate any practical alternatives for conditioning or partial treatment of septic wastes before release into the sewerage network.

Infrastructure Maintenance

3.15 A revised and updated Drainage Area Plan is being prepared to maintain existing assets and meet anticipated future demand on the existing sewerage network, comprising sewers, pumping stations and outfalls. A substantial programme of sewer refurbishment is in progress. Sewer capacity is being enhanced by provision of new surface water sewers. Two large mobile pumps have been purchased and pipelines constructed to facilitate essential maintenance at key pumping stations.

3.16 There are now 64 foul and surface water pumping or macerator stations to be maintained. Routine maintenance is undertaken by States Works under a service level agreement. However, electromechanical plant has an economic service life of no more than 25 years; instrumentation and electronic controls require replacement within ten years. Remote alarms are currently being replaced with modern SCADA monitoring and control systems operating through broadband Internet connections. Structures and buildings have a longer working life, subject to repairs and refurbishment at regular intervals.

3.17 The sea outfalls and associated installations are programmed for upgrading or replacement as capital projects. Some pumping stations are new, others have been refurbished under previous capital schemes; Vazon Pumping Station is currently being upgraded under the Network Extension Plan. Further station refurbishment work is an inevitable requirement of operating the sewerage network. A sustainable long term rolling programme of pumping station refurbishment will need to be funded.

3.18 There is a regular cleansing programme to maintain the service condition of gravity sewers by removing accumulated sediment and fatty deposits. The Public Services Department is exploring alternatives to prevent entry of excess fat into the sewer network and has already introduced improved cleansing techniques.

3.19 Following a condition survey of the sewer network in 1993, a programme of sewer refurbishment and replacement was established. Although many of the older brick trunk sewers have been relined or reconstructed, the refurbishment programme has not yet been completed. Parts of the sewerage network remain in an unsatisfactory condition, particularly the smaller lateral sewers.

3.20 In addition to the risk of structural collapse, blockage or flooding, sewers in poor condition can deplete underground water resources by infiltration and cause pollution by leaking [exfiltration].

3.21 The sewer condition survey has been repeated during 2006 and the results are anticipated shortly. Considerable structural damage has been observed downstream of designated tanker emptying points, where cesspit contents are discharged. The Foul Sewer Rehabilitation Programme has been subject to budget restraint and may need to be accelerated to maintain the existing infrastructure in satisfactory structural and hydraulic condition.

Storm Overflows

3.22 Drainage of surface water to combined sewer generates much higher flows during wet weather. This higher flow helps to flush debris from the sewers. However, there is a risk of foul sewage flooding if sewer capacity is exceeded under storm conditions.

3.23 Pumping stations constructed to transfer wastewater from the original short sea outfalls to the long Belle Greve outfall were not designed to transfer maximum storm flow, as this would have been considered uneconomic. Instead the former short sea outfalls were retained to discharge excess wastewater arising under storm conditions. These overflows are only used during essential maintenance or emergency situations where there is no practical alternative.

3.24 Further development in urban areas has increased the area of paved surface that drains to existing combined sewers. This increases the maximum flow in the sewer under storm conditions, which may exceed existing sewer capacity. When capacity is exceeded at a critical point in the sewerage network, the foul sewer can overflow into the adjacent streets and buildings. Fortunately, the Island has experienced only minor and infrequent sewer flooding. However, more intense rainfall can be expected in future years as a result of climate change.

3.25 The Public Services Department has therefore commenced a long-term programme to construct a new network of surface water sewers. Where and when the opportunity arises, surface water flows are being diverted away from combined foul sewers into the new separate surface water sewers. This will reduce the frequency of coastal storm overflows and reduce the risk of foul sewage flooding inland.

3.26 Removing surface water from foul drains will reduce the wastewater flows requiring treatment and disposal.

Salinity

3.27 Under high spring tide conditions a very substantial volume of seawater infiltrates foul sewers on the eastern seafront. Works completed since 1997 under the Surface Water Separation and Foul Sewer Rehabilitation programmes have considerably reduced saline inflows. However, further work is required to identify and eliminate numerous small inflows associated with the highest spring tides.

3.28 Microbiological organisms capable of treating wastewater exist in both fresh and saline water, but the microbiological organisms that develop in saline water are not the same organisms that thrive in fresh water. Fluctuating salinity of wastewater due to tidal ingress would therefore damage the microbiological balance of a wastewater treatment plant and thereby inhibit effective treatment. The inflow of saline water would need to be further reduced before wastewater treatment is commissioned.

Wastewater Disposal - Belle Greve Long Sea Outfall

3.29 The Belle Greve wastewater disposal facility includes a long sea outfall and onshore Headworks, which includes a preliminary treatment unit and separate pumping station. The Headworks is located at Marais Rise, off Les Banques near the Red Lion road junction. Incoming sewers are slightly above low tide level.

3.30 Foul drainage from 90% of properties throughout the Island, including most of the tanker emptying points, flows through a complex network of gravity sewers and pumping mains to the Belle Greve Headworks. The area served includes all urban areas and most rural areas from L'Ancresse in the north, Jerbourg in the south, to Cobo and Vazon in the west. The network has recently been extended to Perelle Bay and is programmed to extend inland towards the village centre of St Pierre du Bois during 2007. By the end of 2008, the network will extend to Creux Mahie in Torteval and will receive flows from the Airport and adjacent areas.

3.31 Drainage from the combined sewers in urban areas includes drainage of surface water from roads, roofs and other paved surfaces. The volume of wastewater increases dramatically in wet weather such that maximum flow is more than 5 times the average dry weather flow and can exceed 1,000 litres per second.

3.32 Wastewater receives preliminary treatment comprising maceration and grit removal in an open chamber at the Headworks. There is no coarse screen to protect preliminary treatment plant from bulky debris and no fine screen to remove non-biodegradable materials such as plastic. Preliminary treatment capacity is not adequate to treat the whole flow arising during storm conditions.

3.33 Residential development has encroached ever closer to the Belle Greve Headworks, since this facility was constructed in the late 1960's. Public acceptance of perceived nuisance may have decreased as the Island has become more affluent. These factors have led to complaints and a requirement to invest in higher standards of noise suppression and odour control and treatment.

3.34 The site is located below the level of high spring tide and the incoming sewers just above the low tide level. There is no provision to store excess wastewater so all flows have to be pumped to sea immediately after preliminary treatment.

3.35 The long sea outfall comprises a pipe laid in a submerged shaft and tunnel up to 45 metres below sea level, which rises to the seabed over the final 500 metres. Wastewater is discharged approximately one mile out into the Little Russel, near the channel used by commercial shipping between the harbours of St Peter Port and St Sampsons.

3.36 The Belle Greve facility has operated continuously for 35 years and has not been subject to major refurbishment since it was commissioned in 1971. Major refurbishment of the Belle Greve wastewater disposal facility is urgently required. Further investigations including proposals for refurbishment of the existing Belle Greve wastewater facility are reported in Section 6.

Wastewater Disposal – Creux Mahie Outfall

3.37 The Creux Mahie Headworks and Pumping Station are discreetly located in a Torteval valley, adjacent to the south coast cliffs. Sewage is macerated and discharged through a pipe down the face of the cliffs to a short outfall designed to discharge at least three metres below low water.

3.38 Creux Mahie receives approximately 10% of the Island's sewage, collected from the parishes of Torteval, St Peters, and the Forest, and also from parts of St Saviours and St Andrews. There is a gravity sewer from the Airport to Creux Mahie that also collects wastewater pumped from areas adjacent to the Airport.

3.39 Road tankers deliver septic sewage from areas where public sewers have not yet been installed and this represents a large proportion of the total flow discharged from Creux Mahie. The flow in the sewerage network includes some surface water but proportionately much less than from combined sewers in the urban areas. Wastewater discharges from Creux Mahie are therefore very concentrated and often septic with peak flows during tanker operating hours.

3.40 The Creux Mahie outfall is exposed to severe wave action and repair of the resulting damage is difficult because there is no safe access to it from either sea or land. The cliffside pipe and outfall are known to be in poor condition. Although discharges are rapidly diluted and subject to natural marine treatment processes, the tidal currents disperse wastewater along the coast rather than offshore.

3.41 The Public Services Department is progressing a centralisation strategy approved in principle by the States in April 1999. A gravity sewer is currently being extended inland from Perelle Bay to the Longfrie Inn area of St Pierre du Bois. Pumping stations linking Creux Mahie and Les Sages areas to the sewerage network are planned for completion in 2008.

3.42 After 2008 flows arriving at Creux Mahie will be treated to restore aerobic conditions and transferred through the sewerage network to Belle Greve where the long sea outfall is more effective. This will end regular discharge to sea at Creux Mahie.

Wastewater Disposal – Fort George

3.43 A short sea outfall located south of Soldiers Bay discharges both foul and surface water from approximately 70 houses on the eastern part of the Fort George Estate. Wastewater is macerated prior to discharge. This minor outfall serves less than 1% of the population.

3.44 The Public Services Department plans to transfer flows to the main sewerage network after the Creux Mahie project has been completed. As an interim measure until flows are transferred, the outfall has been extended to ensure a 3 metre minimum depth of water at all stages of the tide.

Wastewater Disposal - Herm

3.45 Wastewater from Herm is discharged into the Little Russel through a short sea outfall on the west coast of that Island. The population served is small in winter but increases substantially during the tourist season when bathing water quality is most important.

3.46 The Treasury and Resources Department, which has responsibility for the lease and built environment of Herm, is discussing provision of wastewater treatment with the tenant of Herm.

Wastewater Disposal – Other Discharges

3.47 In addition to the main outfalls noted above, there are minor wastewater discharges from the smaller inhabited islands and marine craft.

3.48 There are no other regular wastewater discharges to sea. However, bathing water quality can also be adversely affected by:

- surface water discharges including contamination from cesspits, farm wastes and leaking sewers;
- Direct excreta from animals, birds and fish;
- Intense recreational use of beaches and bathing water.

Wastewater Disposal - Natural Marine Processes

3.49 Natural marine processes utilise organic waste in wastewater with results similar to biological treatment in a wastewater treatment plant. Organic waste is recycled naturally by biological communities that have evolved to utilise this as a food source. Marine biological communities include the many types of fish, shellfish and smaller living organisms that live in the sea or seabed. Fish higher in the food chain eat other fish or organisms but the whole biological community ultimately depends on organic matter and other minerals in the sea.

3.50 The ultraviolet element of sunlight disinfects bacteria and viral pathogens just as artificial ultraviolet light is used to disinfect wastewater in the tertiary stage of some modern treatment plants.

3.51 Natural marine processes take longer than the accelerated processes used in sewage treatment works and require a large area of sea instead of the small area of land required for a treatment works.

3.52 The design of effective long sea outfalls ensures that the natural marine processes are not overloaded. The design also ensures that sewage does not come into contact with areas of significant human activity until natural disinfection is substantially complete.

3.53 At Belle Greve effective dilution and dispersion is achieved and human contact minimised by:

- Maceration before discharge;
- Discharging through 5 purpose designed diffusers;
- A 10 metre minimum depth of water at all stages of the tide;
- Strong tidal currents taking wastewater generally out into the shipping lane and open water.

Marine Dispersion Model

3.54 In order to consider the impact of surface and wastewater discharges on the marine environment, a computerised model of tidal currents and natural marine processes was developed by WRc plc [formerly the UK Water Research Centre]. The mathematical model was developed in the mid 1990's and proven by associated tracer studies. The model takes account of key parameters such as:

- tidal stage [full 24 hour cycle in hourly increments];
- tidal range [spring/neap tides];
- discharge flow and strength;
- weather conditions such as sunlight intensity, wind direction and strength.

3.55 Appendix A in the original Green Paper provides an example of output from the model; the output shown is a composite picture of the worst bacterial quality in each location over the full 24 hour cycle, on a spring tide with no wind. Many alternative scenarios were considered including neap tides and onshore winds.

3.56 The model remains valid for the present situation but the computer format requires updating for further use. Large-scale seawater sampling and analysis would be useful to further improve or confirm our present understanding of the environmental impacts and this is given further consideration in Section 6.29+ of this report, in connection with Environmental Impact Assessment.

Bathing Water Quality

3.57 The marine dispersion model shows that wastewater discharged from the outfalls at Belle Greve, Creux Mahie, Herm & Fort George does not affect bathing water quality at beaches on the west and south coasts of Guernsey. However, further investigations may be prudent to confirm the accuracy of the model under all the potential combinations of weather and tide.

3.58 In contrast, the model demonstrates that surface water can have a significant impact on bathing water quality because surface water discharges directly onto the beach and remains within the enclosed bays rather than dispersing out to sea.

3.59 In respect of the Belle Greve Outfall, the model also shows that:

- The general pattern of water movement is a gradual circulation around the island in an anticlockwise direction;

- Areas of poor water quality exist but these are generally offshore in the Little Russel in the shipping lane between St Peter Port and Bordeaux Harbours;

- More than 95% of the bacterial contamination is removed within the area between Fermain in the south to the Plate Fougere lighthouse in the north, by natural marine processes;

- The outfall does occasionally affect the quality of bathing water on the east coast of Guernsey but samples taken at Fermain, Havelet and Bordeaux show that bathing water quality in these east coast bays:

    - Remains within the Mandatory Standard of the 1976 European Bathing Water Directive [with the exception of one year at Fermain which may have been due to pollution of surface water].

    - Usually complies with the Guideline Standard of the 1976 European Bathing Water Directive.

  - Is better than many popular west coast bays – see Appendix II.

- The outfall is well located: extending the outfall would improve water quality on the east coast of Guernsey but the plume of contamination could then adversely affect water quality around Herm.

3.60 In respect of the other outfalls, the model shows that:

- The impact of discharges from the Herm outfall is limited to the west coast of that Island;

- Discharges from the Creux Mahie outfall affect water quality adjacent to the south coast cliffs between Petit Bot and Pleinmont Headland;

- The impact of the Fort George outfall has an impact on water quality adjacent to the east coast cliffs between Les Terres Point and Ozanne Steps, including Soldiers Bay.

3.61 Bathing water quality samples have been taken from 13 bays over a period of 15 years from 1992. The pattern of bathing water quality results set out in Appendix II could not arise solely from the wastewater outfalls: other factors appear to be adversely affecting bathing water quality.

3.62 The quality of surface water streams and reservoirs was monitored over a 12-week period in autumn 2006. The microbiological quality of most surface water during that period may not be suitable for bathing and would fail by a substantial margin the Mandatory Standard of the 1976 European Bathing Water Directive. The microbiological quality of water was significantly improved by storage in reservoirs. The sampling points and water quality are reported in Appendix III.

3.63 The microbiological quality of surface water during this period appears to be similar to the worst areas of the Little Russel where water quality is adversely affected by the Island's main wastewater outfall. However, microbiological indications of contamination in surface water include bacteria from natural and animal sources which are of lower health significance. It should be noted that estuarine beaches throughout Europe are also be affected by surface water quality because treatment of wastewater discharged to rivers is not normally disinfected.

3.64 Surface water discharges are one factor that can adversely affect the quality of bathing water, particularly in shallow enclosed bays where streams discharge directly onto the beach. Potential solutions might include longer surface water outfalls or reinstating natural wetland water storage.

3.65 There are other potential contributors to substandard bathing water quality including underground and direct pollution from a variety of sources: for example birds, animals and fish, decaying vegetation and people on the beach. The cause of unsatisfactory bathing water quality should be thoroughly investigated beach by beach, but this will require commitment of significant resources.

Shellfish

3.66 Some shellfish feed by filtering large volumes of water [bivalve molluscs]. Any bacterial or viral contamination present in the water is therefore concentrated in the shellfish. Shellfish may be eaten raw or after light cooking, so the microbiological quality of shellfish sold commercially is subject to monitoring by environmental health officers.

3.67 The quality of farmed Guernsey shellfish is regulated by the local Food Safety [Live Bivalve Molluscs and other Shellfish] Ordinance, 1996 which is based on the EU Shellfish & Fishery Products Directive [91/492/EEC]. Farmed bivalve shellfish mainly comprise oysters and mussels. Crabs, lobsters, crayfish [crawfish] and ormers are not bivalve molluscs.

3.68 Shellfish waters are graded A – D in accordance with the bacterial quality of the water and resulting quality of shellfish. Most local waters meet the highest standards [A] but some areas are of lower quality [B]. However, shellfish harvested from water of quality [B] can be cleansed of contamination by transferring them to good quality water prior to human consumption; this precaution is important to ensure shellfish quality.

3.69 It is understood that there are 12 licensed areas for shellfish production of which only 5 are currently in operation. There are oyster beds located at Rocquaine, Grande Havre, Houmet Paradis and Herm but no local mussel beds. Seed oysters are farmed for export in a former quarry north of Bordeaux. Oysters and Mussels are also imported for local consumption. The gradings of these beds are currently under review following recent changes to international shellfish standards but all local shellfish beds are likely to remain in either A or B category.

3.70 Although not all local marine waters meet the highest standards of the Shellfish Directive, there are sufficient areas of Grade A water to purify both locally farmed and imported shellfish harvested from beds in Grade B water. All farmed shellfish are of the requisite standard when they are marketed. However successful seafood marketing depends upon maintenance of a positive public image.

3.71 Although scallops are bivalve molluscs, they are harvested from natural stock and therefore exempt from the regulations. It would be difficult to apply the shellfish bed grading approach to scallops because these shellfish are mobile. Scallop harvesting supports 5 small businesses and also forms an important source of income for other fishing enterprises.

3.72 It should be noted that lower shellfish water quality grading appears to be associated with both surface water and wastewater discharges. Wastewater treatment is unlikely to achieve Grade A in all shellfish waters; completion of the Network Extension Plan and other measures to improve surface water quality may also be required.

International Standards

[Note: Primary, Secondary and Tertiary treatment are defined in Appendix IV and Section 6.19]

3.73 Treatment of wastewater discharged through the Belle Greve long sea outfall would be required to comply with the European Urban Wastewater Treatment Directive. In view of the high natural dispersion in the Little Russel, it is possible that primary treatment would be sufficient to comply with this Directive. However, it should be noted that the UK government has opted for secondary treatment as the minimum standard.

3.74 A review of Marine Treatment Policy and Practice was undertaken for the Public Services Department by WRc plc in August 2005. This review revealed rapid development of standards and practice in recent years. The long sea outfall may comply with best practice for developing countries but would no longer be considered an acceptable permanent means of wastewater disposal in any developed country.

3.75 Secondary treatment would now be considered standard with disinfection added as tertiary treatment where there are significant shellfisheries or bathing waters.

3.76 If the Island intends to adopt different standards or defer implementation of international norms, it would be prudent to undertake a thorough environmental appraisal to be used in conjunction with the marine dispersion model.

Liquid Waste Strategy

3.77 The current Liquid Waste Strategy was approved by the States in 1997 and confirmed in 1999. The strategy gives priority to preventing pollution of surface and underground waters within the Island including vital water resources. This strategy includes:

- Maintaining and improving existing sewerage infrastructure;
- Network Extension;
- Centralisation of wastewater disposal;
- Planning future treatment facilities.

3.78 The Foul Sewer Rehabilitation and Surface Water Separation Programmes are funded from the Public Services Department's revenue budget for drainage infrastructure. The 2006 revenue budget was deployed broadly as follows:

Tanker Operation [income from charges £1,390,064]	1,623,100
Foul Sewer Rehabilitation Programme	880,400
Operation and Maintenance of Pumping Stations	654,200
Surface Water Separation Programme	424,500
Maintenance of Surface Water Drainage	278,700
Maintenance of Foul Sewers	267,300
Gross Operating Expenditure	£4,128,200

3.79 The operating costs quoted above do not include technical and administrative staff and general overheads which are funded from other revenue budgets. Revenue budgets have traditionally excluded provision for replacement of vehicles and more extensive maintenance or upgrading projects such as refurbishment of pumping stations; these have been funded from capital expenditure allocations. Total expenditure necessary to sustain the existing sewerage network is assessed in Section 10 to be in the region of £6 million per annum, equivalent to £250 per property.

3.80 The Department received income from charges for emptying cesspits amounting to £1,390,064 in 2006; all other expenditure was funded from general taxation.

3.81 Current pressures on revenue budgets leave little scope to accelerate rehabilitation of foul sewers or install separate surface water sewer networks, other than by increasing charges for wastewater collection. In addition to revenue budgets, regular capital allocations are required to replace the ageing fleet of wastewater collection tankers and refurbish or upgrade the 64 pumping stations. After 35 years in continuous use, major refurbishment of the Belle Greve Wastewater Disposal facilities is now urgently required.

3.82 The Network Extension Plan is funded by a separate capital allocation, determined annually. Since 2004, priority has been given to construction of a trunk sewer to drain properties in the southwest of the Island, including provision to divert flows from Creux Mahie. This trunk sewer is due for completion during 2008, which will end regular discharge to sea through the Creux Mahie outfall. Diversion of the Fort George outfall would be a relatively small scheme to be funded within the Network Extension Plan.

3.83 There are many more properties that could be connected for less than £20,000 per property. However, if future funding for the Network Extension Plan were reduced to £1 million per annum instead of the current £3 million per annum, it would take another 50 years to connect 95% of the population to main drain, the original objective of the Network Extension Plan.

3.84 In addition to the convenience and increased property value for those able to connect to new public sewers, the whole community would benefit from reducing the number of cess pits in the following respects:

- Reduced traffic movements;
- Minimise odour nuisance;
- Protect environment and bathing water quality;
- Minimise wastewater operating costs;
- Public perception of Guernsey.

3.85 The current Liquid Waste Strategy will help to protect public health, coastal bathing water quality and the environment and will prepare for future wastewater treatment.

4. Response to Green Paper

4.1 During 2004/5, The Departments prepared a comprehensive joint report on Sewerage and Wastewater Treatment with the objective of informing and encouraging public debate. This was achieved through the media, at public meetings, through the Island Douzaine Council and by debate in the States chamber.

4.2 The report was published in the form of a ‘Green Paper’ [Billet d’ Etat I of 2006]. As a consultation document, the Green Paper did not make any substantive recommendations. The joint report outlined the development of current strategy for sewerage and sewage disposal, reported progress and set out options for the future with resources required to deliver each alternative.

4.3 The Green Paper also reviewed natural marine processes, the sewerage network and the procedures that would need to be followed should further sewage treatment be required. Emphasis was placed on the need for an assessment of current impacts and a full Environmental Impact Assessment before any decisions are taken on sewage treatment.

4.4 Public consultation commenced with early publication of the Billet on 16 December 2005 accompanied by initial media briefings. The report was presented to States Members on 5 January and the Guernsey Douzaine Council on 9 January 2006.

4.5 The Departments made two public presentations at Hautes Capelles School on 12 January and Les Beaucamps School on 17 January to a total audience of 113, responded to lively questions from the audience and listened to the response from this forum. As intended these presentations generated wide debate and further media coverage.

4.6 The States noted the joint report after a debate on 25 January 2006, giving rise to further media coverage of the points made by Members of the States.

4.7 The period of public consultation continued after the States Debate until 28 February 2006 to provide a further opportunity for submission of written representations. During the consultation period 32 press articles were published in addition to radio and TV coverage.

4.8 A total of 33 written representations were received during the consultation period, including e-mails and facsimile submissions. Of these responses 27 came from individuals, 4 came from businesses and 2 from pressure groups. Many of the submissions received were substantial, raising many points and including reasoned argument. In addition a petition totalling 4,000 signatures was received from Surfers Against Sewage.

4.9 As might be expected full treatment was supported by most of the written responses, although there were some who considered extension to the sewerage network to be a higher priority and others who do not accept the need for treatment. There was also support for extension of the sewerage network.

4.10 The response from States Members was similar but with more reservations about the need for and cost of treatment, and an awareness of other priorities for use of resources. States Members were very supportive of further extensions to the sewerage network within funding constraints.

4.11 There was less enthusiasm to offer suggestions on the key issue of funding, but among those that did comment, there was substantial acceptance that treatment would have to be funded by introduction of a wastewater charge. However, it is not clear whether States Members and the silent majority of the general public would accept wastewater charges at the level necessary to provide full treatment. States Members were keen to explore alternative processes in the hope that costs might be reduced.

4.12 Many of the comments received concerned health risks, seeking reassurance and understanding of the issue. Similarly there was concern for the impact of chemicals and plastics on the marine environment. There was also some concern that treatment would disrupt the marine food chain. Some further investigations have been undertaken and these are reported in Section 5 of this report.

4.13 Expressions of interest were received from private sector organisations willing to provide treatment facilities to be financed either by future income or in conjunction with development of the eastern seafront. One preliminary proposal received would provide joint facilities for treatment of both wastewater and solid waste in one building to be located on the Longue Hougue Reclamation site. Another suggestion was to provide solid and liquid waste treatment on adjacent sites at Longue Hougue[See Note[1] below].

4.14 Several representors mentioned the importance of treating wastewater from Herm and the opportunity to supplement water resources by recycling treated effluent was also mentioned. Other valuable suggestions included further development of the marine dispersion model and active management of bathing water quality. Very few comments about the disposal of sludge resulting from wastewater treatment were received.

4.15 As promised, the Public Services Department has listened very carefully to all the views expressed by the public and States Members. The Department has undertaken further research and reflected upon the various issues and concerns raised in written submissions.

5. Subsequent Developments

5.1 The following paragraphs report on developments arising during the period since the Green Paper was drafted.

Capital Prioritisation

5.2 In October the States debated priorities for capital expenditure for the duration of the present House, years 2007 and 2008 [Billet XVII of 2006]. The following drainage projects were included in the priority list that will progress, subject to adequate funding being available:

- Continuation of Network Extension Plan to complete the Creux Mahie Link;
- Initial phases of Belle Greve Wastewater Disposal Facility Refurbishment.

5.3 The Treasury and Resources prioritisation report to the States indicates that the Network Extension Plan might continue after completion of the Creux Mahie Link, but funding would be reduced from the current £3 million per annum and was not a priority project.

5.4 The Treasury and Resources Department recognised that deferring capital projects could increase future revenue expenditure: postponing extension of the sewer

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[1] The concept of joint facilities for treatment of both solid and liquid waste is addressed in Section 6 of this report: Alternatives for financing and procurement are discussed in Section 7 of this report.]

network would have substantial long term revenue implications including:

- Extending the current commitment to empty cess pits;
- Continuing refurbishment of the existing sewerage network damaged by septic sewage;
- Costs of sewage conditioning or pre-treatment.

5.5 The Treasury and Resources prioritisation report also indicates that wastewater treatment might proceed if 'extra fees and charges' fund this project.

Development of a Waterfront Strategy for the East Coast

5.6 The 2006 Policy and Resource Plan, which was approved by the States in December 2005, referred to the Strategic Land Planning Group's intention to develop a long-term strategy for the future of Guernsey's east coast from Vale Castle to Havelet.

5.7 In February 2006, public consultation about sewerage and wastewater treatment generated a significant proposal from Long Port Properties Limited. A private finance initiative was proposed that would include facilities for treatment of both wastewater and solid waste in conjunction with comprehensive development of the east coast of Guernsey. The Long Port Group suggests that wastewater treatment could be delivered for less than £50 million, but the full scope of this proposal has not been defined.

5.8 The Long Port Group is offering support and financial assistance 'to help realise the capital investment of the plant needed, without immediate recourse to the public purse'. The associated commercial and housing developments would be sited on public and crown land; if the project were to be approved, clearly the value of this land would need to be taken into account.

5.9 The Public Services Department arranged for presentation of this proposal to States Members with subsequent publication for wider debate by the public. The proposed development has been dubbed 'Little Venice' by the media.

5.10 Following media reports about proposed waterfront development, the Public Services Department received an approach from Cascual Services Limited, part of the Biwater Group. This Group operates internationally in the water and wastewater sector and would be able to finance, design, construct and operate wastewater facilities through its subsidiary company Cascal BV. Cascal Services expressed interest in a private finance initiative for wastewater treatment, and referred to a wastewater treatment plant constructed underground for Southern Water, serving the town of Eastbourne in Sussex.

5.11 In September 2006, The Policy Council issued a public statement explaining that, following initial research, the Strategic Land Planning Group intended to consult widely and develop a set of different scenarios for the east coast for consideration by the States and public. The States considered and approved the eastern Seaboard Initiative in March 2007.

5.12 Should a waterfront strategy emerge from this process, it will need to take account of existing arrangements for wastewater disposal and accommodate future requirements for both liquid and solid waste disposal, amongst many other considerations. The existing outfalls could prove a significant restraint on development of the east coast. Similarly, liquid waste strategy must facilitate and complement an overall strategy.

5.13 This States Report therefore includes consideration of potential sites for wastewater treatment, to be considered in the context of developing a broader strategy for the east coast.

Environmental Pollution [Guernsey] Law, 2004

5.14 The previous Green Paper explained that the Environmental Pollution [Guernsey] Law, 2004 provides a comprehensive legal framework to prevent pollution of air, land and water. The general provisions of this Law and those related to solid waste came into effect on 26 July 2006. However, Sections of the Law relating to water, air, sound and light pollution, are not yet in force.

5.15 The Director of Environmental Health and Pollution Regulation acts as environmental regulator responsible for implementing the provisions of this new Law. The Public Services Department is designated as the Waste Disposal Authority for solid waste with the exception that some waste management planning functions of this Authority have been transferred to the Environment Department with effect from 24 August 2006.

Solid Waste Strategy

5.16 In February 2007 the States approved a revised strategy for treatment and disposal of solid waste including a Solid Waste Management Plan [Billet I of 2007]. The recommended strategy is based on high recycling in conjunction with either mass burn incineration or advanced thermal treatment or mechanical biological treatment (including mechanical heat treatment) or any combination thereof with or without modular capacity.[1]

5.17 Substantial quantities of sludge would be generated by wastewater treatment; this sludge would need to be treated prior to recycling or disposal with other solid waste. Sludge disposal strategy would need further development in conjunction with procurement of a solid waste treatment plant. Section 6 of this report includes further consideration of sludge treatment issues.

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[1] Paragraph 5.16 amended in light of comments received from Environment Department.

5.18 The Public Services Department is now responsible for implementing both solid and liquid waste treatment strategies and will ensure appropriate evaluation of all practical options.

Adoption of Private Sewers

5.19 The UK Government has announced the intention to transfer ownership and responsibility for maintenance of private drains in England to the sewerage utility companies, to be funded by an increase in wastewater charges. The transfer is intended to integrate and improve management of the sewerage network and to relieve customers of an unwanted burden. Further details of this transfer will be subject to public consultation in the UK.

5.20 There are a substantial number of private foul water drains and pumping stations in Guernsey. Responsibility for maintenance of communal drains serving private estates can be difficult to arrange and finance, particularly where legally binding arrangements have not been incorporated into property title deeds. Further public pressure on the States to adopt private sewers can be anticipated to resolve outstanding maintenance issues and prevent pollution.

New Bathing Water Directive

5.21 A new Bathing Water Directive was approved by the European Union on 15 February 2006; this comes into force in Member States with effect from 24 March 2008. The period for phased implementation of new requirements extends until 31 December 2014 when repeal of the previous Directive takes effect.

5.22 Although the Island is not legally committed to compliance with this Directive, the Island has previously measured and promoted bathing water quality with reference to the previous European Bathing Water Directive.

5.23 If the provisions of the new Directive were applied in Guernsey, the States, as competent authority, would be required to designate and manage bathing water quality for those beaches where a large number of people are expected to bathe, taking into account promotion of beaches by Visit Guernsey and the beach facilities provided. It is understood that, at present, the Environment Department has no intention of adopting the whole of the European Directive but is minded to adopt the water quality standards of the Directive when assessing local bathing waters.[3]

5.24 The new Directive is based on the principles of risk assessment and requires proactive monitoring and management of designated bathing waters, including public information and advice. The monitoring regime must be tailored to a

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[3] See letter from Environment dated 16 August 2007 at Appendix VIII.

formal assessment of the pollution risks and water quality results from previous years. The States would be required to investigate and rectify poor quality bathing waters and if necessary prohibit or advise against bathing at beaches with unsatisfactory water quality.

5.25 As far as the Public Services Department is aware, the implications of the new standards for bathing water quality have not yet been fully assessed. However it would appear that beaches meeting the former Guideline standard would be classified as ‘Good’ or even ‘Excellent’. However, some beaches meeting the former Mandatory standard may only be classified as ‘Sufficient’ under the new standard and others may be classified as ‘Poor’ quality and deemed unsuitable for bathing.

5.26 It can be seen from Appendix II that although all bays normally meet the former Mandatory standard, no local bay has consistently achieved the previous Guideline standard in every year. Beaches that did not meet the former Guideline standard in recent years include Ladies Bay, Cobo, Petit Bot, Pembroke and Vazon. There is a risk that water quality in these popular bays may not meet the requirements of the new Bathing Water Directive.

5.27 The pattern of bathing water quality is not easily explained by discharges from the wastewater outfalls using the mathematical model; this suggests there are other local sources of pollution to be investigated and addressed. Measures such as completion of the Network Extension Plan may offer the most effective solution for wastewater of domestic origin.

Proposed Marine Strategy Directive

5.28 A draft Marine Strategy Directive has been prepared to counter significant environmental degradation evident in European marine waters. The Directive would apply to all territorial waters, extending to the outermost reach of the sovereignty or jurisdiction of Member States in the Northeast Atlantic Ocean, the Mediterranean, Baltic and Black Seas. The initial draft Directive is subject to current inter-governmental negotiations and may be amended prior to final approval by the European Union.

5.29 The stated objective of the proposed Directive is to achieve ‘good environmental status’ of Europe’s marine environment by 2021. Member States would be required to assess, monitor and protect or restore European marine waters to their natural biologically diverse condition and ensure that human activities are sustainable. Further definition of the ‘good environmental status’ objective is anticipated during current negotiations and arising from scientific research during the initial phases of this project.

5.30 When the Marine Strategy Directive is adopted, the governments of all countries adjacent to the North Sea including the English Channel will be required to work together to develop a strategy to protect and restore the Greater North Sea Sub

Region. Within three years after approval, the Channel Island and UK governments will have to decide whether and how the Directive will be implemented in Bailiwick Territorial Waters. It seems improbable that marine waters around the Channel Islands would be excluded from a strategy for the waters of the continental shelf, between mainland Europe and the UK.

5.31 Local waters may achieve ‘good environmental status’ despite current wastewater and surface water discharges. However, the Marine Strategy Directive could generate international pressure for implementation of the Urban Wastewater Treatment and Water Framework Directives throughout the Channel Islands.

6. Further Investigations

6.1 Further investigations have been undertaken to address questions and issues arising during the consultation period for discussion of the Green Paper.

Health Risks

6.2 The Public Services Department has reviewed recent research and advice published by the World Health Organisation[456] and has also consulted with the Director of Public Health [Medical Officer of Health] and Director of Environmental Health and Pollution Regulation, whose views are summarised in Section 6.15 of this report.

6.3 The presence of dilute wastewater discharges in a marine environment presents a risk to human health by transmission of pathogens. The main infection risks arise through immersion in water or by eating contaminated shellfish. However, in practice these risks are relatively low and can be managed [paragraphs 3.57+ in respect of bathing water quality and paragraphs 3.65+ in respect of shellfish].

6.4 It is important to emphasise that not all illness contracted after immersion in marine waters is due to contamination by wastewater discharges; minor infections of ear, nose and throat or gastro-enteritis are quite common. Similarly, not all illness attributed to eating shellfish is caused by contamination from marine wastewater discharges.

6.5 There are no local statistics recording the incidence of illness caused by wastewater discharges. Although infectious diseases should be reported to the Medical Officer of Health and any increased notifications would be investigated, local doctors are not in a position to investigate the source and cause of each and every illness presented for treatment.

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4 The Health-based Monitoring of Recreational Waters: The Annapolis Protocol - 1999

5 Guidelines for safe recreational waters: Volume 1- Coastal and fresh waters - 2005

6 Water Recreation and Disease by Kathy Pond - 2005, [subtitled Plausibility of associated infections: Acute effects, sequelae and mortality]

6.6 The World Health Organisation has published Guidelines[7] based on epidemiological studies estimating the incidence of gastroenteritis and acute febrile respiratory illness that may be expected after a 10 minute swim involving three head immersions in faecally contaminated marine waters.

6.7 The new European Bathing Water Directive aims to improve management of recreational waters to reduce the incidence of illness estimated from epidemiological research but is not intended to totally eliminate all risk of such illness.

6.8 Hepatitis A is a more serious illness of particular concern to Surfers Against Sewage. This pathogen can survive for a relatively a long time in marine waters, but would only present a risk to the extent that the disease is present in the local population. Hepatitis A is far more likely to be contracted on holiday in areas of the world where this disease is endemic and the occasional cases reported locally may be attributed to travel rather than local water sports.

6.9 Wastewater treatment would be an expensive means to prevent potential transmission of Hepatitis A. Cost effective alternatives to wastewater treatment might include inoculation of higher risk groups such as regular participants in water sports and temporary bathing restrictions in the unlikely event of an outbreak in the local population.

6.10 The World Health Organisation has assessed the risk to human health to be ‘Low’ if wastewater is discharged through an effective long sea outfall after preliminary treatment and ‘Very Low’ after secondary treatment with disinfection. By comparison, wastewater discharge through a short outfall presents a ‘High Risk’ even after secondary treatment and ‘Medium Risk’ after secondary treatment and disinfection. In terms of reducing risk, an effective long sea outfall is considered better than wastewater treatment**.** The combination of secondary treatment, disinfection and a long sea outfall provides the lowest risk.

6.11 If or when treatment is provided, effluent discharge through the existing long sea outfall would be valuable to increase operational resilience and further reduce risk.

6.12 Although the existing Belle Greve outfall is near optimum for discharge into the Little Russel, the mathematical model shows that it should not be considered fully effective in terms of the risk category quoted by the World Health Organisation. Unfortunately, the benefits of extending the existing outfall would be limited by the presence of Herm.

6.13 To protect human immersion and shellfish quality on the east coast and throughout the Little Russel, wastewater discharged through the Belle Greve

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[7] Table 4.7 in Guidelines for safe recreational waters: Volume 1- Coastal and fresh waters - 2005

outfall would need secondary treatment with disinfection. However, the limited health benefits may not justify a high priority for investment of public resources in wastewater treatment in comparison to other opportunities to improve public health and medical services.

6.14 It should be noted that the World Health Organisation considers untreated discharges from combined sewers through short outfalls to be High Risk. Contamination of surface water can present the highest risks of all because surface water discharges directly onto the beach. The risks to public health from contaminated surface water on the west coast and storm overflows on the east coast may justify higher priority than wastewater treatment.

6.15 The Director of Public Health [Medical Officer of Health] and Director of Environmental Health and Pollution Regulation have summarised their views, communicated during a presentation to the Public Services Department, as follows:

- "There are numerous studies from around the world to confirm that contact with sewage contaminated bathing water (through swimming or otherwise) can have an adverse effect on human health.

- Although we have no firm evidence that sewage contaminated seawater has actually caused any adverse effect on human health in Guernsey, it is impossible to 'prove a negative', and therefore the '*precautionary principle*' should apply.

- However, we are aware through our work on both the Solid Waste and Liquid Waste Strategies that most treatment processes would lead to a residual 'sewage sludge' and that unless this was correctly handled, it would cause a bigger environmental health problem than that which we are trying to prevent.

- We are therefore fully in agreement that the Solid Waste Strategy needs to be agreed and implemented as a priority. Since residual sewage sludge has thermal value, should some sort of waste to energy technology be agreed, then integrating the liquid and solid waste strategies would have both potential health and environmental benefits".

6.16 The Public Services Department notes the difficulty in reporting and verifying the local incidence of illness attributed to contact with wastewater. There are no local health statistics to support or refute the case for investment in wastewater treatment.

<u>Other Environmental & Health Questions</u>

6.17 During the consultation period, concern was expressed about the other environmental and health impacts of wastewater discharge. This section seeks to address those questions and improve general understanding of what would be achieved by treating wastewater and what would not be achieved.

6.18 Conventional wastewater treatment is not a universal solution to remove all pollution; treated wastewater effluent is not pure water or drinking water.

6.19 **Preliminary treatment** is designed to remove grit, plastics and large objects that will not biodegrade and to prepare wastewater for the next stage of treatment. **Primary treatment** removes most organic sediment as biosolids [sludge] for further treatment or disposal. **Secondary treatment** utilises biological processes and oxygen to remove or convert dissolved and colloidal organic material that is not removed by primary treatment, generating further biosolids for treatment or disposal. **Tertiary treatment** is used to further improve effluent quality where required to meet specific objectives. More detailed explanation of these terms is provided in Appendix IV.

6.20 Natural decomposition of organic material in wastewater requires oxygen. Organic matter forms a vital part of the food chain for natural biological communities. However excess organic matter can lead to exhaustion of dissolved oxygen and kill the biological community that depends on oxygen dissolved in the water. The main objective of conventional wastewater treatment is to maintain sufficient oxygen in the body of water to which treated effluent is discharged, by removing excess organic matter. Secondary treatment is also required to prepare wastewater for more advanced treatment.

6.21 The volume of organic matter discharged into the Little Russel is quickly dispersed in a large body of well-oxygenated water and does not appear to adversely affect the marine biological community. Indeed, primary and secondary wastewater treatment would probably have an adverse effect on the current marine food chain and make local waters less productive fisheries. Conventional wastewater treatment to secondary standards may not be environmentally beneficial and would not address the main risks to public health.

6.22 Further wastewater treatment can be designed to achieve a variety of objectives, including disinfection or removal of excess nutrients such as nitrate or phosphate. Disinfection is the most relevant treatment for compliance with Shellfish and Bathing Water Standards. Nutrient removal is not normally provided for discharge to marine waters with high natural dispersion and would provide no benefit to public health.

6.23 One recent concern is the impact of natural and synthetic hormones present in wastewater on aquatic life in receiving waters and through drinking water or the food chain on human reproduction. The collective scientific name for this class of chemicals is Endocrine Disrupting Chemicals [EDCs]. The Public Services Department has therefore obtained expert advice on this topic from WRc plc.

6.24 The Board was advised that there is currently much uncertainty about the collective impact of Endocrine Disrupting Chemicals. Unfortunately, there is very little information about the extent to which EDCs are removed in conventional wastewater treatment processes. Research programmes funded by the UK Water Industry are currently in progress but appropriate methods for treating EDCs in wastewater from domestic sources remain at the research stage.

6.25 EDCs of human origin of particular concern are steroid oestrogens. Current expert advice is that future limits on steroid oestrogens EDC in treated wastewater effluent are likely to be introduced. These limits are most likely to be site specific, assessed taking account the dilution available in the receiving watercourse. Wastewater discharge through an effective long sea outfall provides massive dilution, which is likely to satisfy potential future standards for discharge of steroid oestrogens without further treatment. The full text of advice received from WRc on this subject is contained in section 4.6.4 of their report, which is attached as Appendix VII.

6.26 The threat posed by toxic chemicals was also another valid concern expressed during the consultation process. Conventional wastewater treatment plants are not designed to remove or treat toxic chemicals. The normal strategy has been to remove or treat specific chemicals at source and thereby minimise the presence of toxic materials in wastewater. Fortunately, wastewater in Guernsey is mainly of domestic origin: an assessment undertaken by WRc in 1996 concluded that the low levels of persistent or toxic chemicals present in local wastewater were well within the relevant Environmental Quality Standards[8].

6.27 Persistent chemicals including any heavy metals present in wastewater may be concentrated in the biosolid sludge waste during primary treatment. Options for sludge treatment and disposal would therefore be complicated and limited by any significant concentrations of toxic or persistent chemicals. Should significant concentrations of toxic material reach the secondary biological treatment process, the secondary treatment process would be inhibited for a prolonged period until the biological culture could be regenerated.

6.28 Whether or not wastewater is treated, the risk posed by toxic or persistent chemicals in wastewater or surface water has to be managed. It may be prudent to introduce a more formal system to monitor and control effluent discharges from business premises where such chemicals may be stored or used. In the UK there are specific wastewater charges for disposal of trade effluent to sewer based on an assessment of the waste, including concentration and volume discharged.

Objectives of EIA

6.29 There was considerable discussion during the consultation period about the

[8] Section 5.1 of WRc report for States of Guernsey dated April 1996 ‘Effects of Guernsey’s Current Sewage Disposal upon the Marine Environment’

benefits of undertaking an Environmental Impact Assessment [EIA]. With hindsight, the discussion was confused by the choice of different types of EIA. It may help to clarify the objectives and extent of the two main alternatives, which are labelled 'Marine EIA' and 'Full EIA' in the following text.

6.30 The objective of the 'Marine EIA' is to assess the impact of current methods of wastewater disposal on the marine environment, for the following purposes:

- To assess the environmental impact of existing wastewater discharges through the Belle Greve long sea outfall;
- To investigate the causes of poor bathing water quality;
- To compare the effect on the Island's carbon footprint of treating wastewater in contrast to current methods of wastewater treatment;
- To establish whether wastewater treatment is necessary to protect public health and the marine environment;
- In the event that wastewater treatment is not required, to provide comprehensive scientific evidence to establish the adequacy of current methods of wastewater disposal.

6.31 The mathematical model indicates that wastewater discharges have a measurable impact over a significant area extending well beyond the Little Russel. However, the impact at any location is highly variable, being subject to many factors, including diurnal and lunar tidal cycles, wind speed and direction, sunlight intensity, temperature and rainfall. The complex interaction of these variables changes with the seasons and weather patterns, with significant differences between the years. A long term water quality monitoring programme has been advised to obtain an accurate and reliable understanding of water quality.

6.32 A 'Marine EIA' would include:

- A long term water quality monitoring programme;
- A Benthic[9] Survey of the sea bed;
- Confirm or improve the accuracy of the existing mathematical model of wastewater dispersion and natural marine processes;
- Investigation of other potential sources of pollution.

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9 A Benthic survey would generally include sampling sea bed sediments and assessing the plants, fish and other forms of marine life living in the sediments and on the sea bed, in order to determine any impact from wastewater discharges.

6.33 The cost and duration of such a ‘Marine EIA’ have been revised, based on the most recent advice; a 5-year programme with an overall budget of £600,000 would be appropriate to achieve the stated objective and purposes. This work would be undertaken using local resources where practical, including obtaining and analysing water quality samples. The marine environmental monitoring required under this option may be more extensive than would be required for the ‘Full EIA’ option.

6.34 A ‘Full EIA’ would be required to establish the environmental impact of proposals for wastewater treatment at a specific site or alternative sites, for the following purposes:

- To demonstrate the proposed plant represents the Best Practical Environmental Option for wastewater disposal;
- To select or confirm the suitability of proposed treatment site[s];
- To satisfy the requirements of a statutory planning inquiry.

6.35 A ‘Full EIA’ would be undertaken in several stages and include:

- Review of environmental quality objectives and standards;
- Investigate the causes of poor bathing water quality;
- Confirm that wastewater treatment is necessary to protect public health and the marine environment;
- Assess the increased carbon footprint of wastewater treatment;
- Investigation of potential alternative sites;
- Identification of environmental restraints and potential planning conditions associated with use of the proposed sites;
- Preliminary process selection, outline design and preparation of budget costs for each option;
- All documents and support required for a formal planning inquiry.

6.36 The cost of a ‘Full EIA’ has been provisionally estimated to be in the region of £1.5 million, but this would depend on the number of alternative sites and processes to be investigated. The duration would depend on the number of evaluation stages adopted prior to formal planning inquiry but is unlikely to be completed in less than 2 years.

6.37 The emphasis of the ‘Full EIA’ would focus on the impact of potential treatment plants whereas the 'Marine EIA' explores the impact of existing discharges on the sea. If a 'Marine EIA' is undertaken first, followed by a 'Full EIA' in the event that a treatment plant is required, the overall cost and duration of EIA and pre project planning would be substantially increased.

Supplementary WRc Report [formerly the UK Water Research Centre]

6.38 In 2004 WRc plc was appointed by the Public Services Department to undertake an independent comprehensive overview of potential treatment processes including typical capital costs and minimum land areas required. This initial review was dated January 2005 and published as Appendix M in the Green Paper [Billet I of 2006].

6.39 The WRc report published in the Green Paper was limited to generic treatment processes for which there are independent sources of cost and performance data. The initial WRc review did not attempt to identify and evaluate the many patented or branded variations of generic treatment processes because available information was limited to unverified promotional material or restricted by commercial agreements.

6.40 The response to the Green Paper included comments about the potential advantages of alternative modern treatment processes. The Public Services Department has therefore investigated the use and potential of alternative modern proprietary treatment processes, including those suggested by States Members. Research undertaken by the Public Services Department is reported under the sub-heading 'Alternative Treatment Processes' which follows later in this section.

6.41 A supplementary report from WRc plc was commissioned to research and evaluate modern proprietary alternative treatment processes selected after research by the Public Services Department. The WRc Supplementary Report attached as Appendix VII evaluates the alternative processes on the same basis as the earlier report for comparison with generic processes including calculations of the areas required for each process and an estimate of capital cost.

6.42 WRc Supplementary Report also addresses other issues raised during the consultation process, including treatment of biosolids [sludge], nutrient removal processes, toxic and Endocrine Disrupting Chemicals.

Alternative Treatment Processes

6.43 In April 2006, the Board and technically qualified staff met with operational, scientific and engineering staff of Wessex Water to review 7 wastewater and sludge treatment plants serving coastal towns in Dorset. The plants visited were practical modern examples of the generic treatment processes reported in the Green Paper, including two very different forms of Sequencing Batch Reactor [SBR]. A brief summary of these plants is attached in Appendix V attached.

6.44 It was useful to contrast different approaches to minimising environmental impact. The plants inspected include two constructed underground [Weymouth and Swanage] and two others with key odour generating elements contained within a building [Poole and Charmouth]. At Bournemouth and Swanage sludge is pumped to another site for treatment, at Charmouth and Tarrant Crawford sludge is partially treated before transport by road tanker to another site.

6.45 The Swanage wastewater treatment plant makes a very positive contribution to a sensitive waterfront site. It is constructed underground on the site of a former hotel, wedged between new residential development, the town centre and a prominent open hillside. In addition to the high cost of constructing the process plant underground, a further 10% of the overall project budget was expended to deliver an impressive landscaping solution using natural stone.

6.46 Three of the key points arising out of the visit to Wessex Water treatment sites are:

- Substantially more land is required than had previously been estimated from process calculations;

- A variety of wastewater treatment solutions is available – treatment processes are generally selected to meet the specified effluent discharge consent standards within the constraints of particular sites;

- Wastewater treatment plants require regular investment to maintain satisfactory performance and meet rising volumes and standards. Plant life varies from less than 5 to over 50 years but all plants have required frequent upgrading [every 15 years as a guide];

- Wessex own 350 wastewater treatment plants: they were refreshingly honest about their mistakes and successes; they are still learning. Guernsey will have an opportunity to build a new plant drawing on the experience of others. However, even with the best external advice, Guernsey will embark upon a steep learning curve and will need to allow scope to improve and develop the plant and operating methods in future years.

6.47 In May 2006, the Public Services Department Minister visited the IRIS wastewater project in the Isle of Man [Integration and Recycling of Island Sewage] including a new wastewater treatment plant located on a green field site at Meary Veg, between Douglas and Castletown, near the south east coast of that Island.

6.48 The Isle of Man is about 10 times the size of Guernsey with a much lower density of population [pop 76,315 in 2001]. The interior of the Island rises to over 600 metres [2,000 feet] above sea level. Most of the population live in the 6 discrete towns and villages, all located on the coast.

6.49 Prior to 1992, wastewater disposal in the Isle of Man comprised 19 short coastal outfalls, 27 small inland treatment plants and septic tanks serving 6,000 people living in isolated properties. The IRIS project commenced with an assessment of strategic options for wastewater treatment and disposal throughout the Isle of Man. This review was undertaken by WRc plc, who reported in October 1992. The Best Practical Environmental Option for the Isle of Man was found to be:

- transfer of flows for treatment in a central location;
- secondary treatment;
- discharge of treated effluent through a short outfall into deep water.

Some £82 million has already been spent on the IRIS project, which has not yet been completed.

6.50 The first stage treatment plant was constructed at Meary Veg to treat wastewater from a population 15% smaller than Guernsey using the relatively simple and robust Oxidation Ditch process, within a budget of £20 million. This budget excludes:

- Feasibility, environmental impact, design & supervision;
- Site investigation, acquisition, preparation & access;
- Wastewater transfer pipelines.

6.51 The full cost of constructing a similar plant in Guernsey would be substantially higher but the relatively low budget for Meary Veg does illustrate the advantage of a robust long established process located on a remote green field site.

6.52 In July 2006, the Public Services Board and technically qualified staff met with staff of Anglian Water to review some proprietary variations to the generic wastewater treatment processes set out in the Green Paper. Alternative processes reviewed included the compact Deep Shaft process at Tilbury, a ‘Biobubble’ Sequencing Batch Reactor at Thorrington near Colchester and the Anglian Water plant near Lowestoft which was constructed as a flagship plant to demonstrate the company’s capability to international clients and therefore includes a variety of modern alternative processes.

6.53 Alternative processes reviewed at Lowestoft include Helical Lamella Separators for primary treatment, Moving Bed Biofilm Reactor [Kaldnes] with Dissolved Air Floatation [DAF] for secondary treatment, and sludge Pasteurisation. These alternative processes have subsequently been evaluated and compared to generic processes by WRc plc [Appendix VII].

6.54 The Board has also obtained information on the Eastbourne underground wastewater treatment plant operated by Southern Water. This compact plant provides secondary treatment for a population of 130,000 using the generic process identified as A2 on Appendix IVA [Lamella primary settlement with Biological Aerated Flooded Filters]. Treated effluent is discharged to sea through a new long sea outfall; excess storm flows are discharged through the original medium length outfall.

6.55 The main treatment process has been installed in a reinforced concrete box measuring 130 metres by 40 metres in plan and 14 metres deep, constructed under a large public car park with extensive landscaping including 5,000 trees. Above ground facilities have been located within a substantial new building constructed in the shape of a Redoubt, a style of fort dating from the Napoleonic wars.

6.56 Table 2 in the earlier Green Paper included an evaluation of six generic wastewater treatment processes, practical examples of which were seen in Dorset through Wessex Water. A similar evaluation has been undertaken of some modern proprietary variations to these generic treatment processes, practical examples of which were seen in Essex and Suffolk through Anglian Water. The extended comparison of costs and areas is attached as Appendix VI.

6.57 There are applications where the alternative wastewater treatment processes may have an advantage for particular applications but the Board found no evidence to suggest that the capital cost and land requirements quoted in the Green Paper could be significantly reduced by adopting one of the alternative proprietary processes.

Sludge Treatment and Disposal

6.58 Biosolid wastes [sludge] arise from all wastewater treatment options, other than the status quo option, which relies on natural marine processes. Conventional wastewater treatment in Guernsey would generate in the region of 4,400 tonnes per annum of solid waste. The need to treat sludge and dispose of biosolid wastes is very costly and a major disadvantage in comparison to the present natural marine processes.

6.59 The quantity of sludge produced and sludge characteristics depend on the wastewater treatment process installed and the water content. Omitting primary settlement and extending the biological treatment can reduce the volume of sludge produced. Biomass can be broken down into simple elements such as Carbon Dioxide and water, but in practice some residual biosolid waste has to be treated. The Biobubble SBR is one proprietary example of extended biological treatment.

6.60 Extended biological treatment requires substantially increased process capacity and prolongs an energy intensive process. The additional cost of treating biosolid wastes using extended biological treatment may be acceptable in smaller plants but has been considered prohibitively expensive for medium and larger scale plants. The Department is not aware of any treatment plants of the size that would be required in Guernsey that utilise extended biological treatment to reduce the volume of sludge produced.

6.61 Treatment of sludge must be appropriate for the selected method of ultimate disposal. Disposal Options include energy recovery[10] as fuel or use as soil conditioner, landfill or incineration with solid waste. Treatment for all disposal options commences with gravity or mechanical thickening to reduce the volume of water in the liquid sludge. Liquid released during sludge treatment is returned to the sewage treatment processes for treatment; the greatly reduced volume of thickened sludge progresses to the next stage of sludge treatment.

6.62 Sludge treatment standards for recycling to agriculture depend on the crop grown and the interval between the application of sludge until harvesting or use of the crop. In order to protect public health and the environment sludge must be stabilised and pathogens reduced prior to spreading on land. Standard treatment includes anaerobic digestion, which reduces the volume of sludge and generates methane gas that may be used as a fuel. The capital cost of sludge treatment prior to recycling is significantly higher than for incineration.

6.63 Enhanced treatment such as Pasteurisation is now required for many food crops including horticulture, market gardening and surface applications to grazed grass. Further detail of the Safe Sludge Matrix is provided in Section 3.2 of the WRc Supplementary Report attached as Appendix VII. The capital cost of enhanced sludge treatment is higher than standard treatment for recycling.

6.64 Traditional composting in the open requires large areas of land. Composting within a large rotating drum or tube [in vessel composting] could be used to treat sludge, but microbiological quality control of the product would have to be demonstrated and sustained. Composting is not a recognised solution within the Safe Sludge Matrix. The Department is not aware of any plants producing compost from biosolid sludge where the product is successfully marketed on a commercial scale.

6.65 There are limited areas of land suitable for spreading treated sludge or compost and most of these are already used for disposal of organic waste produced by the Island's dairy herd. The Water Catchment from where water is harvested for public supply extends over the whole Island other than the coastal margins. It is important to avoid adding to nitrate and bacterial pollution of surface and groundwater.

6.66 Recycling biosolids as an alternative to importation of peat and artificial

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[10] Amended as per Environment Department's comments.

fertiliser may be a desirable aspiration but at present it would not offer a sustainable and secure disposal route for all the sewage sludge that would be produced throughout the year. Commercial experience shows that there is a very limited market for digested or composted sewage sludge. If sludge recycling were the preferred disposal route, facilities for sludge treatment would need to provide flexibility for both recycling and co-disposal with solid waste.

6.67 During the final stages of sludge treatment it is necessary to further reduce water content of the sludge by chemical conditioning and compressing or centrifuging to achieve suitable solids content in the range 20 – 25%. If necessary for storage or fuel preparation, sludge can then be thermally dried to 85% solids concentration, subject to particular care to minimise odour, dust, and risks of fire or explosion.

6.68 Several of the compact wastewater treatment processes omit primary settlement to reduce land area requirements. The WRc Supplementary Report warns that biosolid sludge arising from secondary wastewater treatment has a lower calorific value and is difficult to treat unless it is mixed with a greater volume of primary sludge. In the local context, there are no biosolid wastes from other treatment plants.

6.69 Biosolids from wastewater treatment plants without a primary treatment stage may be unsuitable for recycling, although they could be suitable for incineration with solid waste. The difficulty of treating biosolid wastes from compact treatment processes may offset the advantage of their small footprint.

<u>Integration of Solid and Liquid Waste Treatment</u>

6.70 The previous solid waste strategy included provision for incineration of biosolid wastes from future wastewater treatment. In February 2007 the States approved a revised strategy for treatment and disposal of solid waste, but the volumes of waste and form of treatment have not yet been decided.

6.71 Treatment of biosolid sludge arising from wastewater treatment results in a solid waste requiring further treatment prior to disposal. Treatment of solid waste generates wastewaters with high organic content that require further treatment. Strategies for solid and liquid wastes are therefore inter-related, but that does not mean that solid and liquid waste treatment facilities have to be located on the same site.

6.72 This section considers the potential benefits and disadvantages of locating both facilities on the same site, probably the Longue Hougue Reclamation site as publicly advocated by the Long Port Group and Cenkos Channel Islands Limited.

6.73 Solid waste treatment facilities are designed to receive a large volume of material by lorry. Liquid wastes from solid waste treatment facilities are relatively small in volume and after local pre-treatment could be discharged to sewer for treatment and disposal with other wastewater.

6.74 Wastewater treatment facilities would receive a very large volume of wastewater by pipeline from the existing Belle Greve Headworks. The volume of biosolid wastes would be a relatively small proportion of total flow, which could be transferred to the solid waste plant by road tanker or pipeline. It would not be economic to transfer a large volume of wastewater to avoid transferring a much smaller volume of biosolid waste.

6.75 The suggested construction of both solid and liquid waste treatment in a fully integrated plant appears to offer some potential synergies. However, a combined plant would require a commitment to provide both facilities simultaneously.

6.76 A single fully integrated solid and liquid waste treatment facility located in a single building or confined site could severely limit flexibility to provide for future replacement & development of process plant. Flexibility is particularly important in view of the rapid changes in standards and technology.

6.77 Two adjacent but separate plants for treating solid and liquid waste might achieve the same potential benefits of a single building with more flexibility to adapt to future requirements. However, the area at Longue Hougue currently allocated for solid waste facilities is unlikely to be large enough to provide space for both solid and liquid waste treatment. A formal Planning Inquiry would be required to increase the area zoned for waste treatment.

6.78 If and when wastewater treatment proceeds, it may be practical to locate both solid and liquid waste treatment facilities at Longue Hougue: this is one of 6 alternative sites for wastewater treatment which are reviewed in Section 9 of this report. Further detailed study would be required to evaluate the full potential of Longue Hougue and other potential sites for wastewater treatment. The Department would wish to obtain appropriate professional advice before making any firm recommendations.

6.79 The Public Services Department remains open to explore the potential for integrating solid and liquid waste treatment, provided that this does not unduly extend the programme for development of solid waste facilities.

<u>Refurbishment of Belle Greve Wastewater Disposal Facility</u>

6.80 The Public Services Department commented in the earlier Green Paper on the requirement for major refurbishment of the Belle Greve Headworks, Pumping Station and Outfall[11]. The existing plant has been operating continuously for 35 years without significant investment. The Department announced a comprehensive review to address known deficiencies including:

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[11] Billet I of 2006: page 15 Sections 4.31 – 4.35

- Storm flow exceeding discharge capacity, which is a priority;
- Odour nuisance;
- Operational resilience;
- Outfall maintenance;
- Risk analysis and contingency planning.

6.81 The existing Belle Greve outfall is 1800 metres long and has adequate capacity to discharge foul wastewater from the whole Island, including considerable volumes of surface water that greatly exceed dry weather flow. However, total wastewater flows already exceed outfall capacity under severe storm conditions and storm rainfall is expected to become more intense in future due to climate change.

6.82 The Island must continue to depend on the Belle Greve Wastewater Disposal Facility until an alternative or upgraded facility has been commissioned. If and when wastewater treatment is provided:

- The existing pumping station would still be needed to transfer wastewater to an alternative treatment site;
- The existing outfall could be used to discharge treated effluent and would be needed to discharge storm flows in excess of transfer or treatment capacity;
- Once refurbished and upgraded for the interim period, the existing Headworks could continue to provide preliminary treatment prior to wastewater transfer for further treatment on another site.

6.83 In October 2006 the States agreed to allocate priority to funding refurbishment of the Belle Greve Facility. The Public Services Department is planning a phased refurbishment and upgrading of the Belle Greve Facility over a five year period, commencing in 2007 with enabling and interim works including inspection of the existing outfalls.

6.84 Over most of its length the long sea outfall pipe was installed in an unlined rock tunnel up to 40 metres below high water. This length of outfall has never been inspected or maintained because there is no safe access to the flooded tunnel, which extends over 1300 metres out to sea. Inspection of both pipe and tunnel with state of the art submersible equipment is proposed. A contingency plan for future repair or replacement of the pipe and tunnel must be devised.

6.85 The full scope of refurbishment works required will depend on the results of outfall inspection and other investigations; potential costs range from £8 million to £16 million. The current cost estimate of £10 million is based on:

- Upgrading and replacing existing preliminary treatment plant to meet current standards;
- Refurbishing the pumping station;
- Replacing and enlarging a 500 metre length of the long sea outfall pipe exposed on the sea bed;
- Refurbishing the existing auxiliary Red Lion outfall for emergency use, including occasional discharge of excess storm flow;
- As an alternative to occasional use of the auxiliary outfall, capacity to retain storm flows may be installed at additional cost;
- If refurbishment or replacement of the outfall pipe through the submerged tunnel were required, this would be an additional cost.

6.86 In order to make most effective use of the existing outfall and minimise wastewater transfer capacity requirements, it may be cost effective to provide new preliminary treatment facilities adjacent to the existing Belle Greve Headworks. If space allows, wastewater storage capacity might also be incorporated so that excess flow received during storm rainfall can be stored for later discharge through the main long sea outfall.

6.87 For the interim period until full treatment can be afforded, the refurbished plant at Belle Greve would be more effective at high flows. It would also protect the environment by removing rather than macerating sewage related debris, including plastic items. The refurbished Belle Greve Facility could provide part of the wastewater treatment facilities and thereby reduce the future cost of providing full wastewater treatment.

Revised Site Area Required

6.88 The previous approach to estimating site areas required was based solely on calculations of theoretical process requirements from WRc, which were doubled to give a preliminary estimate of the overall site area required. One analogy is the overall floor area of an office building which is more than the net area of useable office space, because the building must also include access corridors and stairwells, welfare facilities, storage and plant rooms etc. The overall site area required for an office development might also include external areas between buildings and the road frontage, paved surrounds, parking and landscaping.

6.89 Inspection of modern treatment plants in the UK demonstrated that the previous approach was an underestimate that could require an unnecessarily complex and expensive engineering solution. Available sites rarely have the ideal shape and topography. Substantial additional space is usually required for ancillary buildings, internal access roads and landscaping. As wastewater treatment is a continuous process that cannot be interrupted, it is necessary to install additional capacity to provide for maintenance. To create a sustainable solution, space should also be allowed for future modifications and expansion of the treatment plant; a restricted site might require total reconstruction or relocation of the treatment plant to meet future needs.

6.90 The following revised estimates of site area have been prepared to show the range of potential solutions. The minimum area required remains 6,000 square metres but this would require a complex and relatively expensive solution that would not be easy to operate, maintain or change. The recommended site would be approximately 200 metres by 100 metres, a total area of 20,000 square metres as detailed in Table A on the following page.

TABLE A – Revised Site Area Required		
Component	**Minimum Area Square Metres**	**Recommended Area Square Metres**
Preliminary and Storm Treatment	3,500	4,000
Wastewater Treatment	1,000	8,000
Sludge Treatment	1,000	2,000
Ancillary Facilities and Internal Access	Vertically integrated	2,000
Landscaping and external margins	500	4,000
Total	**6,000**	**20,000**

Estimated Capital Cost

6.91 Preliminary estimates of capital costs for the main wastewater treatment processes vary from £9,165,000 for an oxidation ditch up to £18,675,000 for the most expensive proprietary process [Appendix VI]. These typical costs can be subject to significant variations depending on ground conditions, working space and other site related factors.

6.92 Preliminary estimates of overall project cost were summarised in Table 3 of the Green Paper with a project total of slightly more than £50 million. This estimate remains broadly accurate but it may be helpful to explore upper and lower boundaries of total cost, which largely depend on the site selected and sludge disposal route. Table B on the following page shows the original estimates alongside the upper and lower boundaries of cost, excluding extreme or unrealistic alternatives.

TABLE B – Summary of Project Costs			
Project Element	**Capital Cost in Green Paper - £**	**Revised Estimate Minimum Cost - £**	**Revised Estimate Maximum Cost - £**
Water Quality Monitoring	300,000	150,000	600,000 [Marine EIA]
Site Appraisal & Outline Design	1,000,000	500,000	1,500,000
Full EIA & Planning Inquiry	500,000	500,000	500,000
Sub Total EIA and Project Planning	1,800,000	1,150,000	2,100,000
Site acquisition / reclamation	10,000,000	2,000,000	20,000,000
Wastewater transfer and site infrastructure	5,000,000	4,000,000	15,000,000
Preliminary Treatment	4,500,000	May be included with Belle Greve upgrading	4,500,000
Storm Treatment	3,250,000	May be included with Belle Greve upgrading	3,250,000
Wastewater Treatment	10,000,000	9,000,000	12,500,000
Sludge Treatment	4,500,000	4,500,000	11,000,000
Odour Control	4,500,000	3,000,000	6,000,000
Design Supervision and Project Management Fees	1,500,000	1,500,000	1,500,000
Landscaping	included	included	5,000,000
Contingencies	5,000,000	5,000,000	5,000,000
Project Total	**50,050,000**	**30,150,000**	**86,350,000**

6.93 **Site related factors represent more than 50% of overall project cost. Reliable estimates for budget purposes can only be prepared after investigation of specific sites and preparation of outline designs based on the constraints of that site**.

<u>Options to Minimise Capital Cost</u>

6.94 The main process plant for wastewater treatment is only 20% of the overall project cost. All but the two most expensive process plant options are within £3 million of the lowest cost. The difference in capital cost between the realistic alternative processes represents less than 10% of the overall project cost. The choice of process plant should therefore be determined when the site and discharge consent have been selected.

6.95 Omitting the disinfection stage of treatment might save about 2% of overall project costs but could increase overall costs if a new outfall was required.

6.96 Postponing installation of secondary wastewater treatment could save about £5 million or 10% of overall project cost.

6.97 A smaller more compact plant is generally more expensive to construct and operate, with higher energy requirement than a plant of similar capacity on a more generous site.

6.98 The main opportunity to minimise capital cost arises from selection of a spacious well - located site with good topography and ground conditions with minimum landscaping and odour control requirements. A site close to the existing Belle Greve Headworks would minimise the cost of wastewater transfer pipelines and the potential requirement for a new outfall. Selection of an appropriate undeveloped inland site could avoid the cost of land reclamation and release scarce coastal development sites for other purposes. Six potential sites are reviewed in Section 9 of this report.

7. Standards of Treatment

7.1 The following sections of this report assume that a decision to treat wastewater has been made and address the key issues for project delivery.

Objectives of Treatment [Environmental Quality Objectives and Standards]

7.2 What does the Island wish to achieve by treating wastewater? The general objectives might embrace:

- Protecting public health;
- Protecting the environment;
- Compliance with European standards;
- Promoting a positive image of the Island.

7.3 The shipping lanes of the Little Russel are not bathing waters but there is some recreational and commercial activity in that area, which involves human immersion in water. Should water quality in the shipping lanes be suitable for bathing or should such activity be subject to public health advice or even prohibited?

7.4 Such aspirations are generally expressed in the form of Environmental Quality Objectives for the Receiving Waters. Environmental Quality Objectives are expressed in numerical scientific terms as Environmental Quality Standards.

7.5 The States have previously approved the following Environmental Quality Objectives and Standards in principle [Billet XI of 1997- paragraph 5.20a]:

- The maintenance of the highest standards for designated shellfish beds, in accordance with European guidelines and requirements;

- Compliance with guideline standards of the Bathing Waters Directive in all inshore bathing waters;

- Compliance with the appropriate internationally recognised standards in remaining coastal waters, including the Little Russel.

If confirmed, the above standards would require either wastewater disinfection or secondary treatment and a substantial mixing zone within which lower water quality is acceptable[12]. Disinfection is a tertiary treatment process that can only be effective after wastewater has been clarified by secondary treatment.

Consent Standard for Discharging Treated Effluent

7.6 Treated effluent is neither pure water nor seawater. There will be a mixing zone at the end of the outfall. When setting environmental objectives it is usual to allow for dilution and dispersion within the mixing zone. Water quality in the mixing zone will be lower than the surrounding area. The volume of effluent discharged and the size of mixing zone permitted are major factors in determining the standard of treated effluent required.

7.7 The mixing zone around the treated effluent discharge requires further consideration beyond that applying to the shipping lanes in general and the open waters of the Little Russel. Some recreational and commercial activity involving human immersion in water is undertaken within the mixing zone of the existing outfall. Should water quality in the mixing zone be suitable for bathing or should such activity be subject to public health advice or even prohibited?

7.8 A typical discharge consent will specify the point of discharge, maximum flow, mixing zone as well as water quality parameters such as suspended solids, biological oxygen demand and bacteriological indicators.

Cost and Benefit of Staged Wastewater Treatment Construction

7.9 The existing preliminary treatment facilities at Belle Greve are 35 years old and now require replacement. This urgent work is essential to maintain the current wastewater disposal facilities. The new facilities would be more effective at high flows and would protect the environment by removing rather than macerating sewage related debris, including plastic items.

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[12] Amended in light of Environment Department’s comments.

7.10 The existing Belle Greve outfall has adequate capacity to discharge both foul wastewater from the whole Island including considerable volumes of surface water. However, wastewater flows under storm conditions can exceed outfall capacity; storm rainfall may become more intense due to climate change. In view of limitations on existing outfall capacity, it may be appropriate to provide storm retention capacity when preliminary treatment facilities are modernised.

7.11 The estimated cost of providing preliminary treatment is £4,500,000 and storm retention facilities £3,250,000 plus odour control and ancillary project management costs totalling approximately £10 million. This first phase of construction may be incorporated in the refurbishment of the existing Belle Greve Headworks, reducing the future cost of providing full wastewater treatment.

7.12 Wastewater treatment by primary settlement would generate biosolid sludge requiring treatment and disposal. Primary treatment is unlikely to be located adjacent to the existing Belle Greve Headworks so it would be necessary to develop a new site. Wastewater transfer, primary settlement, sludge treatment, site acquisition and infrastructure are unlikely to cost less than £25 million and could cost substantially more, depending on the site selected.

7.13 The benefit of providing primary settlement alone is questionable. Based on our current understanding of marine ecology in the Little Russel, removal of organic matter would not significantly improve the marine environment. The production of biosolid wastes and reduced input to the marine food chain could render primary treatment less environmentally sustainable than the status quo option.

7.14 Primary treatment does reduce the number of pathogens in treated effluent but does not disinfect the treated effluent. It is not therefore adequate to resolve the identified minor risks to human health.

7.15 Whilst primary settlement might comply with the Urban Wastewater Treatment Directive criteria for receiving waters with high natural dispersion, it would not meet the minimum secondary treatment standard adopted in other developed countries.

7.16 Provision of primary treatment is not an essential first step to provide full treatment. Several modern treatment processes, both generic and proprietary alternatives, omit the primary treatment stage. The additional capital cost of providing secondary treatment while construction plant is on site could be as low as £5 million.

7.17 Secondary biological treatment requires energy to convert and remove more organic matter. Environmentally, secondary treatment appears to be less advantageous and incurs the same disadvantages as primary treatment. In respect to human health, secondary treatment generates microbiological growth and reduces the number of pathogens but does not disinfect the treated effluent.

7.18 The capital cost of including disinfection by ultraviolet light would be about £1 million. This tertiary treatment would fully address the identified minor risks to human health in conjunction with an effective long sea outfall.

7.19 It would appear advantageous to upgrade preliminary treatment and provide storm retention capacity in conjunction with refurbishment of the existing Belle Greve Wastewater Disposal Facility. This is the first phase to maintain and upgrade the current facilities on the current site.

7.20 If and when further treatment is required, the whole plant should all be constructed as a single project, to commence after a site has been confirmed and funds secured.

7.21 Wastewater treatment alone would not be sufficient to protect water quality and achieve potential environmental objectives and standards. A balanced programme addressing all sources of pollution and supported by extensive monitoring and investigation would be required. Further improvements to surface water quality and reduced frequency of storm overflows should not be forgotten.

7.22 Completion of the Network Extension Plan would also contribute towards water quality objectives.

8. Outfall Location

8.1 An outfall or outfalls will be required to discharge treated effluent and occasional storm flows exceeding treatment and storage capacity. This requirement is a prime consideration in setting standards of treatment and for selection of treatment sites.

8.2 The World Health Organisation has assessed the risk to human health to be ‘Low’ if wastewater is discharged through an effective long sea outfall after preliminary treatment and ‘Very Low’ after secondary treatment with disinfection. By comparison, wastewater discharge through a short outfall presents a ‘High Risk’ even after secondary treatment and ‘Medium Risk’ after secondary treatment and disinfection. In terms of reducing risk, an effective long sea outfall is considered better than wastewater treatment**.** The combination of secondary treatment, disinfection and a long sea outfall provides the lowest risk.

8.3 The existing Belle Greve long sea outfall is well located to achieve maximum dilution and dispersion offshore. There are few potential alternative locations to discharge into the rapid tidal currents in the Little Russel. Tunnelling would now be prohibitively expensive; any replacement would probably be assembled onshore and pulled out to sea into a previously prepared trench at a cost in the region of £10 million.

8.4 Current outfall construction techniques require a site suitable for assembly of outfall pipes where they can be jointed and winched rapidly out to sea as a continuous pipe. An outfall from the Longue Hougue reclamation site could be shorter but the rock breakwater, rocky seabed, fast currents, and navigation requirements could make construction of a new outfall relatively difficult and expensive. A feasibility study would be required to assess the potential cost and benefit of an outfall in this location.

8.5 The existing Belle Greve long sea outfall would not necessarily preclude any proposed offshore development in Belle Greve Bay: the outfall pipe would need to be protected and wastewater would probably need to be treated. However, the existing auxiliary storm and emergency outfalls at La Piette and Red Lion would not be compatible with any offshore development.

8.6 Wastewater treatment would not remove the need for auxiliary outfalls within the sewerage network.

9. Potential Treatment Sites

9.1 The main criteria for selecting a site for wastewater treatment are considered in the following paragraphs, followed by consideration of some options:

Proximity to existing Belle Greve Headworks and Outfall

9.2 The existing sewerage network delivers wastewater to Belle Greve Headworks, from where it would need to be transferred to the proposed treatment site. Close proximity of the proposed site to Belle Greve would reduce the construction and pumping costs of transferring wastewater.

9.3 Treated effluent will need to be discharged to sea, probably through the existing Belle Greve outfall. Close proximity of the proposed site would reduce the construction and pumping costs of transferring treated effluent back to Belle Greve for discharge through the existing long sea outfall.

Suitable Area of Land

9.4 Modern treatment plants can be fitted into relatively small sites in urban areas but this substantially increases the complexity and cost of both construction and operation. It also leaves little flexibility to accommodate future requirements. In developed areas, effective odour treatment and imaginative landscaping are critical to success.

9.5 The site must also be suitable for excavation and foundation construction for large water retaining tanks and similar heavy engineering structures. The ideal site would be:

- About 200 metres by 100 metres in size and oblong shape;
- Located as far as possible from other development;
- Geologically suitable for excavation and foundations;
- On a slightly sloping site less than 25 metres above sea level;
- Above potential flood level;
- In States ownership or readily available for purchase;
- Accessible for heavy construction plant.

Minimising Environmental Impact

9.6 A simplified version of the Urban and Rural Development Plans has been prepared to show the area within 2,000 metres of the existing Belle Greve Headworks and Outfall [Drawing Ref 6922/285 on following pages]. This drawing illustrates that most open spaces that might be used for wastewater treatment are designated as areas of landscape value [shown green on the drawing].

9.7 Much of the open space near to the existing Headworks is ‘marais’ flood plain designated as an area of Nature Conservation Interest. Other environmental factors to be considered include:

- Odour;
- Visual intrusion;
- Noise;
- Traffic [minor];
- Ancient monuments and archaeology.

Potential Alternative Sites [marked 1-6 on Drawing Ref 6922/287]

9.8 Drawing Reference 6922/287 [following pages] has been prepared to illustrate distances from the existing Belle Greve Headworks using concentric circles. Areas of predominantly developed land are shown pink, housing target areas are shown orange and areas of landscape value are shown green. Five potential treatment sites have been identified for further consideration; these are shown on the plan as oblong areas of 20,000 square metres each, containing the site reference number.

Potential Site 1: Area Adjacent to Belle Greve Headworks

9.9 The area of land adjacent to the existing Belle Greve Headworks is shown in more detail on Plan Ref 6922/286 [on the following pages]. This plan identifies significant areas of land administered by the Public Services Department [bounded in red], the Environment Department [green], the Housing Department [orange], and the Chateau des Marais ancient monument administered by Culture and Leisure Department. The potential site for wastewater treatment is shown hatched in blue; a 10 metre wide margin has been allowed to provide landscaping.

9.10 The Guernsey Housing Association has recently redeveloped the area bounded in purple for social housing. Three-storey houses have been constructed with primary outlook over the proposed site. The Environment Department has recently published a Development Brief for the site administered by the Housing Department, to be redeveloped by the Guernsey Housing Association. The plan also shows other private housing developments surrounding the site to the east. Approximately 2% of the Island's population will reside within 250 metres of the site.

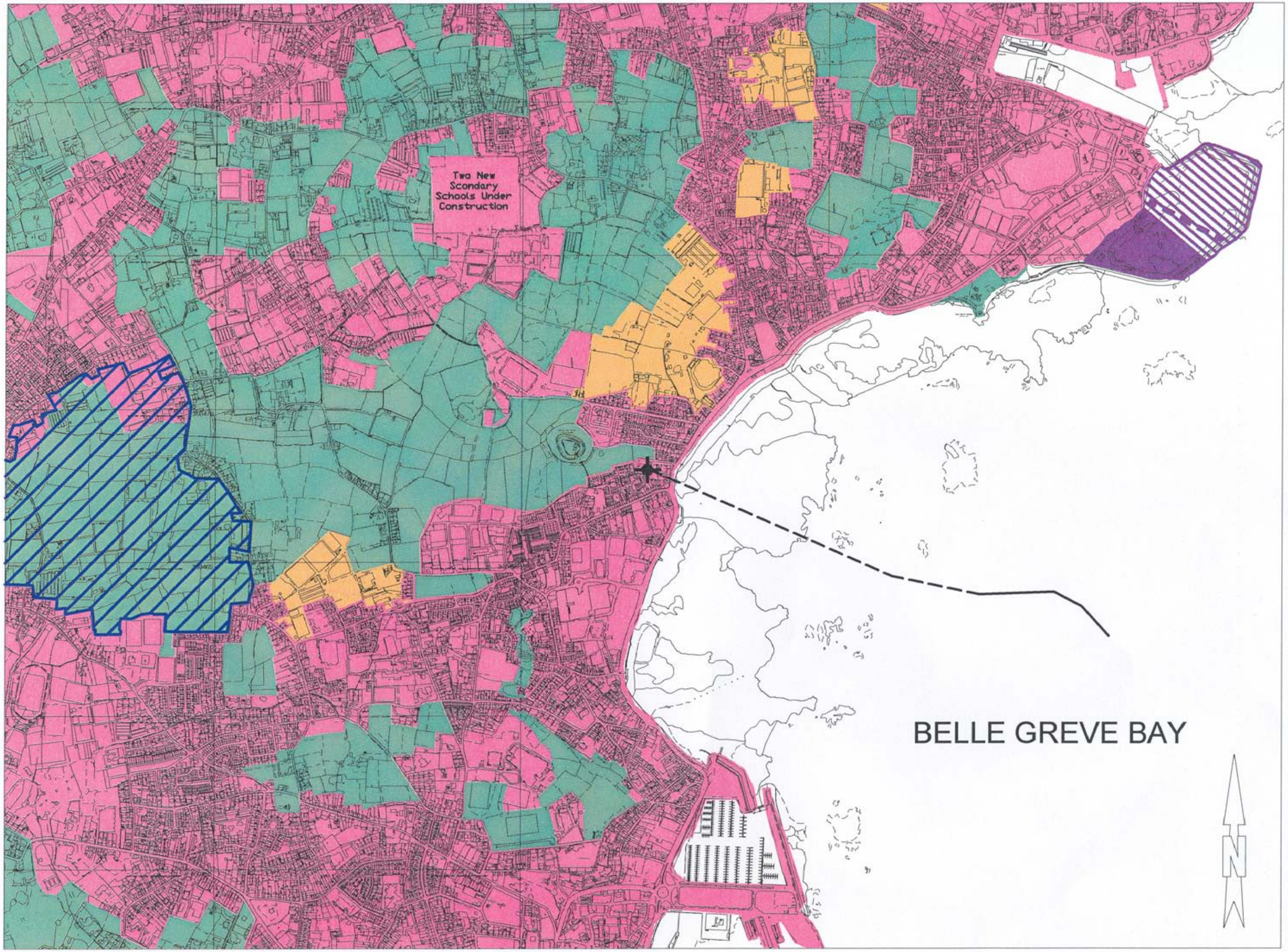
9.11 This site is designated an area of Landscape Value and this narrow wedge of green provides the only break between St Peter Port and St Sampsons urban areas. Wastewater treatment would utilise all the open space between Chateau des Marais and the coast, which might be considered unacceptable.

9.12 The estimated net area available as a potential site for wastewater treatment is just 11,000 square metres. If a treatment plant had to be constructed on this site, it would probably have to be underground, considerably more complex and expensive. Construction on this site would constrain future development of the treatment plant. Potential risks would need careful management to avoid adverse impacts on the adjacent residential environment.

9.13 The Department is concerned that this site may prove unsuitable for full wastewater treatment because it is:

- Too small;
- Too close to housing and the ancient monument;
- Of landscape and nature conservation value;
- An amenity in an area of dense residential development;
- Likely to require a complex and therefore expensive solution.

9.14 To avoid delay and ensure continuity of wastewater disposal, replacement of the existing preliminary treatment facility will need to be located adjacent to the existing Headworks. It would therefore be prudent to reserve this site to upgrade preliminary treatment facilities.



NOTES

KEY

- Area of predominantly developed land, including leisure use
- Area of landscape value
- Land zoned as Housing Target Area
- Land zoned for solid waste facilities
- Current Longue Hougue Reclamation Site
- Area identified for potential 18 hole golf course
- Location of existing Belle Greve Pumping Station
- Route of existing Belle Greve Outfall below seabed
- Route of existing Belle Greve Outfall on seabed
- Current extent of reclaimed land, April 2007

REV.

CLIENT
PUBLIC SERVICES

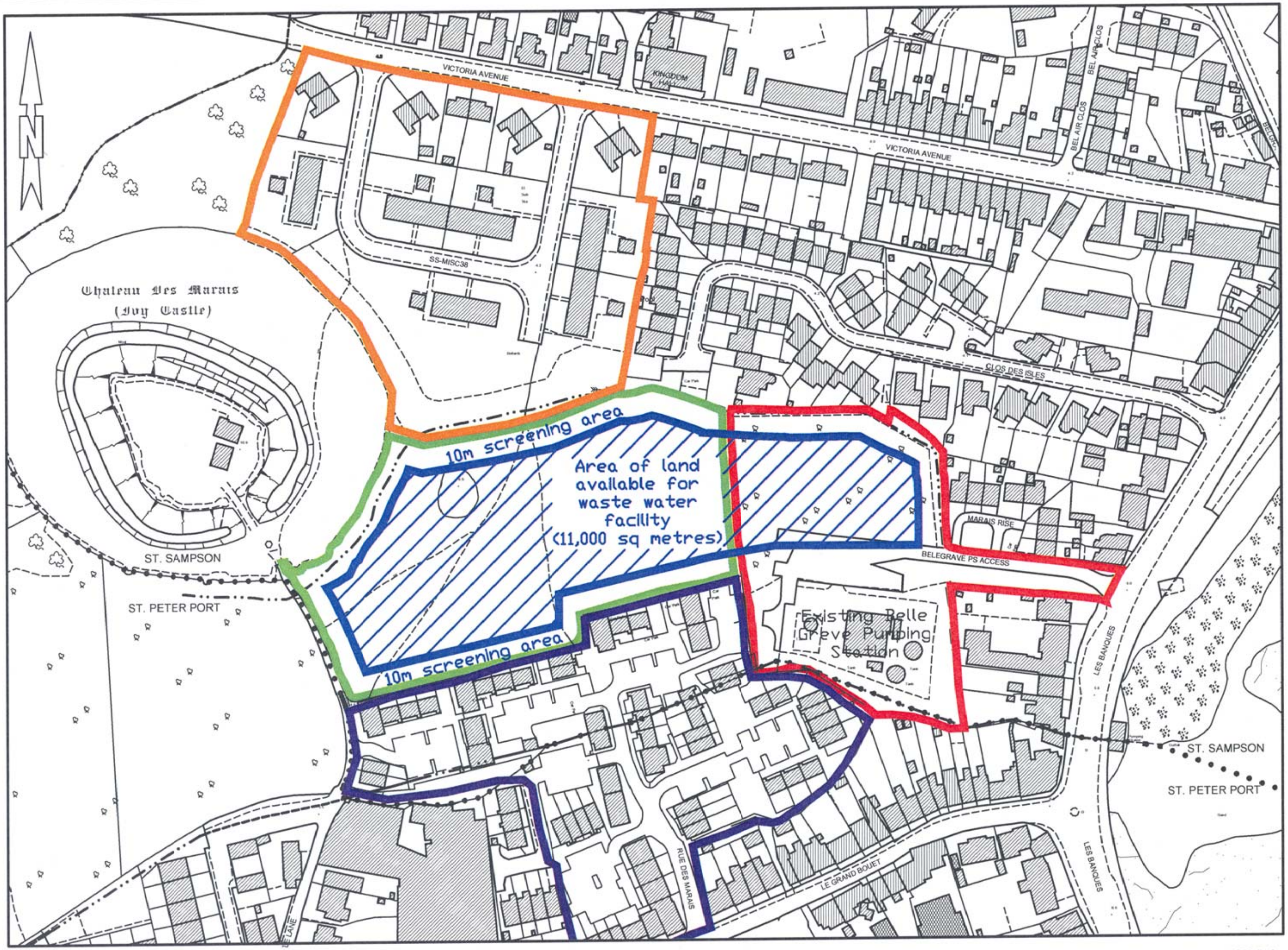
PROJECT
LIQUID WASTE STRATEGY

DRAWING TITLE
SIMPLIFIED LAND USE PLAN – AREA WITHIN 2000 METRES OF EXISTING BELLE GREVE HEADWORKS

STATES OF GUERNSEY
PUBLIC SERVICES DEPARTMENT

SURVEYED	DRAWN BY	CHECKED
–	SJD	–

DATE 23/01/07 DRAWING No. 6922/285
SCALE N.T.S.



March 2004 - DWG Data - Copyright States of Guernsey 2004

NOTES

KEY

- Land Administered by States Environment Department, Total area = 12,200 sq meters
- Land Administered by States Public Services Department, Total area = 8800 sq meters
- Land Administered by States Housing Department for development of social housing
- Social housing development completed Spring 2005

REV.

CLIENT
PUBLIC SERVICES

PROJECT
LIQUID WASTE STRATEGY

DRAWING TITLE
AREA OF LAND AVALABLE AT EXISTING BELLE GREVE PUMPING STATION SITE

STATES OF GUERNSEY
PUBLIC SERVICES DEPARTMENT

SURVEYED	DRAWN BY	CHECKED
–	SJD	–
DATE 23/01/07	DRAWING No. 6922/286	
SCALE 1:2000		

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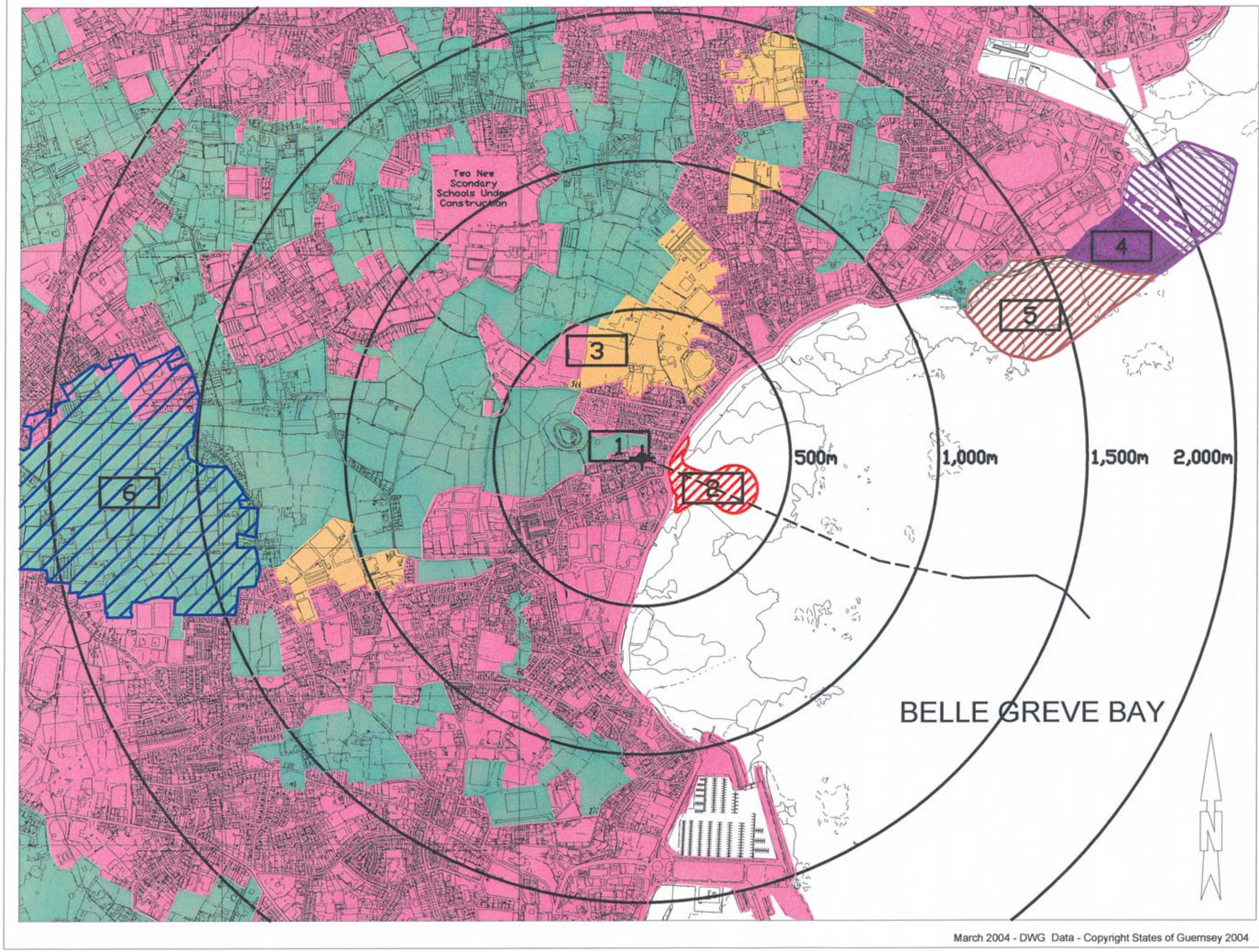

KEY

- Area of predominantly developed land, including leisure use
- Area of landscape value
- Land zoned as Housing Target Area
- Land zoned for solid waste facilities
- Current Longue Hougue Reclamation Site
- Potential future extension of Longue Hougue Reclamation Site
- Area identified for potential 18 hole golf course
- Potential treatment site in artificial headland
- Potential treatment site locations representing 2 hectares
- Location of existing Belle Greve Pumping Station
- Route of existing Belle Greve Outfall below seabed
- Route of existing Belle Greve Outfall on seabed
- Current extent of reclaimed land, April 2007

CLIENT
PUBLIC SERVICES

PROJECT
LIQUID WASTE STRATEGY

DRAWING TITLE
POTENTIAL SITES FOR WASTE WATER TREATMENT

STATES OF GUERNSEY
PUBLIC SERVICES DEPARTMENT

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-	SJD	-
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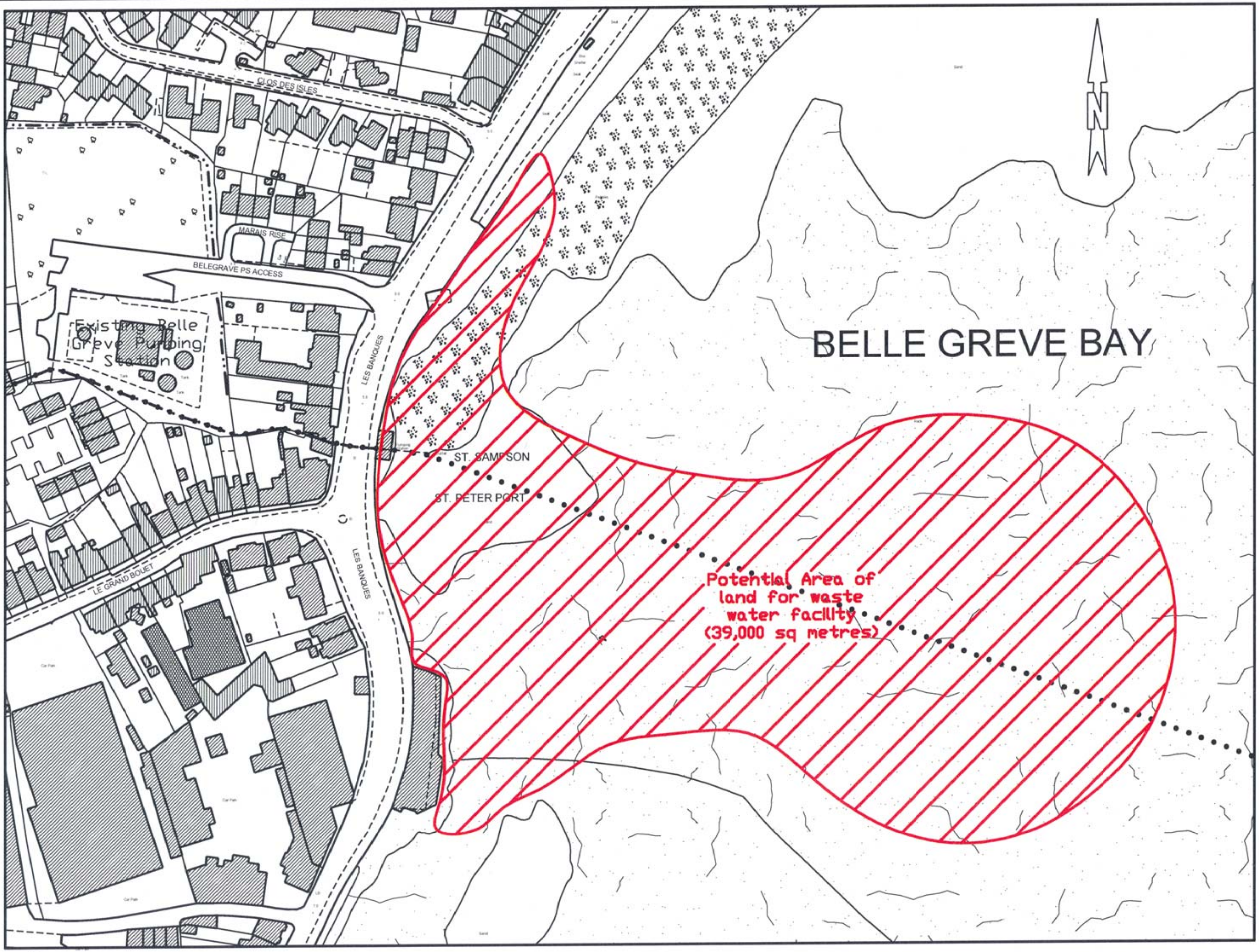


NOTES

KEY

Possible area of Bellegreve Bay to be reclaimed, Total area = 38,000 sq meters

REV.

CLIENT
PUBLIC SERVICES

PROJECT
LIQUID WASTE STRATEGY

DRAWING TITLE
POTENTIAL TREATMENT SITE ON ARTIFICIAL HEADLAND

STATES OF GUERNSEY
PUBLIC SERVICES DEPARTMENT

SURVEYED	DRAWN BY	CHECKED
-	SJD	-

DATE 23/01/07	DRAWING No.
SCALE 1:2000	6922/288

9.15 It may not be economic to transfer the much larger volume of storm flows arising after heavy rainfall to another site for treatment. Any additional space available on this site should therefore be reserved for storm facilities to retain and in future treat storm flows in excess of outfall or transfer capacity.

Potential Alternative Site 1 – Artificial Headland at Hougue a la Perre

9.16 There is a natural headland between Admiral Park and the Red Lion road junction that could be extended by reclaiming the area shown on Drawing Reference 6922/288 [preceding page]. A rock mound breakwater shaped to look like a natural promontory in the bay could surround the reclamation. The treatment plant might be landscaped with natural stonewalls, perhaps architecturally designed to look like a historic fort, similar to Castle Cornet. A public footpath around the site would be possible and small sandy coves might be formed beside the headland. This idea is just one landscaping option intended to reduce the impact of reclaiming a suitable site from Belle Greve Bay.

9.17 A site of generous proportions could be created within 250 metres from the existing Belle Greve Headworks and outfall. The site is above low tide level so breakwater construction would be considerably smaller than at Longue Hougue. Treatment structures could be founded directly on natural rock. The cost of reclamation and landscaping would be partially offset by minimal cost of site acquisition and reduced sewage transfer infrastructure. Prevailing winds are offshore but full odour control and treatment would be required.

9.18 The main disadvantage of this site is the visual and environmental intrusion into Belle Greve Bay. This potential site must be considered within the context of the overall Waterfront Strategy.

Potential Alternative Site 3: Belgrave Vinery

9.19 The States purchased the former Belgrave Vinery in 1985 for light industry, which is currently designated as a Housing Target Area, but there are no firm plans for development of this site. A wastewater treatment plant could be located on Belgrave Vinery within 500 metres of the existing Belle Greve Headworks and outfall. However, wastewater transfer pipelines would be closer to 800 metres in length to avoid intervening development.

9.20 Prevailing winds from the southwest would carry any odours over much of St Sampsons and it would be necessary to ensure effective odour control and treatment. Site acquisition and landscaping costs would be minor and there are few engineering disadvantages apparent at this stage.

9.21 The main disadvantage of this site would be the impact on future development of this Housing Target Area.

Potential Alternative Site 4: Longue Hougue Reclamation

9.22 A substantial area of land is being reclaimed from the sea at Longue Hougue, St Sampsons. Adjacent or integrated facilities for treatment of solid and liquid wastes could be located on adjacent parts this site. Prevailing winds are offshore and the area mainly industrial but some odour control and landscaping would still be required.

9.23 In engineering terms the site has three major disadvantages. Firstly, construction of large or deep tanks in the unconsolidated and variable infill found in this reclamation is far from ideal. The shallow groundwater is subject to tidal variation, which makes excavation particularly expensive.

9.24 Wastewater would have to be pumped approximately 2,000 metres from the existing Headworks at Belle Greve. The coastal route along Les Banques is heavily congested both on the surface by traffic and underground by vital services. Construction of a large diameter pipeline on this route would therefore be very disruptive and disproportionately expensive.

9.25 Treated effluent could be returned to the existing outfall for discharge, which would require a second pipeline on the same congested route. Alternatively, a new outfall would be required at Longue Hougue, which could add substantially to the cost.

9.26 Although the reclamation site appears large, there are many competing uses for this land. The southern area has been allocated for processing and treatment of solid waste, the northern area to port related facilities.

Potential Alternative Site 5: Longue Hougue South [Vivian]

9.27 A southern extension of the Longue Hougue land reclamation site has previously been considered as an option for disposal of inert waste once the current reclamation area has been filled. This would ease pressures for use of the current reclamation. This alternative is slightly closer to the existing Headworks.

9.28 One potential advantage of this sitee is that construction of the wastewater treatment structures could proceed before the site was filled, thus avoiding the need to excavate in difficult ground conditions. Structures would be founded directly on exposed rock within the protective breakwater. Areas between structures could then be infilled as the treatment structures progressed. To avoid delay, fill material could be stockpiled or transferred from the original Longue Hougue reclamation.

9.29 Although this alternative could avoid deep excavation in unconsolidated fill, construction of foundation structures would be subject to tidal inundation and therefore more expensive than for a geologically suitable inland site.

Potential Alternative Site 6: Site West of La Ramee

9.30 The Rural Area Plan designates an area of search for a potential new 18-hole golf course located west of La Ramee. Although the area is of high landscape quality, the current mixture of horticultural and agricultural uses would be changed by construction of a golf course.

9.31 Whilst no firm plans for a golf course have been developed, the course area required would be far greater than that required for wastewater treatment. If a golf course were to be developed on this site, this could offer a unique opportunity to incorporate a site for wastewater treatment. This potential alternative is shown as site 5 on Drawing Reference 6922/287.

9.32 A wastewater treatment plant within the proposed golf course could be as far from residential areas as any potential alternative site anywhere in the Island. The plant would be landscaped to blend into the parkland setting of a golf course without adverse visual impact upon the golf course or surrounding residential properties. Odour control and treatment would be compatible with recreational use of this new open space and surrounding residential areas.

9.33 Traffic movements to the completed treatment plant would be far fewer than visitors to the golf course. A golf course requires substantial volumes of water; it may be practical to recycle treated wastewater and thereby protect valuable water resources.

9.34 Wastewater would need to be transferred to the site but, although the distance from Belle Greve is similar to Longue Hougue, the route is through open fields where foul sewers have previously been laid. This would avoid the cost and disruption of constructing pipelines along the busy coastal route. Another advantage is that a major sewer from the west coast already crosses the site.

9.35 Wastewater treatment located within a golf course on this gently sloping greenfield site is likely to prove less expensive with lower environmental impact than the alternative coastal sites.

Comparison of Alternative Sites

9.36 In order to evaluate alternative sites it will be necessary to invest sums in the region of £1.5 million to:

- Investigate feasibility of a new outfall at Longue Hougue and transfer pipelines along Les Banques;
- Undertake site investigations;
- Assess environmental impact for each site and determine appropriate treatment processes and mitigation measures;

- Prepare outline designs for each site;

- Estimate budget costs.

10. Finance and Procurement Strategy

10.1 In addition to current sewerage operating costs in excess of £4 million per annum, regular expenditure in the region of £1 million per annum is required to refurbish pumping stations and replace wastewater collection tankers. A provisional budget of £10 million has also been requested for essential refurbishment of the Belle Greve wastewater disposal facility.

10.2 Including ancillary administrative and technical staff costs, the current sewerage network represents a long-term commitment in the region of £6 million per annum at current costs, of which just over £1.3 million is funded by charges for wastewater collection, paid by customers with cess pits. The balance of nearly £5 million per annum is a liability funded from general taxation revenue, including a small contribution from increased rateable values of property connected to main drain.

10.3 The Green Paper raised the possibility of a wastewater charge to supplement or replace contributions from general revenue. The equivalent wastewater charge to raise £6 million per annum from 24,000 customers would be about £250 per annum. This is the average annual wastewater charge; in practice some customers would pay less and some would pay more, depending on factors such as water consumption, rateable value and trade use. A suitable scale of charges would need to be devised to yield the required income: development of an appropriate scale of wastewater charges is beyond the scope of this report.

10.4 An average wastewater charge of £250 per property would be sufficient to sustain the existing sewerage network without contribution from general revenue or wastewater collection charges, but would not be sufficient to fund adoption of private sewers, network extension or wastewater treatment.

10.5 The Network Extension Plan was originally programmed over 20 years at £3 million per annum, expressed at 2000 prices. Although about a quarter of the work has been done, the outstanding work is likely to cost a further £50 million at current prices. An additional wastewater charge of £105 per annum from 24,000 customers, increased annually by RPI, would be sufficient to complete the Network Extension Plan within 20 years.

10.6 If wastewater treatment was to be funded by a wastewater charge, it would be necessary either to save up until sufficient revenue had accrued, or alternatively to borrow for early construction against future revenues. Assuming the treatment plant costs £50 million to be funded by borrowing from treasury funds at 6% over 25 years, the repayments would work out at approximately £4 million per annum. Assuming that operating costs are in the region of £1 million per annum, the total annual funding requirement is £5 million.

10.7 The annual wastewater charge required to raise £5 million per annum to fund treatment for 24,000 properties would be about £210 per property. However, the charge applied to individual properties would probably vary, taking into account factors such as water consumption, rateable value and any trade effluent discharged.

10.8 The annual cost to the community of providing wastewater services [whether paid directly through a wastewater charge, through general taxation or by a combination of direct charge and general taxation] is summarised in Table C, based on the average cost per property:

TABLE C: Cost of Wastewater Service Options

Option	Cost of Service £ Per Annum	Average Cost Per Property £ Per Annum
To sustain current sewerage network without treatment	6,000,000	250
Extra to extend 'main drain' to connect 95% of dwellings within 20 years	2,500,000	105
Extra for wastewater treatment	5,000,000	210
Total to complete sewerage network over 20 years and provide wastewater treatment	13,500,000	565

10.9 The typical cost in recent years of providing sewerage services has been approximately £5 million per annum including capital maintenance and upgrading projects; this would need to be increased to about £6 million to sustain the current sewerage network.

10.10 The Network Extension Plan has progressed for several years utilising a separate capital allocation of £3 million per annum: the annual budget for network extension is likely to be reduced to approximately £1 million in 2008 and may be further reduced until the Island's fiscal revenues are sufficient.

10.11 **The overall cost of wastewater services has been in the region of £8 million per annum, approximately £335 per property. The additional cost to the community to complete the sewerage network over the next 20 years and provide wastewater treatment would be approximately £5.5 million per annum or £230 per property.**

Alternative Funding

10.12 The cost of wastewater treatment shown in Table C above includes interest on the capital that would need to be borrowed from the Treasury or from commercial sources at a nominal 6% per annum. Borrowing from commercial sources is likely to cost more than the 6% assumed for the above calculations. Long-term loans from the public at 6% to provide treatment might be an acceptable alternative to progress wastewater treatment.

10.13 One alternative is to spread the cost over a longer period by allocating revenue to a reserve account until the Island can afford wastewater treatment. If a wastewater charge was introduced during the planning phase, 10 years before construction of a wastewater treatment plant, and increased annually to maintain its real value for 35 years, the initial wastewater charge required could be reduced to perhaps £150 per property. However, it may be considered unacceptable to charge current customers for the cost of future services.

10.14 Sale of development rights or land for development has been suggested as a means to provide wastewater and solid waste treatment. However, income from development could be used for any public purpose and need not be allocated to wastewater services.

10.15 Another alternative would be to involve the private sector more directly to provide and finance the project. The potential for Private Finance Initiatives or Public Private Partnership is explored further within the following summary of alternative procurement routes. However, the cost of private finance would have to be recouped from future revenues and seems unlikely to offer a significant saving on the costs quoted in Table C above.

10.16 Realistically, the cost of wastewater services may need to be shared between a wastewater charge and general taxation.

Alternative Procurement Routes

10.17 There are several alternative means of procuring and operating treatment plant, such as:

- Traditional;
- Design & Build;
- Design, Build & Operate;
- Finance, Design, Build & Operate.

10.18 The traditional process is to employ a consultant to design the plant, prepare tender documents and supervise construction, but this limits competition between alternative processes and omits input from experienced operators.

10.19 The design and construct approach based on a performance specification allows for competition between alternative treatment processes. However, careful evaluation of design and construct tenders is required to ensure best value throughout the life of the plant. Defects in the initial specification can invalidate or obstruct enforcement of performance guarantees. This approach was tried in Jersey in recent years and remedial work has been necessary to improve the outcome.

10.20 For a small island without previous experience of wastewater treatment, there would be some advantage in collaborating with an experienced operator. An operator with a substantial programme of similar work could draw on substantial technical resources and market strength to minimise cost and risk. However, choice of partner and commercial arrangements would need careful consideration; the ownership of utility companies has proved unstable in recent years. The interface with the sewerage network would require particular consideration. A long-term concession would not necessarily deliver the most economical solution for the Island.

10.21 Private finance can offer a means to manage risk and defer payment but this service is likely to be reflected in the price.

10.22 The wastewater treatment process would probably be selected by suppliers rather than the States. The choice of treatment process should be based on commercial and technical factors, including the selected site, environmental constraints and effluent standard required.

11. Conclusions

Requirement for Wastewater Treatment

11.1 The World Health Organisation has assessed the risk to human health to be ‘Low’ if wastewater is discharged through an effective long sea outfall after preliminary treatment and ‘Very Low’ after secondary treatment with disinfection. By comparison, wastewater discharge through a short outfall presents a ‘High Risk’ even after secondary treatment and ‘Medium Risk’ after secondary treatment and disinfection. In terms of reducing risk, an effective long sea outfall is considered better than wastewater treatment**.** The combination of secondary treatment, disinfection and a long sea outfall provides the lowest risk to human health.

11.2 The mathematical dispersion model shows that the existing Belle Greve outfall is well located but does not fully protect water quality on the east coast of Guernsey. A long term monitoring programme would be required to fully assess the environmental impact of the current wastewater discharges.

11.3 The pattern of bathing water quality results over the past 15 years is unlikely to be significantly improved by treating wastewater discharged through the Belle Greve outfall. Bathing water quality appears to be adversely affected by other sources of pollution such as surface water discharges or direct contamination. Further investigation of unsatisfactory results would be required to comply with the new Bathing Water Directive.

11.4 There is no evidence of significant environmental degradation as a result of wastewater disposal into the Little Russel through the long sea outfall.

11.5 The primary objective and benefit of wastewater treatment would be disinfection, as a precaution to protect public health.

11.6 Priority for wastewater treatment should be considered in the broadest policy context and take into account other risks to human health, the environment and public perception. Within the wastewater function there are other priorities associated with over 5,000 cesspits, other outfalls and deficiencies in the existing sewerage network.

11.7 The case for wastewater treatment may be summarised as minimising risk to human health, recreation and public perception. The case against is the substantial resources of land, energy, people and money required. In environmental terms it would appear that wastewater treatment will have a:

- Negative impact on the atmosphere by increasing the Island's carbon footprint;
- Negative impact on land due to treatment processes and generation of solid waste;
- Broadly neutral impact on the marine environment, the improvement in water quality may be offset by reduced productivity of local fisheries.

Cost of Wastewater Treatment

11.8 A preliminary estimate of capital cost to provide wastewater treatment including disinfection was summarised in the Green Paper with a project total of slightly more than £50 million. Further investigations, including evaluation of some modern proprietary alternative processes, have lead to the following conclusions:

- The cost of the main process plant may be only 20% of overall project capital costs;
- The difference in capital cost between alternative processes is less than 10% of overall project cost;
- Reduced standards of treatment may offer savings of only 10% of overall capital costs;
- Site related factors represent more than 50% of overall project capital cost;

- The compact plant necessary on a small site is generally more expensive to construct and operate, and requires a higher energy input to achieve the same standard of treatment;

- Reliable estimates for budget purposes can only be prepared after investigation of specific sites and preparation of outline designs based on theconstraints of that site;

- Total project costs are likely to be in the range £30 million to £85 million, depending mainly on the site and means of sludge disposal.

11.9 Capital and future operating costs can be minimised by selecting a spacious well - located site with good topography and ground conditions, minimum landscaping and odour control requirements. The target site area has therefore been increased to 20,000 square metres, 200 metres by 100 metres.

Site for Wastewater Treatment

11.10 Further investigations should now focus upon selection of a suitable treatment site – the choice of treatment process may best be determined later in the procurement process when site, outfall location, discharge standards and procurement strategy have been agreed and strategy for disposal of the Island's solid waste further advanced.

11.11 Outfall location and selection of a site for wastewater treatment will need to take into account any potential long-term strategy for conservation and development of the east coast.

11.12 The open space adjacent to the existing Belle Greve Headworks is unsuitable as a site for wastewater treatment because it is too small, surrounded by dense residential development and of high landscape value. However, the eastern part of this site will be essential as a site for replacement of the existing preliminary treatment plant and for storm water retention, regardless of whether further wastewater treatment is provided. The area should therefore be designated for development of the existing Headworks and protected from other development incompatible with this strategic requirement.

11.13 A wastewater treatment site close to the existing Belle Greve Headworks would minimise the cost of wastewater transfer pipelines and the potential requirement for a new outfall.

11.14 Selection of an appropriate undeveloped inland site could avoid the cost of land reclamation and release scarce coastal development sites for other purposes. If a third golf course was provided at La Ramee, this could include a suitable site for wastewater treatment.

11.15 A full Environmental Impact Assessment will be required as part of the site selection and planning process. The cost of an EIA will depend on the number of sites and complexity of issues to be considered. A budget of £1,500,000 would be appropriate to provide for site investigation, outline design, environmental impact assessment and technical support during a planning inquiry.

Solid Waste arising from Wastewater Treatment

11.16 Biosolid wastes [sludge] arise from all wastewater treatment options, other than the status quo option, which relies on natural marine processes. A reliable and continuous means of sludge disposal, independent of weather and season is fundamental for wastewater treatment. The need to treat sludge and dispose of biosolid wastes is very costly and a major disadvantage in comparison to the present natural marine processes.

11.17 Although some sludge could be recycled to land after appropriate treatment as a substitute for artificial fertilizers, this would require substantial additional capital investment to ensure an appropriate microbiological quality. Experience in the UK, Jersey and the Isle of Man does not support reliance on recycling as the primary means of sludge disposal; an alternative sludge disposal route is essential.

11.18 Strategies for solid and liquid wastes are inter-related, but that does not mean that solid and liquid waste treatment facilities have to be located on the same site. Combining both waste treatment plants in one building would involve a commitment to provide both facilities simultaneously and severely limit flexibility to provide for future replacement and development of either plant. Flexibility is particularly important to accommodate rapid changes in standards and technology. Two adjacent but separate plants for treating solid and liquid waste under common management could offer similar synergies, but large sites are in short supply and this could preclude integration of other solid waste processing activities.

Other Practical Issues

11.19 Periodic ingress of saline water would have to be further reduced before wastewater treatment could be commissioned. The revenue budget for sewer rehabilitation may need to be increased, depending on the overall programme for wastewater treatment.

11.20 Planning policies should prevent significant new development in locations requiring cesspool drainage systems.

Financial Planning

11.21 The typical cost of providing sewerage services in recent years has been approximately £5 million per annum including capital maintenance and upgrading projects; this would need to be increased to about £6 million to sustain the current sewerage network. The annual cost to the community of sustaining the current sewerage network with preliminary treatment and disposal by long sea outfall [whether paid directly through a wastewater charge, through general taxation or by a combination of direct charge and general taxation] is in the region of £250 per property.

11.22 The Network Extension Plan has progressed for several years utilising a separate capital allocation of £3 million per annum: the annual budget for network extension is likely to be reduced to approximately £1 million in 2008 and may be further reduced until the Island's fiscal revenues are sufficient. Completion of the Network Extension Plan to connect 90% of properties within 20 years would add a temporary annual cost in the region of £105 per property. In the longer term this investment would reduce the overall revenue costs for the reasons set out in 11.12 above.

11.23 Postponing extension of the sewer network would have substantial long term revenue implications including:

- Extending the current commitment to empty cess pits;
- Continuing refurbishment of the existing sewerage network damaged by septic sewage;
- Costs of sewage conditioning or pre-treatment.

11.24 Provision of wastewater treatment including disinfection would add an additional cost in the region of £230 per property, if the capital cost had to be financed by borrowing.

11.25 The overall cost of wastewater services has been in the region of £8 million per annum, approximately £335 per property. The additional cost to the community to complete the sewerage network over the next 20 years and provide wastewater treatment would be approximately £6 million per annum or £250 per property.

Refurbishment of Belle Greve Wastewater Disposal Facility

11.26 In October 2006 the States agreed to allocate priority to funding refurbishment of the Belle Greve Facility. The Public Services Department is planning a phased refurbishment and upgrading of the Belle Greve Facility as a five year programme. Subject to necessary approvals, this project will commence in 2007 with enabling and interim works, including inspection of the existing outfalls.

11.27 The refurbished facilities at Belle Greve will upgrade preliminary treatment and odour control to modern standards, and may include storm retention capacity. It is envisaged that the refurbished plant will provide the first stage of full wastewater treatment.

11.28 Further progress would require allocation of significant resources.

11.29 **This report provides a comprehensive basis for the States and the community to decide whether the provision of a wastewater treatment is just desirable or absolutely essential. If treatment is essential, then there are three main questions that need to be answered:**

- **Where will the wastewater treatment plant be sited?**
- **What method of disposal should be used in respect of the resulting bio solid sludge or residue?**
- **How will the financial requirements be funded?**

12. Liquid Waste Strategy

12.1 The liquid waste strategy approved by the States in 1997 gave highest priority to protecting the Island's ground and surface water systems, to protect both water resources and bathing water quality. This strategy included a plan for the continued rehabilitation, future maintenance and extension of the sewerage infrastructure together with measures related to management of agricultural and horticultural wastes that go beyond the scope of this report [Appendix I provides further information].

12.2 The liquid waste strategy approved in 1997 also included agreement in principle to introduce wastewater treatment as soon as practical, within a five to ten year timescale. Investigating the possibility and desirability of a wastewater charge was another aspect of this strategy.

12.3 Although substantial progress has been made in the intervening period, implementation of the approved long term strategy is far from complete. Refurbishment of the Belle Greve Wastewater Treatment Facility is a priority for which funding from the Capital Reserve has been agreed in principle. In October 2006 the States decided that further extension of the sewerage network was not a priority project and in view of the need for fiscal restraint could be undertaken over a longer period.

12.4 Table C in this report sets out the annual revenue that would be necessary to sustain the existing sewerage network, with options for completing extension of the sewerage network over the next 20 years and for providing wastewater treatment using borrowed funds.

12.5 The Public Services Department has noted the broad range of opinion expressed by the public and in the States. It has therefore decided to suggest alternative Resolutions that might be preferred as an alternative to the recommendations submitted by the Public Services Department.

12.6 The following paragraphs explain the resolutions submitted by the Department and then offer two alternatives: 'Planning Future Wastewater Treatment' and 'Progressing the Approved Liquid Waste Strategy'.

Recommendation submitted by the Public Services Department

12.7 The recommendation submitted to the States with this report is to undertake a Marine EIA including baseline environmental monitoring over 5 years at a total cost of £600,000. This option is designed to provide robust scientific evidence sufficient to establish the impact of current wastewater discharges.

12.8 Comprehensive scientific assessment of the evidence would be valuable to assist the community in deciding priority for investment in wastewater treatment. Such evidence is absolutely essential to help defend the Island from adverse public and international perception associated with discharging partially treated wastewater into the sea. This recommendation minimises expenditure during this period of exceptional restraint.

12.9 If necessary the Marine EIA could be subdivided into the following phases –

- Comprehensive investigation of poor bathing water quality, to be followed by:
- long term baseline survey of wastewater dispersion and natural treatment to refine the existing mathematical model;
- a Benthic survey of the sea bed around the Belle Greve outfall to establish any adverse impact from wastewater disposal.

Other Options

Option 1 – Planning Future Wastewater Treatment

12.10 No site has yet been allocated for wastewater treatment. Selection of a suitable site and the associated statutory planning processes require a full Environmental Impact Assessment. This process will inevitably take several years and members may feel that planning for future treatment should be advanced so that it could be implemented quickly when funds become available or if required to protect the Island's international reputation.

12.11 This option requires investigation of alternative sites and preparation of outline designs with a full Environmental Impact Assessment and Planning Inquiry for the selected site at an estimated cost of £1.5 million. This could be achieved by asking the States to proceed as per the box below:

PLANNING FUTURE WASTEWATER TREATMENT

Members might substitute the following propositions so that the States:

(i). Direct the preparation of feasibility studies and a full environmental impact assessment necessary to develop proposals for wastewater treatment at a specific site or alternative sites as set out in Sections 6.34 – 6.36 of this report [Full EIA] at a budget cost of £1,500,000;

(ii). Instruct the Policy Council to arrange any statutory planning inquires that may be necessary to confirm a designated site for wastewater treatment facilities;

(iii). Direct the Treasury and Resources Department to make provision for the cost of planning future wastewater treatment in the budgets of the Public Services Department and Policy Council.

<u>Option 2 - Progress the Approved Liquid Waste Strategy</u>

12.12 A second potential option is to continue the previously approved strategy but extend implementation over a longer period, to keep funding requirements within affordable limits. This could be achieved by asking the States to proceed as per the box below:

TO PROGRESS PREVIOUSLY APPROVED LIQUID WASTE STRATEGY INCLUDING NETWORK EXTENSION AND TREATMENT

Members might amend the propositions so that the States

(i). Allocate highest priority within funds available for wastewater collection and disposal to sustaining the existing sewerage network including essential refurbishment of the existing Belle Greve Wastewater Disposal Facility;

(ii). Assign second priority within funds available for wastewater collection and disposal to continue extension of the sewerage network;

(iii). Reaffirm agreement in principle for the introduction of wastewater treatment for implementation as soon as is practical [Resolution 6 of Billet XIII, June 1997];

(iv). Reaffirm Environmental Quality Objectives and Standards approved by the States in 1997 [Resolution 5 of Billet XIII, June 1997] and update these to achieve:

(a). the highest standards for designated shellfish beds, in accordance with European guidelines and requirements;

(b). compliance with highest standards of the 1976 Bathing Waters Directive and the subsequent replacement Directive approved by the European Union in 2006 in all inshore waters;

(c). compliance with the appropriate internationally recognised standards in remaining coastal waters, including the little Russel;

(v). Direct the Public Services Department to prepare a firm programme to upgrade and extend the sewerage network to connect 95% of Island homes and treat wastewater to meet updated Quality Objectives and Standards for the marine environment by 2028.

(vi). Direct the Public Services and Treasury and Resources Departments to investigate and report to the States on alternative options to finance wastewater services including the proposed infrastructure required by 2028;

(vii). Direct the preparation of feasibility studies, including a full Environmental Impact Assessment and planning inquiry, to develop proposals for wastewater treatment at a specific site or alternative sites as set out in Sections 6.34 – 6.36 of this report [Full EIA] at a budget cost of £1,500,000.

(viii). Direct the Policy Council to arrange any statutory planning inquires that may be necessary to plan the proposed wastewater treatment facilities;

(ix). Direct the Treasury and Resources Department to make provision for the cost of planning future wastewater treatment in the budgets of the Public Services Department and Policy Council.

Consultation with States Departments

12.13 Before finalising and publishing this report, the Public Services Department sent it to the following stakeholder Departments for comment:

Environment
Health and Social Services (HSSD)
Culture and Leisure
Commerce and Employment

12.14 Their letters of comment are appended in full at appendix VIII for the information of the States. It can be seen that some Departments do not support the Public Services Department's recommendations. The Public Services Department decided not to make any fundamental amendments to the Report as a result of feedback received, preferring to adhere to its original proposals but providing for the information of the States the views of other Departments in full.

12.15 It did, however, make some minor amendments as a result of the Environment Department's comments on specific paragraphs. Such amendments are indicated in the Report for information.

12.16 In addition to those Departments listed above, the Public Services Department also consulted the Treasury and Resources Department, as a result of which a number of points have been clarified.

13. Recommendations

13.1 The Public Services Department recommends that the States:

(i) direct the preparation of an environmental impact assessment as set out in sections 6.30 – 6.33 of this report [Marine EIA] at a budget cost of £600,000 to establish:

- the impact of current methods of wastewater disposal on the marine environment;
- the causes of poor bathing water quality;
- the potential effect of wastewater treatment on the Island's carbon footprint;

(ii) direct the Treasury and Resources Department to take account of the costs of the Marine EIA when recommending to the States, Cash Limits for the Public Services Department for 2008 and future years;

(iii) allocate priority within the limited financial resources available for wastewater services to those measures necessary to sustain and develop the existing sewerage network, including measures to reduce ingress of saline and surface water.

Yours faithfully

William M Bell
Minister

APPENDIX I

DEVELOPMENT OF LIQUID WASTE STRATEGY

[EXTRACT FROM GREEN PAPER, Billet I of 2006]

3. Development of Liquid Waste Strategy

WASTE STRATEGY ASSESSMENT 1994 – 1997

3.1 In June 1994 the States resolved to conduct an assessment of the Island's long-term strategy for all waste, both solid and liquid. Due to the overlapping nature of the issues, political responsibility for this corporate project was allocated to the Advisory and Finance Committee in July 1996 (Billet d'Etat XIV).

3.2 Extensive research and consultation was undertaken, drawing upon external specialists and internal resources from several departments, led by the Waste Services Section of the former Department of Engineering, now Guernsey Technical Services. The research phase of this project resulted in two separate reports, the first focussing on liquid waste and the second on solid waste. In respect to sewage the most significant findings were:

- WRc plc (formerly the UK Water Research Centre) developed a computerised model, proven by associated tracer studies, showing the dispersion and decay of sewage discharged through each of the four outfalls currently in continuous use (Belle Greve, Creux Mahie, Fort George and Herm); the impact of polluted surface water was also modelled;

- The project established a consensus that inland pollution of streams and ground water affected natural water resources and bathing beaches, was more damaging and justified higher priority than the negligible impact of sewage discharges to the marine environment from existing outfalls;

- Proposed a comprehensive strategy for improving the collection and transfer of sewage for treatment;

- Addressed the need to plan for treatment and disposal of biosolid sludge arising from future sewage treatment.

3.3 Appendix A shows the maximum bacterial concentrations for each of the existing sewage outfalls predicted by the WRc sewage dispersal model, as one example of many scenarios modelled. The Executive Summary of Waste Strategy Assessment Report No 1 is also attached as Appendix N of this States Report.

LIQUID WASTE STRATEGY APPROVED BY THE STATES IN JUNE 1997

3.4 The project report dealing with Liquid Waste was summarised in a policy letter from the Advisory and Finance Committee dated 23 May 1997 (Billet XI). The States decisions in respect of sewage were as follows:

- *"To approve in principle the adoption of Environmental Quality Objectives and Standards for the Island's surface and groundwaters, as set out in paragraph 5.2"* of the policy letter [Paragraph 5.2 refers to "compliance with European Union guideline standards of water intended for the abstraction of drinking water"].

- *"To direct the States Public Thoroughfares Committee"… "to report to the States with a plan for the continued rehabilitation, future maintenance and extension of the sewerage infrastructure, as detailed in paragraph 5.10"* of the policy letter.[The PTC Business Plan – see section 5 of this report]

- *"To direct the Advisory and Finance, in consultation with the Public Thoroughfares Committee, to investigate the possibility and desirability of levying an equitable charge on owners of property… connected to the foul sewer network, such charge to be used for the maintenance of the network, and to report back to the States as soon as possible".*

- *"To approve in principle the adoption of Environmental Quality Objectives and Standards as detailed in paragraph 5.20(a)" of the policy letter* [see Section 4.3].

- *"To agree in principle that the introduction of sewage treatment measures be brought forward for implementation as soon as is practicable and to direct the States Advisory and Finance Committee to give consideration to the means for achieving this, within the resources available to the Island, and to report to the States as appropriate and with reference to the issues raised in paragraphs 5.18 and 5.20 (b)"* of the policy letter. [See Strategic and Corporate Plan 2002 & 2003 – Section 6 of this report]

3.5 In paragraph 5.18 of the 1997 policy letter the Advisory and Finance Committee confirmed that " highest priority should be given to the containment of pollution of the Island's ground and surface water systems" Paragraph 5.18 ends "the Committee considers that sewage treatment should come into operation within a five to ten year timescale".

3.6 Paragraph 5.20(a) of the 1997 policy letter determines objectives and standards for sewage treatment, *"to achieve:*

- *the maintenance of the highest standards for designated shellfish beds, in accordance with European guidelines and requirements;*

- *compliance with guideline standards of the Bathing Waters Directive in all inshore bathing waters;*

- *compliance with the appropriate internationally recognised standards in remaining coastal waters, including the Little Russel"*

DEVELOPMENT OF SEWAGE TREATMENT AND SEWERAGE STRATEGY 1998 – 2000

3.7 In April 1998 the former Public Thoroughfares Committee presented a comprehensive Business Plan to the States (Billet d'Etat VII). In accordance with States Resolution of June 1997 (6 above), the PTC Business Plan included an option for the construction of sewage treatment facilities by 2002, subject to availability of funds.

3.8 The Business Plan included the following two major capital plans to reduce pollution within the Island and prepare for future sewage treatment:

Drainage Area Plan

3.9 This comprehensive Plan addressed deficiencies in existing sewerage infrastructure and provides for planned development. The Plan was based on a CCTV survey of all sewers undertaken during 1993, flow measurement, analysis and assessment of projected future development. Capital programmes included renewal and rehabilitation of sewers and pumping stations to meet hydraulic, structural and service requirements.

3.10 Septic waste from cess pits releases hydrogen sulphide, a toxic gas which forms sulphuric acid in wet conditions that can destroy the concrete and mortar and ancillary metalwork used in sewerage systems. Rehabilitation of damage caused by hydrogen sulphide to relatively new sewers, manholes and pumping stations was a significant part of the necessary capital programme.

3.11 The environmental and economic impact of this programme included reduced infiltration into sewers, minimising flows and future operating costs, less traffic disruption and reduced pollution due to breakdown, overflow or leakage.

3.12 Reduction in surface water and saline water flows in the sewerage system is fundamental to obtaining an efficient and effective treatment process prior to the discharge of effluent to the receiving waters (Note: considerable progress has been made since 1997 by installing new separate surface water sewers and relining old foul sewers).

3.13 Intermittent Saline intrusion associated with high tides entering the sewerage network would adversely affect the microbiological balance of a conventional sewage treatment works. Modern systems can be designed to operate with relatively consistent levels of salinity, but react badly to sudden shock loadings that can adversely affect the beneficial organism environment in the process (Explanatory Note: microbiological communities capable of treating sewage exist in fresh water and also in saline water but the microbiological organisms that develop in saline water are not the same organisms that thrive in fresh water).

3.14 Surface water flows in the sewerage system can have a similar impact by flushing the organisms through the works, but more importantly these high flows and volumes require larger pumping capacity, storage tanks and energy consumption to deal with these conditions. Infiltration of groundwater reduces dry weather flow in the island's streams and thereby reduces water resources.

3.15 The Drainage Area Plan included separation of surface water drainage from foul sewers.

Network Extension Plan

3.16 The objective of the second plan was to extend main drain to 95% of Island homes within 20 years. The plan commenced with three traditional contracts that were awarded to provide sewers in the Cobo area, L'Islet Phase IV and Les Nouettes in the Forest.

3.17 The key States Resolutions arising from that policy letter were as follows:

- *"To note the States Public Thoroughfares Business Plan"*

- *"That the Public Thoroughfares Committee be required to appoint appropriately experienced consultants to investigate the viability and technical possibility of a distributed treatment system for the Island's waste water ……. And report back to the States within 12 months."*

3.18 The Public Thoroughfares Committee returned to the States in April 1999 with a policy letter entitled "Investigation into the Viability and Technical Possibility of a Distributed Treatment System for the Island's Wastewater" (Billet XI). This policy letter summarised the consultant's conclusions and expanded on some of the programmes included in the Business Plan. The States decided:

- *"……To centralise sewage treatment unless there is an overriding reason to consider localised treatment."*

- *"To approve in principle the future programme of the States Public Thoroughfares Committee as outlined in Section 5 of that Report"*

3.19 A detailed long-term programme for sewer construction was prepared and published in July 2000, to be undertaken as a rolling programme under a term contract. This programme would eliminate most of the pollution caused by leaking cess pit drainage systems, which would become redundant if the property owners connect to main drain. Damage to sewerage infrastructure and offensive odour from septic sewage would also be minimised.

STRATEGIC AND CORPORATE PLAN 2002 / 2003

3.20 In 2002 the States were advised " a report is to be prepared which will review the priority of sewage treatment within the Capital Works programme" (Section 8.8.8 on page 1245 of Billet d' Etat XV).

3.21 In 2003 the States approved a revised Strategic and Corporate Plan, which concluded …. " Provision of sewage treatment will therefore offer minimal environmental benefits, compared with other liquid waste priorities." (Section 10.8.8 on page 19 of the 2003 Plan published as an appendix to Billet XXI 2003). Although Strategic Policy 27 refers to identification of sites for sewage treatment, the text of the revised Plan indefinitely deferred provision of wastewater treatment in favour of an "action plan", agreed between the former Advisory and Finance and Public Thoroughfares Committees. This Action Plan comprised the following three components:

- *"For the PTC to liase with the Board of Health's Environmental Health Department to establish a regular sampling programme to monitor the discharge effects of the long sea outfall at Belgrave Bay on surrounding waters". (Note: Appendix B provides summary results for 2004 water quality on the east coast shore at Fermain, Havelet, St Sampsons and Bordeaux)*

- *"For the PTC to maintain a watching brief on proven technical innovation within the waste water treatment industry in order to keep under review the best environmental option for the Island's sewage disposal, until such time as provision can be made within the Capital Works Programme for these works".*

- *"For the PTC to investigate, and report back as appropriate, on the possibility of executing inexpensive works to end discharge of untreated sewage from the waste water effluent discharges at Fort George and Creux Mahie (and for the Board of Administration to do likewise in relation to Herm), together with upgrading of the existing headworks and preliminary treatment facility at Belgrave."*

3.22 The approved Strategic Land Use Policy (27) reads "The identification of sites for sewage treatment works may be incorporated into the relevant Detailed Development Plans and technical assessments of methods of sewage treatment shall be taken into account in the identification of those sites"

THE ENVIRONMENTAL POLLUTION (GUERNSEY) LAW 2004

3.23 The Environmental Pollution (Guernsey) Law 2004 provides a comprehensive legal framework to prevent pollution of air, land and water. This Law establishes the post of "Director of Environmental Health and Pollution" as an environmental regulator responsible for implementing the provisions of this new Law. A "Director Designate" has been appointed; the new Law is expected to come into force during 2005, subject to States approval of a commencing Ordinance.

3.24 The new primary legislation was drafted as a framework for more detailed regulations on specific issues to be enacted by Ordinance. The first substantive Ordinance under this Law is being prepared to regulate management and disposal of solid waste. The secondary legislation on solid waste has already been approved in principle and is being drafted for approval by the States to come into force simultaneously with The Environmental Pollution (Guernsey) Law 2004.

The legislation anticipates a parallel future Ordinance regulating disposal of liquid waste to the marine environment. Subject to the enactment of further secondary legislation, the "Director of Environmental Health and Pollution" would enforce the prescribed standards for discharge of treated sewage.

APPENDIX II

Bathing Water Quality in Guernsey from 1992 to 2006

Guernsey Bathing Water Quality 1992-2006

Bathing water at the beaches listed below is tested on a weekly basis, between April and September, against the standards set in the Bathing Water Directive 76/160/EEC

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Vazon	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Good	Excellent	Good	Good	Excellent
Pembroke	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Good	Fail
L'Eree	Good	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Port Soif	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent
Cobo	Excellent	Good	Excellent	Good	Excellent	Excellent	Excellent	Good	Good	Good	Good	Good	Good	Good	Good
Fermain	Good	Good	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Fail	Good	Excellent	Excellent	Excellent
Petit Bot	Excellent	Good	Excellent	Good	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Good	Good	Good	Good	Good
Havelet	-	Good	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent	Excellent	Excellent	Excellent
Ladies Bay	-	-	-	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Portelet	-	-	-	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Excellent	Good
Saints	-	-	-	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Bordeaux	-	-	-	-	-	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good
Grandes Rocques	-	-	-	-	-	-	-	Good	Good	Good	Excellent	Good	Excellent	Excellent	Excellent

Excellent

The test passed the higher, recommended standards for faecal coliform, total coliform and faecal streptococci.

- ***Total coliform no more than 500 per 100ml.***
- ***Faecal coliform no more than 100 per 100ml.***
- ***Faecal streptococci no more than 100 per 100ml.***

To achieve this overall result for a season, 80% of all samples must be equal to, or better than the above standards for total and faecal coliform and 90% must be equal to or better than the standard level for faecal streptococci.

Good

The test passed the legal minimum standards for faecal coliform and total coliform.

- ***Total coliform no more than 10,000 per 100ml***
- ***Faecal coliform no more than 2,000 per 100ml***

To achieve this result for a season, 95% of all samples must be equal to, or better than, the above standards.

Fail

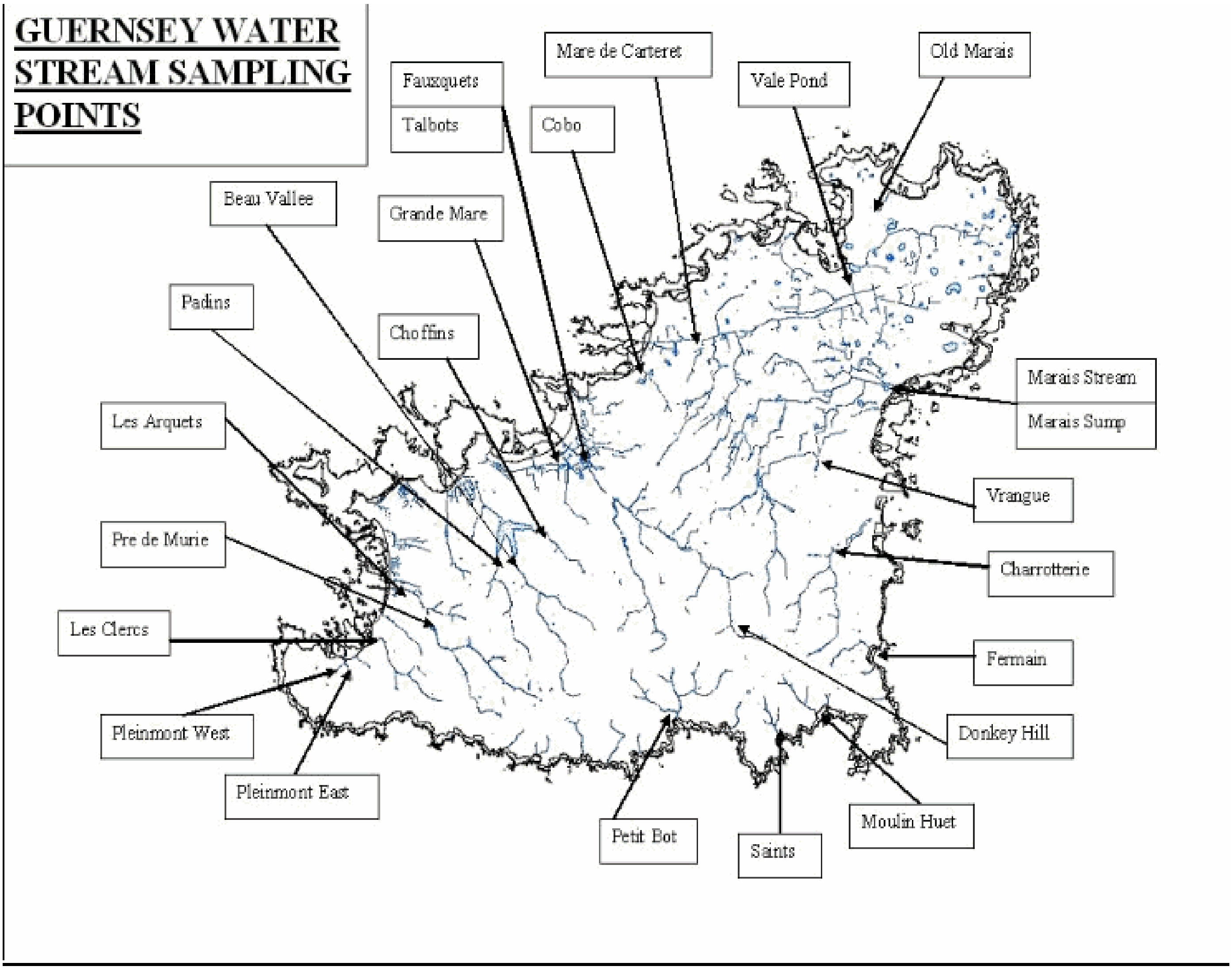
The test failed the legal minimum standards for faecal coliform and total coliform.

APPENDIX IIIA

Summary of Surface Water Quality: October 2006 – January 2007
Source: Guernsey Water

Layout of Appendix III	
Stream sampling points	below
Surface water quality	Appendix IIIB
Reservoir water quality	Appendix IIIC
Bathing water standards	Appendix IIIC

Surface Water Quality Sampling Points



APPENDIX IIIB

Surface Water Quality: October 2006 – January 2007

Sample point	Coliforms (number in 100ml)			Faecal Coliform E.coli (number in 100ml)			Faecal streptococci (number in 100ml)			Ammonium (mgNH_4/l)		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Vale Pond	2800	18642	57000	1100	5700	17000	320	2778	14900	0.06	0.16	0.54
Marais Stream	2200	18733	90000	1300	8917	66000	100	2229	>10000	<0.03	0.13	0.36
Marais Sump	1200	31325	>100000	50	16607	89000	40	2620	>10000	0.04	0.60	5.10
Choffins	900	29175	>100000	130	9213	43000	200	2586	>10000	0.02	0.10	0.33
Beau Vallee	1200	16317	41000	580	3981	24000	160	1339	2500	<0.01	0.03	0.07
Padins	2100	21233	69000	1000	6967	34000	120	7382	67000	0.04	0.09	0.22
Pre du Murie	4400	28367	>100000	3600	14325	26000	300	2025	5200	0.08	0.12	0.20
Les Clercs	2100	18942	57000	510	6748	43000	280	2179	>10000	0.02	0.05	0.10
Pleinmont East	2200	10250	25000	30	1107	4800	10	1041	6300	<0.01	0.04	0.17
Pleinmont West	1200	15017	120000	30	2153	21000	70	12066	140000	<0.01	0.04	0.24
Les Arquets	160	19825	>100000	70	5367	38000	6	1105	6000	0.04	0.17	1.00
Petit Bot	2500	15508	47000	390	3740	15000	220	968	3300	0.01	0.03	0.08
Saints	1100	13650	>100000	300	3163	19000	200	1147	4700	<0.01	0.03	0.07
Moulin Huet	2900	38233	190000	360	5847	27000	400	9908	>100000	<0.01	0.02	0.04
Fermain	230	4206	24000	50	1104	3400	60	609	2900	<0.01	0.01	0.02
Charrotterie	3400	23242	>100000	300	3331	11000	160	1457	4900	0.01	0.05	0.12
Mare de Carteret	1100	4092	14000	350	1156	2000	110	498	1200	0.05	0.08	0.18
Old Marais	700	7200	49000	250	1792	14000	90	531	1200	0.04	0.09	0.22
Vrangue	390	2733	9000	70	418	1200	60	250	860	<0.01	0.03	0.05
Donkey Hill	3200	24675	>100000	200	11133	46000	100	3164	14000	0.07	0.10	0.15
Fauxquets	1500	4833	14000	400	1696	6400	100	478	1600	0.04	0.35	1.20
Talbots	2800	13858	69000	1200	2858	8900	110	2414	18000	0.01	0.03	0.05
Cobo	1200	6808	23000	310	2783	15000	90	889	2500	<0.01	0.03	0.08
Grande Mare	1900	43817	>100000	1000	21908	>100000	270	14902	>100000	0.05	0.37	0.83

Note: European standards for bathing water quality are shown on the following page

APPENDIX IIIC

Storage Reservoir Quality coinciding with Surface Water Sampling

Sample point	Coliforms (number in 100ml)			E.coli (number in 100ml)			Faecal streptococci (number in 100ml)			Ammonium (mgNH4/l)		
	Minimum	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**
St Saviours	200	993	2300	10	289	480	-	-	-	<0.01	0.02	0.03
Juas	10	453	1100	62	152	270	-	-	-	0.01	1.91	5.70
Longue Hougue	170	1127	2000	10	506	1200	10	150	300	0.01	0.01	0.02
Grosse Hougue	110	728	2400	50	273	570	40	103	230	0.01	0.02	0.02
Capelles	140	1688	8000	140	488	1300	40	248	700	0.03	0.09	0.16
Jamblin	0 in 10ml	877	5300	0 in 10ml	553	2500	0 in 10 ml	159	270	<0.01	0.20	0.45

Note: Water stored in the reservoirs is treated to potable standards before distribution to customers

1976 Bathing Water Directive Standards

Microbiology	Mandatory	Guideline
Total Coliforms per 100ml	Maximum10,000	Maximum 500
Faecal Coliforms per 100ml	Maximum 2,000	Maximum 100
Faecal Streptococci per 100ml	Not applicable	Maximum 100
Compliance limits	80% samples must pass above coliform criteria 90% samples must pass Streptococci criteria	95% samples must pass above criteria

Note: It is impractical to monitor all the pathogens [organisms causing disease] that could affect human health - Total Coliforms, Faecal Coliforms and Faecal Streptococci are monitored as indicators of recent faecal contamination: such indicator organisms are not necessarily harmful to human health.

APPENDIX: IVA

Wastewater Treatment Stages and Process Options

Option	Primary	Secondary	Tertiary
A1	Sedimentation – Removal of settleable biosolids by settlement in a large tank	Biological Filtration - conventional biological treatment. Settled sewage treated by trickling through filter media in beds designed to develop and aerate fixed microbiological film. Effluent settled to remove resulting humus.	Disinfection using Ultra Violet light
B1	Sedimentation as for option A1 above	Activated Sludge- accelerated natural biological treatment using forced air and recycled bacterial cultures in suspension. Surplus activated sludge drawn off as waste for treatment.	Disinfection using Ultra Violet light
A2	Sedimentation using Lamella Separator – using inclined plates to reduce area required for settlement.	BAF – Biological Aerated Filters combine processes A & B above – uses flooded fixed film filter media with forced air to accelerate treatment in a smaller area. Excess biological film removed by backwashing – this waste stream requires treatment.	Disinfection using Ultra Violet light
P1	As A2 above but Helical arrangement of Lamella Separators	BAF as A2 above Excess biological film removed by backwashing – this waste stream requires treatment.	Disinfection using Ultra Violet light
B2	Oxidation Ditch – a variation of the activated sludge process for smaller plants that does not require primary treatment. Air is entrained as sewage and bacterial cultures circulate around a continuous horizontal loop. Final settlement required to remove excess suspended activated sludge for separate treatment.		Disinfection using Ultra Violet light
Prefix Notes: • Treatment processes with the prefix "A" utilise biological cultures in a fixed film attached to media with a large surface area; • Treatment processes prefixed "B" are variations of the activated sludge process utilising biological cultures as a suspension in the wastewater to be treated; • Treatment processes prefixed "P" are proprietary variations of generic treatment processes A and B.			
Table continues on next page			

APPENDIX IVB

Wastewater Treatment Stages and Process Options continued

<table>
<tr><th>Option</th><th>Primary</th><th>Secondary</th><th>Tertiary</th></tr>
<tr><td>P2</td><td colspan="2">Deep Shaft – a variation of the activated sludge process that does not require primary treatment. Air is entrained as sewage and bacterial cultures circulate around a continuous vertical loop. Settlement is required to remove entrained air followed by final settlement to remove excess suspended activated sludge for separate treatment.</td><td>Disinfection using Ultra Violet light</td></tr>
<tr><td>B3</td><td colspan="2">SBR – Sequencing Batch Reactor – another variation of the activated sludge process that does not require primary treatment or final settlement. Sewage is treated in batches rather than a continuous stream, using forced air and a bacterial culture retained by settlement of the previous batch.</td><td>Disinfection using Ultra Violet light</td></tr>
<tr><td>P3</td><td colspan="2">Biobubble SBR - a proprietary variation of the SBR process B3 above. Wastewater batches are rapidly loaded into the reactor and treated for extended periods to remove more organic material, producing a high quality effluent with reduced sludge volumes.</td><td>Disinfection using Ultra Violet light</td></tr>
<tr><td>B4</td><td colspan="3">MBR – Membrane Biological Reactor uses membranes to filter and disinfect final effluent after sewage treatment using the activated sludge process. Surplus activated sludge drawn off as waste for treatment.</td></tr>
<tr><td>P4</td><td>Lamella Separators as A2 above</td><td>Moving Bed Biological Reactor
Excess biological film removed by injecting dissolved air and skimming off surface [Dissolved Air Flotation] – this waste stream requires treatment.</td><td>Disinfection using Ultra Violet light</td></tr>
<tr><td>P5</td><td>Helical Lamella Separators as P1 above</td><td>Moving Bed Biological Reactor as P4 above
Excess biological film removed by Dissolved Air Flotation – this waste stream requires treatment.</td><td>Disinfection using Ultra Violet light</td></tr>
</table>

APPENDIX V

Practical Examples of Wastewater Treatment Plants

Option	Location	Type	Population served	Area – m^2	Comment
B1	Holdenhurst, Bournemouth	Activated Sludge	187,000	127,155	Excludes sludge treatment
Biosolid Sludge	Berry Hill Sludge Treatment Centre, Bournemouth	Anaerobic digestion plus centrifuge	250,000 [approx]	39,251	Sludge treatment only
A2	Poole, new part	40% flows to Lamella / BAF	72,000 [40% of 180,000]	30,420 [30 % of 101,400]	60% flows to activated sludge plant
B2	Tarrant Crawford	Oxidation Ditch	20,000 [plant also receives brewery effluent]	24,367	[generous site layout includes sludge treatment]
B3	Charmouth	Sequencing Batch Reactor [continuous feed]	7,500 [design]	4,300	Successful new plant
B3	Weymouth	Sequencing Batch Reactor	95,000	15,100	Underground: without storm treatment – cost £35 million in 2000
B4	Swanage	Membrane Biological Reactor	21,500	10,700 [main site 7,076 + lower site 1,245 + sludge site 2,380]	£37 million cost includes landscaping & storm sewer

APPENDIX VI

Comparison of Alternative Treatment Processes including Proprietary Variations

Option	Processes as described in Appendix III	Gross Area required for main process - m^2	Capital Cost £
A1	Biological Filtration	9,100	14,715,000
A2	Lamella Separators and Biological Aerated Flooded Filters	1,100	10,755,000
P1	Helical Lamella Separators with Biological Aerated Flooded Filters	800	12,300,000
B1	Activated Sludge	7,660	12,285,000
B2	Oxidation Ditch	6,220	9,165,000
P2	Deep Shaft	3,440	11,475,000
B3	Sequencing Batch Reactors	4,260	9,345,000
P3	BioBubble Sequencing Batch Reactors	10,520	18,675,000
B4	Membrane Bio Reactors	800	9,945,000
P4	Lamella Separators with Moving Bed Biological Reactor and Dissolved Air Flotation	1,320	10,680,000
P5	Helical Lamella Separators with Moving Bed Biological Reactor and Dissolved Air Flotation	1,020	12,225,000

- The above;
- Costs and areas are based on treating waste from an equivalent population of 75,000, which allows for visitors and trade effluent;
- Capital costs cover construction of core wastewater treatment processes, excluding ancillary processes, project management and site specific costs;
- Costs estimated by WRc are based on typical UK costs relevant to a large client with a substantial programme of similar work. Capital costs shown in this report have been increased by 50 % to provide realistic local construction costs on a one off project;
- Land areas quoted by WRc are the net area of the process units required without allowance for space between units, access and associated infrastructure requirements. Gross site areas have been estimated by doubling the theoretical net areas shown in the WRc report. Further site specific allowances must also be made for ancillary processes and facilities, landscaping and practical restrictions dictated by the shape and topography of the site.
- This comparison was undertaken in advance of site selection procedures, engineering appraisal, environmental impact assessment and planning. The conclusions of the review therefore remain subject to broad margins of uncertainty, including the capital cost and land area required.

APPENDIX VII

Review of Process Options for Wastewater Treatment on Guernsey - Supplementary Report by WRc plc dated December 2006

Note: this report supplements the previous review of process options by WRc plc dated January 2005 that was published as Appendix M in the Green Paper

STATES OF GUERNSEY

REVIEW OF PROCESS OPTIONS FOR WASTEWATER TREATMENT ON GUERNSEY - SUPPLEMENTARY REPORT

WRc Ref: UC 7303
DECEMBER 2006

REVIEW OF PROCESS OPTIONS FOR WASTEWATER TREATMENT ON GUERNSEY - SUPPLEMENTARY REPORT

Report No.:	UC 7303
Date:	December 2006
Authors:	B.Chambers, A.S.Dee
Contract Manager:	R.Hurley
Contract No.:	14323-1

RESTRICTION: This report has the following limited distribution:

External: States of Guernsey

Internal: Authors, Contract Manager

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SUMMARY

I OBJECTIVES

The objective of this report is to provide a non-technical description of processes for wastewater and sludge treatment which might be suitable for installation on Guernsey to meet the approved Water Quality Objectives. The report includes a discussion of the factors which must be taken into account during selection of the optimum process, such as capital cost, area requirements, achievable effluent quality and sludge production.

II CONCLUSIONS

The Water Quality Objectives approved by the States of Guernsey can be met by a number of options for wastewater treatment. Some of these options are based on the use of conventional process sequences while others rely on compact plant, which can be installed at sites where construction area is limited.

The area required by compact plant based on processes such as MBRs, BAFs and MBBRs is only about 18-12% of the area required by some conventional treatment processes.

A disinfection process would be required as a final stage of treatment for all but the MBR treatment option. A system based on the use of UV irradiation would be cost-effective.

The provision of stormwater treatment by conventionally designed settling tanks requires a large land area and could be a problem at a confined site. The cost of preliminary and stormwater treatment is a significant fraction of the total capital costs of wastewater treatment. It might be possible to reduce the cost of stormwater treatment if a detailed study of the environmental impact of stormwater discharge was carried out.

Sludge disposal by incineration would appear to be a viable option. Disposal by recycling depends on the availability of a sustainable market for the sludge product. If the States of Guernsey were to adopt the standards contained in the UK 'Safe Sludge Matrix', then recycling to certain types of food crop would require enhanced sludge treatment, such as pasteurisation, in addition to anaerobic digestion.

The capital cost of sludge treatment prior to disposal by incineration is considerably less than the cost of sludge treatment prior to recycling. This is because neither anaerobic digestion nor sludge pasteurisation is required if the sludge is to be incinerated. The sludge produced by treatment processes which do not include primary sedimentation might not be amenable to anaerobic digestion. If anaerobic digestion is not viable then the agricultural recycling route is unavailable.

The capital cost of the entire treatment process is likely to be in the range £17.2 M to £26.2 M, depending on the selected options for wastewater and sludge treatment.

1. INTRODUCTION AND BACKGROUND

The States of Guernsey are not part of the UK or the EU, but have approved water quality objectives for marine discharge of treated sewage which are intended to ensure compliance with EU guidelines and standards for designated shellfisheries and inshore bathing waters. Wastewater treatment processes which are capable of producing effluent of the quality required by the relevant EU Directives, for a single site in Guernsey serving a population equivalent of 75000, have been reviewed.[1] The design features, construction area requirements and capital costs of six wastewater treatment sequences were given and reference was made to a number of operational plants in the UK where such processes had been installed. The wastewater treatment options consisted of the following combinations of generic processes:

1. Primary sedimentation plus activated sludge plus UV disinfection.
2. Primary sedimentation plus biological filtration plus UV disinfection.
3. Oxidation ditch plus UV disinfection.
4. SBR process plus UV disinfection.
5. Lamella separator plus BAF process plus UV disinfection.
6. MBR process.

In addition, sludge treatment sequences suitable for ultimate sludge disposal by either incineration or agricultural recycling were reviewed and the capital costs and area requirements of both were considered in relation to each of the wastewater treatment options listed previously.

The review concluded that the capital cost of the entire treatment process was likely to be in the range £17.2 M to £23.3 M, depending on the selected options for wastewater and sludge treatment. It was also noted that the area required by compact plant such as MBR and BAF processes was only about 10-12% of the area required by some conventional treatment processes.

The Public Services Department of the States of Guernsey have recently identified further processes that might be suitable, either alone in combination with those reviewed previously, for the provision of wastewater and sludge treatment on Guernsey. The additional processes are proprietary variations of the generic processes listed previously which are claimed to possess advantages in terms of capital cost, area requirement and ability to meet regulatory standards. The proprietary process variants are:

- The helical lamella separator, (a primary treatment option);
- The deep shaft process, (a variant on the activated sludge process);

[1] Review of Process Options for Wastewater Treatment on Guernsey, B.Chambers, WRc Report UC6783, January 2005

- The Bio Bubble SBR;
- Kaldnes beads with dissolved air flotation, (an integrated fixed-film and activated sludge process combined with a novel form of sludge separation).
- Sludge pasteurisation, (a sludge disinfection process available from a number of proprietary sources).

This report reviews these additional wastewater and sludge treatment processes in the same way as the previous list of process options was reviewed in the report referenced in the footnote on the previous page - that report is referred to as Report UC 6783 from this point onwards for convenience.

Report UC 6783 reviewed processes that could meet the standards required by the EU Directives relevant to marine discharge. The States of Guernsey are not bound by legislation which derives from these Directives but Report UC 6783 made reference to the UK regulations resulting from implementation of EU Directives as a convenient basis for discussion. New or revised EU Directives and guidelines are likely to result in more stringent standards for effluent quality, the permitted frequency of storm overflows and sludge recycling to agriculture. Thus, in addition to reviewing the proprietary processes listed above, the current report also discusses the ability of all the processes under consideration to meet improved standards of both wastewater and sludge treatment.

This report is structured in a similar way to Report UC 6783 and is intended to be read in conjunction with that report.

2. WASTEWATER TREATMENT PROCESSES

2.1 Primary Treatment Processes

2.1.1 Helical Lamella Separator

The helical lamella separator is a relatively new primary treatment process that has recently been developed by Southern Water. It is also known as the 'de Hoxar' separator after its inventor, who is a Southern Water employee. It is a development of lamella technology for primary treatment but has an even smaller 'footprint' – about 40-50% of the equivalent lamella separator or about 3 to 5% of a conventional primary sedimentation tank.

The separator consists of a set of vertically mounted helical plates that are arranged so that wastewater must pass upwards through one or more helical flow passages between the plate surfaces. The general arrangement is illustrated in Figure 2.1. The plate assembly is supported from a bridge and rotates slowly about the centre of a circular tank. Sewage is introduced into the bottom of the tank and flows in a well-defined and uniform manner upwards between the helical plates before leaving by passing over a weir. Suspended solids settle onto the large surface area available between the plates and slide downwards into the bottom of the tank, where they are raked into a collection hopper and discharged through the outlet pipe.

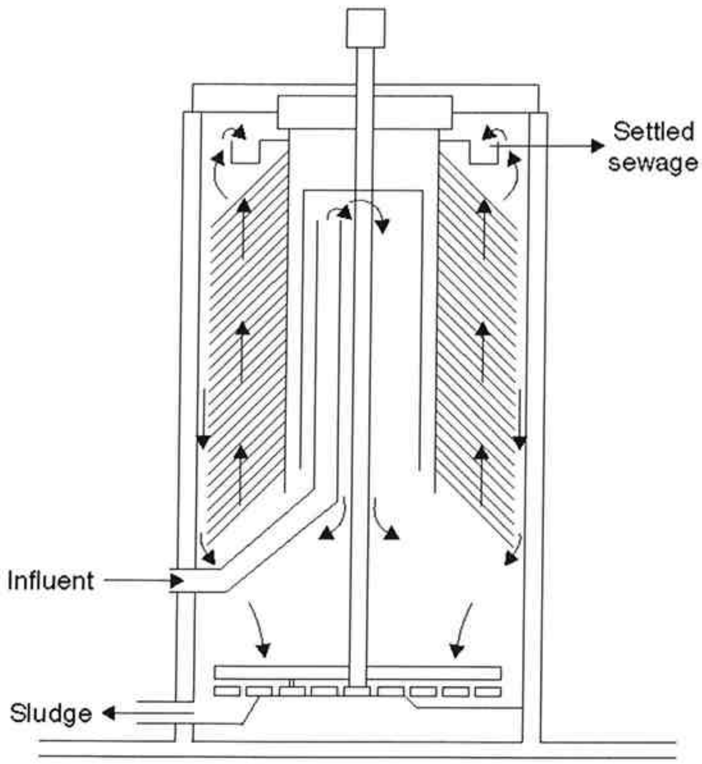

Figure 2.1 de Hoxar Helical Lamella Separator

The rotation of the helical plates reduces the distance that the settling particles travel and thereby increases their settling velocity relative to the plates. The height of the helical plate assembly is typically much greater than a conventional lamella system. Thus, helical separators are often about 7m in depth compared to depths of 3 m for conventional lamella separators. The combination of higher relative settling velocities and deeper tanks allows the spiral separator to occupy a small "footprint".

The spiral separator can achieve suspended solids and BOD removal performance which is similar to conventional primary tanks. A characteristic disadvantage of conventional lamella separators is the production of primary sludge of comparatively low solids concentration. However, it is claimed that the scrapers fitted to spiral separators produce settled sludge with a solids concentration of about 5 %, which is similar to that obtained from a conventional primary sedimentation tank.

Plant construction costs are similar to those of conventional primary sedimentation tanks treating a similar flow. High operating costs can occur if sludge sticks to the plates instead of sliding down to the collection hopper. Frequent cleaning is then required which also results in the affected tank being temporarily removed from service.

The spiral separator was originally developed for wastewater treatment applications in Southern Water. The trials of the separator started in 1993 at Bognor. Since then several other installations have been constructed at sites where space is restricted, mainly around the south and east coasts. Examples include Newhaven (Southern Water), Portsmouth and Havant (Southern Water – population 400,000), Shoreham (Southern Water), and Lowestoft (Anglian Water – population 400,000). Spiral separators are often used in conjunction with downstream treatment processes that are also compact, such as biological aerated filters (BAFs).

2.2 Secondary Treatment Processes

2.2.1 Deep Shaft Process

The deep shaft process was originally developed in the early 1970s as a high-rate activated sludge variant suitable for the treatment of strong, biodegradable industrial effluents. The main difference between the deep shaft and a conventional activated sludge plant is that the aeration tank is built vertically into the ground rather than horizontally. The deep shaft aeration tank might typically be from 50 m to 100 m in depth and 1 to 8 m in diameter. Hence it occupies a small area in relation to conventional systems.

Within the aeration tank, there are two sections with mixed liquor passing down one section (known as the downcomer) and up the other (termed the riser). Screened and degritted crude wastewater enters the downcomer along with process air. Owing to the high circulation rate, the air bubbles are swept downwards and then up through the riser section. Typically the time taken by the wastewater to complete a circulation of the aeration tank is about 2 minutes and it circulates the tank between 20 and 40 times during treatment.

The high hydrostatic heads generated in the deep shaft aeration tank raise the partial pressure of oxygen present in the air bubbles. As a result the oxygen transfer rate is about 10 times higher than in a conventional plant and low flows of process air are sufficient for aeration of domestic wastewater. However, the air has to be compressed to a high pressure for injection into the deep shaft and the aeration energy requirements are similar to a conventional aeration tank.

The mixed liquor from the deep shaft aeration tank is highly aerated and is passed through either a vacuum degasser or stripping unit supplied to remove microbubbles which might attach to the sludge solids and cause settlement problems. The degassed mixed liquor then gravitates to conventional final settling tanks for clarification. A flow diagram of a deep shaft process is shown in Figure 2.2.

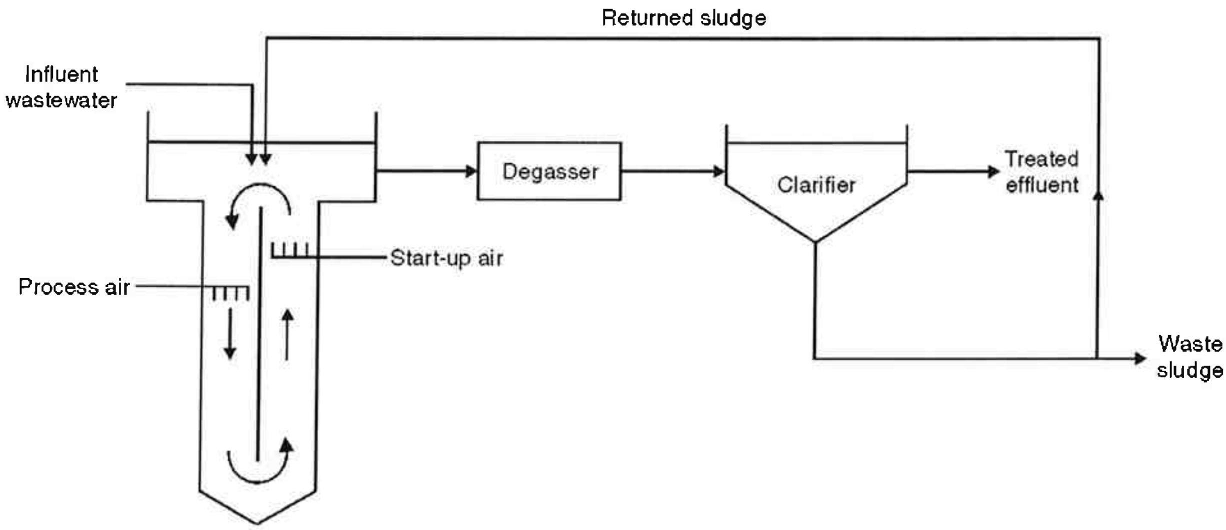

Figure 2.2 Flow Diagram of Deep Shaft Process

The costs of excavating a deep shaft, particularly in wet or rocky ground make it expensive compared to a conventional activated sludge plant. The need for an above ground tank to degas the mixed liquor offsets the small footprint of the deep shaft aeration tank. Deep shafts are normally installed to treat screened and degritted crude sewage without the need for primary sedimentation.

A small deep shaft was installed in 1978 at Tilbury by Anglian Water to treat trade waste but was subsequently decommissioned in the early 1980s. At this time, the domestic wastewater at Tilbury only received preliminary and primary treatment. The first full-scale deep shaft (5.7 m diameter and 60 m deep) was installed at Tilbury in 1986 to serve a population of 260,000. In 1989 an increase in the sewage load caused the works to become overloaded and a second deep shaft (5.7 m diameter and 60 m deep) was constructed in the 1990s. In 1996 United Utilities installed a deep shaft system (83 m depth) at Southport in the UK to serve a population of 110,000 at a confined coastal site. The treated effluent undergoes ultra violet disinfection to protect local bathing waters prior to discharge into the Ribble estuary.

2.2.2 Moving Bed Biofilm Reactor (Kaldnes) + Dissolved Air Flotation (DAF)

Much interest has arisen recently in the development of process technologies that intensify conventional activated plants by increasing the concentration of biomass that can be held in aerated or mixed tanks. The moving bed biofilm reactor (MBBR) was developed in Norway, where Kaldnes installed the first plant in 1989. The performance of the Norwegian plants was widely reported and the process became known as the Kaldnes process after the company which first installed it. The process is now more often referred to as a moving bed biofilm reactor since this terminology provides some indication of the how the system works.

The process uses hollow cylinders of short length (1 cm) and diameter (1 cm) submerged in tanks that are aerated to support the growth of a biofilm containing the micro-organisms which perform the treatment. Each cylinder has a series of external longitudinal fins and two internal sections at 90° to each other in the form of a cross to promote biofilm attachment. The cylinders have a high surface area, (350 m^2/m^3), and occupy up to about 50% of the tank volume, giving a high biofilm area per unit volume of tank. The cylinders are made from polyethylene (with a density of 0.92-0.96 g/cm^3) and require minimal mixing energy for dispersion within the tank.

Each tank is fitted with an outlet sieve to retain the supports. The continual movement of the biomass support media across the outlet sieve provides a gently abrasive motion which prevents the biomass supports from clogging with solids but does not damage them. The treated effluent and solids that detach from the media pass forward to the downstream settling tank for clarification. There is no need for backwashing of the supports and recycling of sludge from the downstream settling tanks to the upstream aerated tanks is not normally required.

The MBBR process is not used for the treatment of crude sewage and is therefore installed following primary sedimentation. The process can be retrofitted to a conventional activated sludge plant to enhance performance. Figure 2.3 shows an MBBR process with sludge recycled from the final settling tank to an inlet zone which is not aerated. This arrangement is suitable for the production of an effluent which would meet ammonia and total nitrogen standards in addition to the BOD and COD standards under consideration for Guernsey. (See section 4.6.2). It would not meet the microbiological standards without a separate disinfection stage. Sludge recycling and the unaerated zone would not be required for the effluent quality that is currently under consideration for Guernsey.

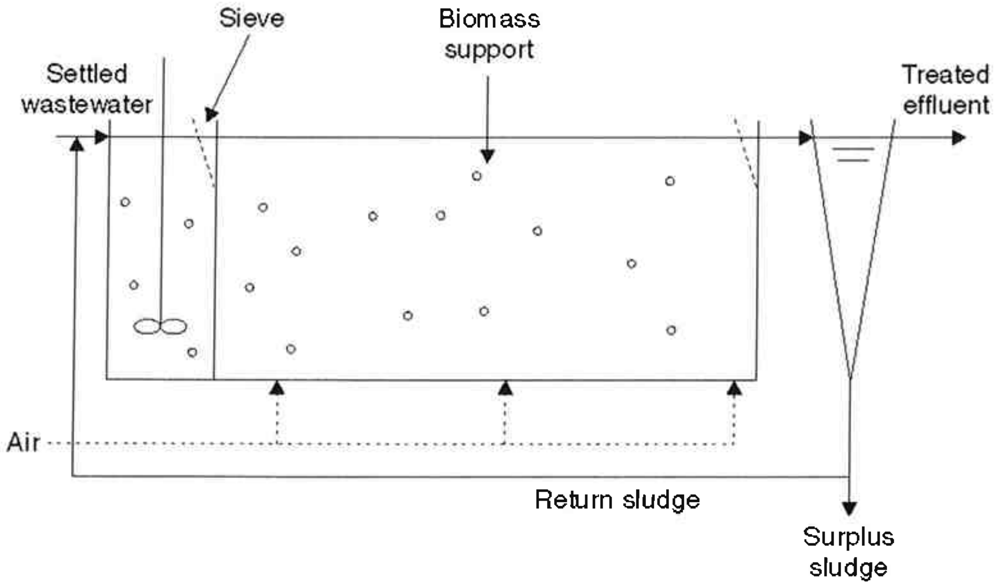

Figure 2.3 MBBR Process for Production of a High Effluent Quality

The main benefit of immobilising the biofilm on the supports is that it prevents wash-out of biomass. The process occupies about half the area of a conventional activated sludge plant and is suitable for locations where area is limited.

The main disadvantage of such processes is the cost of the biomass supports and the extra aeration required to support the higher biomass concentrations held in the plant. In addition there is the risk that the biomass supports could be lost into the effluent as a result of failure of the sieves fitted to tank outlets.

Several MBBR installations have been constructed at UK sites where space is restricted. Examples include Lowestoft, (Anglian Water – population 80,000), where an MBBR plant treats about 20% of the flow; Corby, (Anglian Water – population 200,000); Bury St Edmunds, (Anglian Water), and Braintree, (Anglian Water – population 28,000).

Dissolved air flotation (DAF) is a long-established process that is mainly used for the thickening of wastewater and water treatment sludges. It has largely been superseded by mechanical belt thickeners for wastewater sludge in the UK.

A typical DAF process is illustrated in Figure 2.4. Influent enters a mixing tank where a chemical, such as ferric chloride or aluminium sulphate, is added to promote coagulation of fine solid material into larger particles. At the same time, part of the effluent flow from the DAF plant is introduced into a saturator where air is dissolved under a pressure of about 3 bar. As the coagulated wastewater leaves the mixing tank and enters the clarifier (flotation cell), aerated effluent is injected and a polyelectrolyte flocculant is added. Reduction to atmospheric pressure causes the dissolved air to come out of solution in the form of micro-bubbles, which are only 20 -100 μm in diameter. The micro-bubbles attach to the flocculated solids and float them to the surface. The floated solids form a sludge layer which is removed, usually by means of mechanical scrapers. A weir removes clarified effluent.

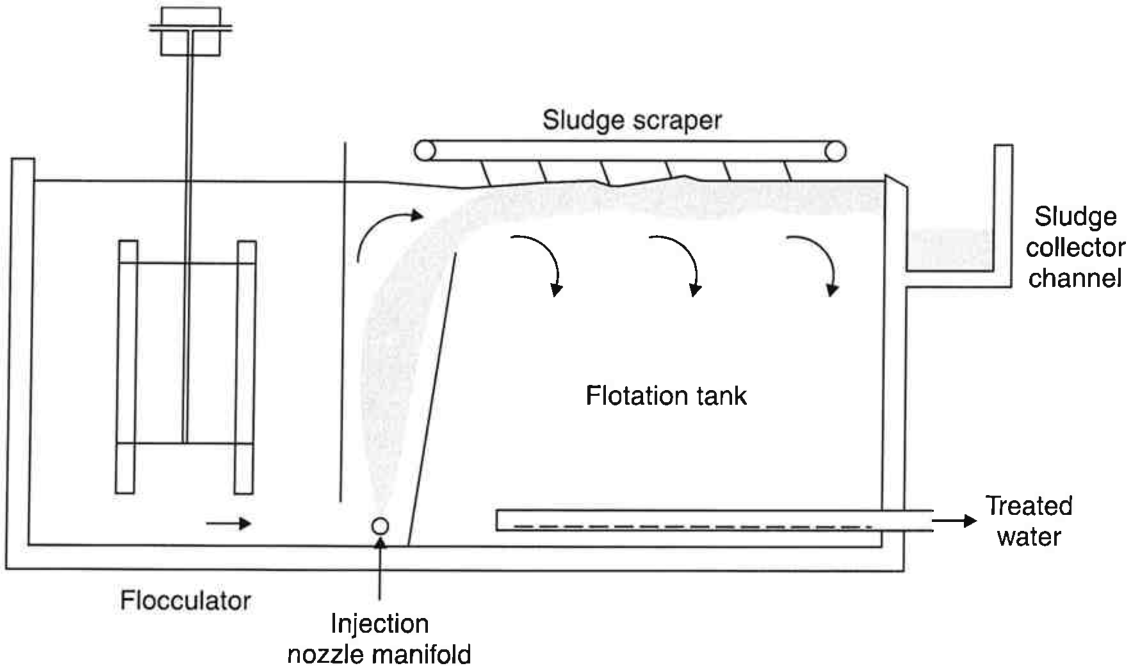

Figure 2.4 DAF Process for Solids Separation and Thickening

DAF is a solids-liquid separation process which can, in principle and with suitable modifications, be used as an alternative to a conventional settling tank in a biofilm system. DAF has not been used for separation of biomass in activated sludge plants because of the high concentrations of suspended solids that have to be removed. However, in biofilm systems the concentration of suspended solids is usually low (less than 100 mg/l SS). DAF plants have been installed downstream of MBBRs at confined sites in Norway. The combination of an MBBR followed by DAF leads to a very compact plant.

DAF plant can operate at five times the throughput of a conventional settling tank and produce effluent of a similar quality. Thus, the main benefit of a DAF process used in this way is that the plant occupies about 20% of the area of a conventional settling tank. The main constraint is that DAF requires the use of chemicals and air, which increase operating costs.

An MBBR plant installed at Lowestoft in Anglian Water has a downstream DAF for solids removal. The DAF treats about 20% of the flow and serves a population of about 80,000.

2.2.3 Bio Bubble SBR Process

This system belongs to the class of SBRs which have an intermittently-fed reactor with an upstream balancing tank. The balancing tank holds the flow of influent and accommodates the daily variations in wastewater flow. It may also act as a storm tank. This type of SBR only requires one reactor tank to treat the flow, although larger plants may have two or more tanks. Figure 2.5 shows a two-tank Bio Bubble system with a single upstream balancing tank.

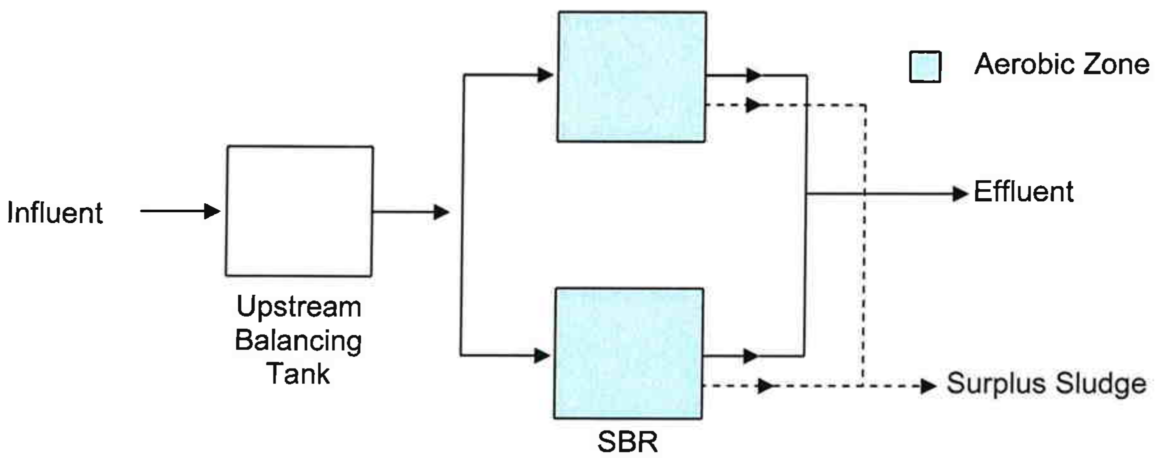

Figure 2.5 General Layout of a Bio Bubble SBR System

At the beginning of each treatment cycle sewage is pumped into the appropriate reactor. Typically, this fill period is of short duration in a Bio Bubble system (about 10 minutes). The short fill period results in the micro-organisms in the reactor tank being subjected to high concentrations of the substances in the wastewater which they use for growth. This initial, high 'food to micro-organism ratio', often referred to as a 'feast' condition, is followed by a period at the end of the reaction stage where hardly any food is available, (the 'famine' condition). The existence of feast-famine conditions is known to be important in the development of activated sludge micro-organisms which have good settling properties.

Activated sludge with poor settling properties is difficult to separate in final settling tanks and can result in high concentrations of suspended solids in plant effluent.

The rapid fill period, which is a feature of the Bio Bubble design, would be difficult to achieve at a large installation without incurring very high pumping costs. A longer fill period might result in a loss of the desirable feast-famine conditions and deterioration in sludge settling properties. (Many large SBRs with long fill periods are known to experience operating problems caused by poor sludge settleability). It is possible, therefore, that a Bio Bubble system for Guernsey would consist of a number of units installed in parallel, each of which was small enough to include the desirable rapid fill period.

Bio Bubble SBRs are typically designed with a hydraulic retention time of about 50 h. This is a very conservative value for most applications. The long retention time and filling regime promote extreme feast-famine conditions and sludge settleability is normally excellent, which allows operation at high MLSS concentrations. This combination of design and operating conditions means that the effluent quality achieved by a Bio Bubble plant is often far better than that required by the discharge consent and nitrification is almost inevitable, (see section 4.6 of this report). These features also provide the conditions which minimise sludge production, which is a claimed advantage of the Bio Bubble process.

A Bio Bubble installation on Guernsey would achieve an effluent quality which would be far better, in terms of organic parameters such as BOD and COD, than the UWWTD BOD and COD standards currently under consideration and could also be expected to produce much less sludge than a conventional plant designed to comply only with the UWWTD standards. The actual amount of sludge produced would depend on the amount of inert material in the influent sewage. However, the Bio Bubble process will not achieve the microbiological standards under consideration without the addition of a disinfection stage such as a UV system.

Several Bio Bubble plants have been installed by Anglian Water, usually to serve small populations. There is a Bio Bubble plant at Portglenone in Northern Ireland which serves a population of about 3,500.

3. SLUDGE TREATMENT PROCESSES

3.1 Introduction

An option for the ultimate disposal of the sludge produced in wastewater treatment is recycling to agricultural land and this option was considered for Guernsey in Report UC 6783. The Regulations and guidelines for agricultural recycling of sludge in the UK continue to become more stringent and now reflect concerns about the pathogen content of treated sludge which might come into contact with food crops. Conventional anaerobic digestion alone is no longer suitable for treating sludges destined for recycling to many types of agriculture.

Sewage contains variable numbers of pathogens which are capable of causing those infectious diseases which are spread by polluted water. The pathogen content of sewage will reflect the state of health of the population drained by the sewage system and the numbers of pathogens excreted by people who are suffering enteric infections.

Many pathogens are removed during sewage treatment by adsorption to biological sludge during aerobic secondary treatment and many more are destroyed by microbial predation. However, sludge will contain residual pathogens, including bacteria, viruses and the eggs and cysts of parasites. It is an important feature of effective sludge treatment processes that they provide a significant reduction in the numbers of pathogens.

This disinfecting property of the sludge treatment sequence must be matched with an appropriate route for utilising sludge in agriculture to minimise, as far as possible, any hazards to the health of man, farm animals and crops. Such policies result from an assessment of the risks to health for the various agricultural uses of the land and usually take the form of restrictions on the use of the land or harvesting for periods after application of the sludge. Residual pathogens can then decay further and potential cycles of infection can be broken.

Advanced sludge treatment processes have been developed to maintain the security of the agricultural recycling route. These new processes are installed at a number of sites in the UK where traditional treatment sequences cannot be guaranteed to produce sludges of the standard required for use with certain types of crop.

3.2 Sludge Treatment Standards for Recycling to Agriculture

In September 1998, an agreement was reached in the UK between the British Retail Consortium, representing the major food and drink retailers and Water UK, representing the 14 UK Water and Sewage Operators for all applications of sewage sludge to agricultural land. The resulting document included inputs from the Environment Agency and the Department for Environment Food and Rural Affairs (DEFRA). The restrictions on sludge applications to various crops are summarised in what has become known as the 'Safe Sludge Matrix'.

The safe sludge matrix is shown in Table 3.1. It defines two different types of sludge product, as follows:

- Conventionally treated sludge – Treatment must ensure that 99% (a 2 log reduction) of the indicator pathogen (*E. coli*) has been destroyed, with a maximum allowable concentration (MAC) of *E. coli* of 10^5 per gram of total dry solids remaining in the sludge.

- Enhanced treated sludge – Treatment must ensure that 99.9999% (a 6 log reduction) of the *E. coli* has been destroyed with a MAC of *E. coli* of 10^3 per gram of total dry solids remaining in the sludge. *Salmonella spp.* must be absent.

CROP GROUP	UNTREATED SLUDGES	TREATED SLUDGES	ENHANCED TREATED SLUDGES
FRUIT	✘	✘	✔ (10 month harvest interval applies)
SALADS	✘	✘ (30 month harvest interval applies)	✔ (10 month harvest interval applies)
VEGETABLES	✘	✘ (12 month harvest interval applies)	✔ (10 month harvest interval applies)
HORTICULTURE	✘	✘	✔ (10 month harvest interval applies)
COMBINABLE AND ANIMAL FEED CROPS	✘	✔	✔
GRASS - GRAZING	✘	✘ (Deep injected or ploughed down only) (3 week no grazing and harvest interval applies)	✔ (3 week no grazing and harvest interval applies)
GRASS - SILAGE	✘	✔ (3 week no grazing and harvest interval applies)	✔ (3 week no grazing and harvest interval applies)
MAIZE - SILAGE	✘	✔ (3 week no grazing and harvest interval applies)	✔ (3 week no grazing and harvest interval applies)

NOTE: ✔ *All applications must comply with the Sludge (Use in Agriculture) Regulations 1989 and DoE Code of Practice 1996*
✘ *Applications not allowed (except where stated conditions apply)*

Table 3.1 Safe Sludge Matrix for Agricultural Recycling

The term 'combinable' in the matrix refers to those crops which are harvested by a combine harvester. These crops include wheat, barley, oats, field beans and oilseed rape. Full details of cropping categories and the latest version of the matrix can be obtained at www.adas.co.uk/matrix.

The introduction of the safe sludge matrix resulted in a need to identify sludge treatment process which could achieve compliance with the sludge treatment pathogen limits given previously. The pathogen standard for conventionally treated sludge can be met by a properly designed and operated anaerobic digestion process but the matrix shows that this type of sludge is not considered safe for many types of land application. The pathogen standard for enhanced treated sludges, as defined by the matrix, cannot be met reliably by conventional anaerobic digestion processes alone, but can be achieved by a combination of anaerobic digestion and an upstream process which raises the temperature of the sludge to a level which results in pasteurisation. Pathogen removal has been found to be a function of temperature and sludge retention time at that temperature. Temperature-retention time combinations have been established as follows:

- Sludge pasteurisation - minimum of 30 minutes at 70°C, or minimum of 4 hours at 55° C (or appropriate intermediate conditions), followed in all cases by primary mesophilic anaerobic digestion as defined below. (This sequence of sludge treatment can achieve enhanced treated sludge standards).

- Mesophilic anaerobic digestion - mean retention period of at least 12 days primary digestion in temperature range 35°C +/- 3°C, or mean retention period of at least 20 days primary digestion in temperature range 25°C +/- 3°C, followed in each case by a secondary stage which provides a mean retention period of at least 14 days. (This process can achieve the treated sludge standard of the matrix).

Sludge pasteurisation has therefore become reasonably well-established in the UK as an additional treatment process which secures the agricultural recycling route.

3.3 Sludge Pasteurisation Processes

Pasteurisation involves raising the temperature of the sludge to 60-80°C in order to inactivate or destroy pathogenic micro-organisms. Typically, the sludge is maintained at 70°C for at least 30 minutes to comply with the safe sludge matrix standards for enhanced treatment. A number of methods are available for heating the sludge:

- Heat exchangers - Usually the sludge is heated in a heat exchanger by hot water produced in a dual-fuel boiler which can be fired using digester gas or an imported fuel. In some processes, heat from the out-going sludge is partially recovered by heating the incoming sludge using a sludge/sludge heat exchanger.

- Steam injection - Steam, usually at about 0.5 bar, is injected directly into a tank of sludge. It may be necessary to provide a degree of mixing in order to ensure that all the sludge reaches the required temperature. This method is not energy-efficient, as only 65% of the energy used to generate the steam is transferred to the sludge. A considerable dilution of the sludge occurs since large volumes of steam are required to heat the sludge to the required temperature. No steam is recovered during the process and all the water used in the steam generating boilers must be softened to prevent scale formation.

- Submerged combustion – This technique utilises the high temperature of the exhaust gases from combustion of digester gas to directly heat the sludge. There are two basic variants. The first involves the introduction of the combustion gases into the sludge from the combustion area. In the second form, the combustion actually takes place under the sludge surface (true submerged combustion). Approximately, 80% of the energy released during combustion is transferred to the sludge. However, submerged combustion has not proved to be reliable at pilot-scale and it has not been taken up on full-scale plant.

Heat exchangers are the most widely used method of heating sludge for pasteurisation. There are several proprietary pasteurisation processes but they all conform to one of the following two variants:

- Batch process - pasteurisation takes place in two or more batch tanks which operate in sequence, e.g. the BioTherm process.
- Continuous process - pasteurisation takes place a plug-flow tank, (plug-flow means that all the sludge remains in the tank for the same retention time. This ensures pasteurisation), e.g. the PURiser process.

The general flow scheme for batch sludge pasteurisation using heat exchangers is shown in Figure 3.1.

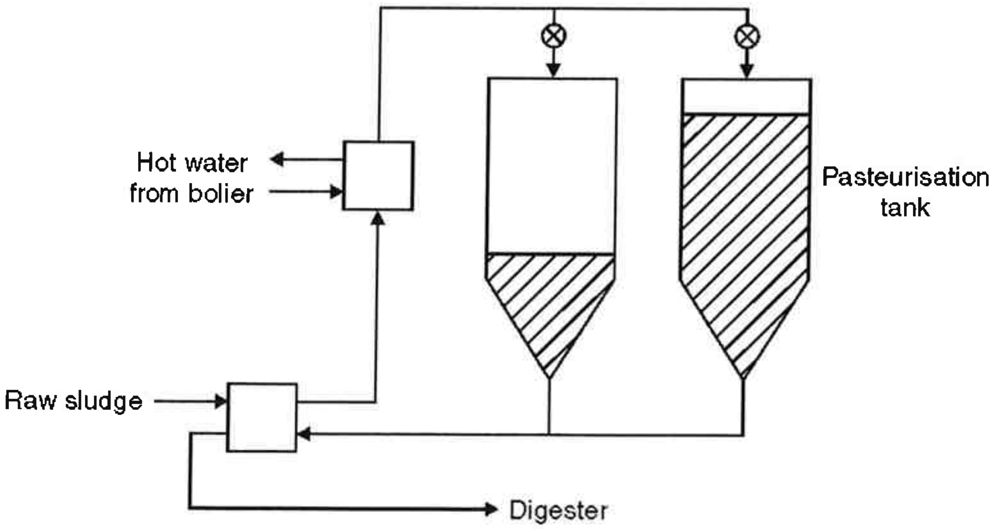

Figure 3.1 Schematic of Batch Sludge Pasteurisation Process

Pasteurisation tanks must be designed so that the pasteurised sludge does not come into contact with the untreated sludge and become re-contaminated. The energy efficiency of these processes varies considerably depending on the amount of heat recovery that is achieved but, in general, the operating costs of sludge pasteurisation processes are high.

Several pasteurisation units have been constructed at large UK sludge treatment sites. Examples include the BioTherm plants at Reading, (Thames Water - population 285,000), Mogden (Thames Water) and Ellesmere Port (United Utilities - 7000 tDS/year) and the PURiser plant at Lowestoft, (Anglian Water - 9000 tDS/year).

4. SELECTION OF TREATMENT PROCESSES FOR GUERNSEY

4.1 Introduction

This section follows the structure of section 5 in Report 6783. The wastewater treatment processes discussed in Report UC 6783 were combined into treatment sequences that are capable of producing effluent of the required quality for discharge to coastal waters from a single site on Guernsey. These treatment sequences are reproduced as options 1 to 6 below. The wastewater treatment processes described in this report have also been combined into suitable treatment sequences and these are listed below as options 7 to 11.

1. Primary sedimentation plus activated sludge plus UV disinfection.
2. Primary sedimentation plus biological filtration plus UV disinfection.
3. Oxidation ditch plus UV disinfection.
4. SBR process plus UV disinfection.
5. Lamella separator plus BAF process plus UV disinfection.
6. MBR process.
7. Deep shaft plus UV disinfection.
8. Bio-Bubble SBR plus UV disinfection.
9. Lamella separator plus MBBR plus DAF plus UV disinfection.
10. Helical lamella separator plus BAF process plus UV disinfection.
11. Helical lamella separator plus MBBR plus DAF plus UV disinfection.

Notes

- Options 3, 4, 6, 7 and 8 do not require primary sedimentation.
- Option 6 (MBR) is the only option that does not require a separate disinfection process.

Similarly, a sludge treatment sequence which includes pasteurisation has been added to the two options which were discussed in Report UC 6783:

1. Incineration - Gravity thickening, (if primary sludge is present), mechanical thickening of secondary sludge, mechanical dewatering of mixed sludges.
2. Recycling - Gravity thickening, (if primary sludge is present), mechanical thickening of secondary sludge, anaerobic digestion of mixed sludges, mechanical dewatering of digested sludge. (Conforms to conventional treatment as defined in the safe sludge matrix).

3. Recycling - Gravity thickening, (if primary sludge is present), mechanical thickening of secondary sludge, sludge pasteurisation, anaerobic digestion of mixed sludges, mechanical dewatering of digested sludge. (Conforms to enhanced treatment as defined in the safe sludge matrix).

4.2 Area Requirements

Following the procedure described in Report UC 6783, the plan areas given in this section are the net areas or 'footprints' of the individual processes and the arithmetic total of these footprints. The actual area required for construction will depend on site details such as ground conditions, hydraulic considerations and the shape and number of the process tanks. In general, the total area required for construction will be greater than the sum total areas of the individual processes by a factor of between 50% and 100%.

Wastewater Treatment

The net plan areas of the individual processes in the wastewater treatment options are summarised in Table 4.1. The areas of storm tanks, preliminary treatment processes, UV disinfection, odour control and sludge treatment processes are not included. Details of the area calculations are provided in the Appendix.

Sludge Treatment

The net area required for sludge pasteurisation is very small (see Appendix) and represents an insignificant increase over the area required for sludge treatment option 2. Hence, as in Report UC 6783, the net area required for the sludge treatment processes, for all disposal options, has been taken as 500 m^2. The total net areas for each process option, including preliminary treatment, stormwater treatment, sludge treatment. UV disinfection and odour control plant, are given in Table 4.2.

	Net Process Area Required (m^2)											
	Prim. Sed.	Lamella	Helical lamella	MBBR plus DAF	BAF	Deep shaft	SBR	MBR	Biol. Filt.	Aeration Tanks	Final Tanks	Total
Option 1	1500	-			-		-	-	-	780	1500	3780
Option 2	1500	-			-		-	-	1500	-	1500	4500
Option 3	-	-			-		-	-	-	1560	1500	3060
Option 4	-	-			-		2080	-	-	-	-	2080
Option 5	-	225			275		-	-	-	-	-	500
Option 6	-	-			-		-	400	-	-	-	400
Option 7						170					1500	1670
Option 8							5210					5210
Option 9		225		385								610
Option 10			75		275							350
Option 11			75	385								460

Table 4.1 **Surface Areas of Wastewater Treatment Process Options**

Table 4.2 Total Net Areas for each Wastewater Treatment Process Option

	Net Area Required (m^2)						
	Option	Preliminary	Stormwater	UV	Odour	Sludge	Total
Option 1	3780	200	1500	50	100	500	6130
Option 2	4500	200	1500	50	100	500	6850
Option 3	3060	200	1500	50	100	500	5410
Option 4	2080	200	1500	50	100	500	4430
Option 5	500	200	1500	50	100	500	2850
Option 6	400	200	1500	-	100	500	2700
Option 7	1670	200	1500	50	100	500	4020
Option 8	5210	200	1500	50	100	500	7560
Option 9	610	200	1500	50	100	500	2960
Option 10	350	200	1500	50	100	500	2700
Option 11	460	200	1500	50	100	500	2810
Inclusions (from Report UC 6783): Preliminary treatment - Screening and grit removal equipment housed in building Stormwater Treatment - Conventionally designed tanks. UV disinfection - Lamps housed in channels. Odour treatment plant. Sludge treatment.							

Table 4.2 shows that:

- Option 8 (Bio Bubble SBR) has the largest net area. This large area is a direct result of the long retention time employed in this process, which also results in an effluent quality which is much better than the UWWTD BOD and COD standards currently under consideration.

- Options 5, 6, 9, 10 and 11(lamella + BAF, MBR, lamella + MBBR + DAF, helical lamella + BAF, helical lamella + MBBR + DAF) have the lowest net areas. These areas can be considered to be identical within the accuracy of the available data.

- The net area required for conventional stormwater treatment is significant.

4.3 Capital Costs

The capital costs of the wastewater treatment options have been estimated using cost functions held by WRc on behalf of most of the UK Water Service Companies. In addition, for proprietary plant, cost information has been obtained from the scientific publications and suppliers literature. The capital cost estimates of the wastewater treatment options are given in Table 4.3.and are subject to the qualifications given in Report UC 6783.

Table 4.3 Capital Costs of Wastewater Treatment Process Options

	Total Installed Cost (£'000)											
	Prim. Sed.	Lamella	Helical lamella	Kaldnes MBBR/DAF	BAF	Deep shaft	SBR	MB R	Biol. Filt.	Aeration Tanks	Final Tanks	Total
Option 1	3000	-			-		-	-	-	1590	2950	7,540
Option 2	3000	-			-		-	-	3070	-	3090	9,160
Option 3	-	-			-		-	-	-	2510	2950	5,460
Option 4	-	-			-		5580	-	-	-	-	5,580
Option 5	-	1970			4550		-	-	-	-	-	6,520
Option 6	-	-			-		-	6630	-	-	-	6,630
Option 7						7000						7,000
Option 8							11800					11,800
Option 9		1970		4500								6,470
Option 10			3000		4550							7,550
Option 11			3000	4500								7,500

Sludge Treatment

The capital costs of the sludge treatment processes for recycling enhanced treated sludge solids are the same as those for option 2 plus the costs of a pasteurisation process. Thus:

Gravity thickener – £240,000.

Building for mechanical thickener and dewatering plant – £780,000

Mechanical thickener - £440,000

Dewatering plant - £1,480,000

Pasteurisation - £250,000

Anaerobic digestion – £2,450,000

Total capital costs - £5,640,000

The total capital costs for each process option, including preliminary treatment, stormwater treatment, sludge treatment, UV disinfection and odour control plant, are given in Table 4.4. The 'Option' values are the total capital costs from Table 4.3. UV disinfection is not required for option 6.

Table 4.4 shows that:

- The capital cost of the pasteurisation process is small in comparison to the capital costs of the other processes in the sludge treatment option 3. The inclusion of sludge pasteurisation does not produce a significant difference in total costs when compared to the total costs which include sludge treatment option 2.
- Option 8 (Bio Bubble SBR) has the highest capital cost. Again this is a direct result of the long retention time employed in this process, which results in an effluent quality which is much better than the UWWTD BOD and COD standards currently under consideration but which does not meet the microbiological standards.
- Options 3 and 4 (Oxidation ditch and SBR) have the lowest capital costs. These costs can be considered to be identical within the accuracy of the available data.
- The capital costs of preliminary treatment, conventional stormwater treatment, odour control and sludge treatment are significant fractions of the total cost of each option.

Table 4.4 Total Capital Costs for each Wastewater Treatment Option

	Total Installed Cost (£'000)										
	Option	Prelim.	Storm.	UV	Odour	Sludge			Total		
Option 1	7540	2960	2140	650	3000	3020	5390	5640	19310	21680	21930
Option 2	9160	2960	2140	650	3000	3020	5390	5640	20930	23300	23550
Option 3	5460	2960	2140	650	3000	3020	*	*	17230	*	*
Option 4	5580	2960	2140	650	3000	3020	*	*	17350	*	*
Option 5	6520	2960	2140	650	3000	3020	5390	5640	18290	20660	20870
Option 6	6630	2960	2140	-	3000	3020	*	*	17750	*	*
Option 7	7000	2960	2140	650	3000	3020	*	*	18770	*	*
Option 8	11800	2960	2140	650	3000	3020	*	*	23570	*	*
Option 9	6470	2960	2140	650	3000	3020	5390	5640	18240	20610	20860
Option 10	7550	2960	2140	650	3000	3020	5390	5640	19320	21690	21940
Option 11	7500	2960	2140	650	3000	3020	5390	5640	19270	21640	21890

Sludge and Total costs by column: first - incineration, second - recycling treated sludge and third - recycling enhanced treated sludge.

* These treatment options produce only secondary sludge. It is likely that such sludges would not be amenable to anaerobic digestion and would not, therefore, be suitable for agricultural recycling as defined by the safe sludge matrix. Thus, no estimates of sludge treatment costs have been made for the agricultural recycling route. See also section 4.4.4.

4.4 Effects of Sludge Production and Sludge Characteristics on Sludge Treatment Costs

4.4.1 Introduction

All wastewater treatment processes produce sludge which must be further treated before disposal. Sludge treatment and disposal costs are a significant fraction of the overall costs of wastewater treatment and they are an important factor in process selection. The amount of sludge produced during treatment depends on the type of process that is installed and the conditions under which it is operated. However, it is an over-simplification to assume that the process which produces the lowest amount of sludge will automatically lead to the lowest sludge treatment and disposal costs. The costs of sludge treatment also depend on sludge characteristics, such as the ease with which it can be dewatered and its amenability to anaerobic digestion. These sludge characteristics, in turn, also depend on the type of process and its design and operating conditions. It is, therefore, a difficult and complex procedure to arrive at a wastewater treatment sequence which will result in minimum sludge treatment and disposal costs, while at the same time satisfying effluent quality requirements and other constraints, such as availability of land area for construction.

There are also many practical difficulties inherent in the measurement of sludge production at operational sewage treatment sites. These difficulties, in conjunction with various different definitions of sludge production, have resulted in a wide range of values being reported in the technical literature. It is particularly difficult to obtain accurate values of sludge production from individual biological treatment processes. Selecting reasonable values of sludge production to use in process design is a procedure that requires a high level of experience.

The assumptions of sludge production used to derive some of the costs and areas given in previous sections of this report and in Report UC 6783 were reasonable for these purposes but they did not take into account many of the factors which would need to be considered in a more detailed assessment.

4.4.2 Quantities of Sludge Produced by Wastewater Treatment Options

The amount of sludge produced by a given sequence of wastewater treatment processes will ultimately depend to large extent on the amount of polluting material in the influent wastewater. This consists of both dissolved and suspended solids and each of these fractions can be further sub-divided into fractions of biodegradability, ranging from very biodegradable to completely inert. During treatment, some of the dissolved solid fraction will be converted into sludge by biological activity, as will some of the suspended solids fraction. Inert suspended solids will appear unchanged in one or more of the sludge streams leaving the treatment processes and inert dissolved material will pass unchanged into the final effluent. Detailed information on the characteristics of the solids in wastewater is rarely available and predictions of sludge production from various processes are often made by reference to typical values of polluting material in influent wastewater expressed on a per capita basis. Commonly used values are 60 g BOD/day per capita and 65 g suspended solids/day per capita. The conversion of BOD into sludge, and other biological transformations which occur during treatment, often result in more sludge being produced per capita than was originally present in the wastewater as suspended solids.

For a typical wastewater as defined above it is possible to make the following statements about sludge production from treatment sequences which are designed to meet the effluent quality requirements of the UWWTD:

- Primary sedimentation processes produce about 50 g/d of sludge per capita. This rate is reduced if the wastewater is dilute and, in such cases, more sludge will be produced by downstream processes. Properly designed conventional primary tanks, lamella separators and helical lamella separators should produce similar amounts of sludge.

- Conventional activated sludge installed after primary sedimentation processes produces about 30 g/d of sludge per capita. If no primary sedimentation is installed then the rate of production increases but should be less than the sum of primary treatment and conventional activated sludge – say 60 g/d per capita. The Deep Shaft, oxidation ditch and SBR activated sludge process variants are normally designed to treat unsettled sewage and should produce similar amounts of sludge. (See also section 4.4.3).

- Biological filters produce, on average, about half the sludge produced by the equivalent activated sludge process. More sludge is produced in the spring when biomass is shed from the filtration medium. The MBBR process should produce a similar amount of sludge to a conventional biological filter. BAF plants are intermediate, in terms of sludge production, between biological filters and activated sludge plants, but few data have been published. It is probably safer to assume the same sludge production as the equivalent activated sludge plant.

4.4.3 Effect of Design and Operating Conditions

Biological treatment processes can be designed to produce effluent of various qualities. In general, effluent quality can be improved in activated sludge processes by increasing the retention time and in biological filters by reducing the loading rate. In activated sludge processes in particular, the design can have a significant effect on the rate of sludge production. Thus:

- Long retention time activated sludge processes are lightly loaded in terms of influent BOD per unit of tank volume. The sludge micro-organisms have time to use all of the available BOD for food and so produce a high effluent quality. In doing this, many of the micro-organisms enter a 'starvation' phase and begin to use cell material as a food source. Thus, the rate of surplus sludge production in activated sludge processes is reduced as the retention time increases.

- Many process variants include additional features designed to minimise sludge production. These features generally involve subjecting the micro-organisms to conditions which induce them to produce carbon dioxide and water as metabolic products rather than new cell material (sludge).

The Deep Shaft process operates at a short retention time and is a high-rate process but it has been claimed that the hydrostatic pressure and dissolved oxygen cycles caused by liquid circulation in the shaft result in reduced sludge production. However, there is little operational evidence to substantiate such claims and it is probably safest to assume a sludge production equivalent to a conventional activated sludge process.

The Bio Bubble SBR is designed with a long retention time and operates in a regime of very low BOD loading per unit tank volume. The 'feast famine' regime which results from the rapid fill period will also promote a lengthy period during which the sludge micro-organisms will use cell material as food. There are few independently obtained and accurate data on sludge production from Bio Bubble plants but the available information confirms that the rate of production is much less than that in a conventional activated sludge plant or SBR. The Bio Bubble tank contents are aerated during the long retention period and reduced sludge production is countered to some extent by higher than average energy costs for aeration.

4.4.4 Effect of Sludge Characteristics

Some compact treatment schemes, designed for installation at sites where space is restricted, do not include primary treatment processes. The sludge produced in such installations will have characteristics which are similar to a typical secondary sludge. Secondary sludges alone are more difficult to dewater than mixtures of primary and secondary sludge. In addition, anaerobic digestion is normally used for mixtures of primary and secondary sludge. Secondary sludges alone are not very amenable to separate anaerobic digestion and gas production can be drastically reduced. There are no installations in the UK where conventional anaerobic digestion is used only for secondary sludges. The sites where crude sewage is treated are often small and the sludge produced is taken for treatment to larger sites. At larger sites where crude sewage is treated, the sludge produced is mixed with imported sludges before treatment.

Attempts to digest secondary sludge could cause difficulties in maintaining the digester temperature at a level which ensured compliance with the conditions required for the production of treated, or enhanced treated, sludges as defined by the safe sludge matrix. If effective anaerobic digestion cannot be included in the sludge treatment sequence then the agricultural recycling route is unavailable.

The gas produced by anaerobic digestion reduces the calorific value of the sludge and digested sludge cannot be incinerated without using a large amount of additional fuel. Adequately dewatered mixtures of primary and secondary sludges normally have a calorific value which allows incineration to proceed without the need for additional fuel. Secondary sludges produced by the treatment of crude sewage also have a much reduced calorific value in comparison to mixtures of primary and secondary sludge and the calorific value is reduced as the rate of treatment is reduced. Thus, secondary sludge alone, even assuming it can be adequately dewatered, is unlikely to be suitable for incineration without the use of additional fuel.

The oxidation ditch, SBR, MBR, deep shaft and Bio Bubble SBR options all treat crude sewage and the sludge produced by these processes might not be suitable for agricultural recycling. The sludge from these processes might require additional fuel for incineration but co-incineration with municipal waste, (which has been proposed for Guernsey), would probably be relatively unaffected by the presence of such sludges.

4.5 Stormwater Treatment

Report UC 6783 assumed that all the wastewater treatment processes would be designed to treat maximum influent flowrates of three times the dry weather flow. Flows in excess of 3 DWF being diverted to storm tanks of conventional design. This is the basic approach which has been adopted, with a few slight variations, at the vast majority of treatment sites in the UK.

Storm sewage is dilute in comparison to 'normal' sewage but the suspended solids concentration is typically high enough to prevent UV disinfection being effective. The marine discharge of untreated storm sewage therefore results in the risk that bacterial standards for the receiving water will be exceeded. There is obviously a balance between the cost of treating more than 3 DWF at a particular site, the cost and effectiveness of storm tanks of various capacities and the risk of failure of bacterial discharge standards. This is a complex, catchment and site-specific problem which can best be dealt with by a modelling exercise which predicts the impact of stormwater discharges by taking account of the details of the sewer system, storm tank capacity, marine dispersion and local rainfall data. .

In the UK, the results of such exercises have been used in discussions with the Environment Agency to establish the optimum requirements for stormwater treatment. An important consideration is the predicted frequency of stormwater spills into the receiving water. There are coastal sites in the UK where stormwater is allowed to be discharged after receiving no other treatment than screening and grit removal.

It is possible that the results of such a modelling exercise would show that the size of the storm tanks proposed for Guernsey could be reduced if additional capacity were built into the wastewater treatment processes.

It would be possible to design any of the treatment options being considered for Guernsey to treat flowrates higher than 3 DWF. The capital cost implications would be significant and during operation at normal flows the effluent quality would, by virtue of the extra treatment capacity available, be much better than that required by the UWWTD standards. The Bio Bubble SBR has aeration tank capacity in excess of that required to meet the UWWTD treatment standards and has storage capacity available in the upstream balancing tank. It is possible, therefore, that the Bio Bubble SBR could treat about 6 DWF because its standard design features allow it to do so. Some idea of the cost of including this extra treatment capacity can be gained by comparing the capital cost estimates of the Bio Bubble process with the other treatment options, (Table 4.3).

4.6 Effluent Quality

4.6.1 Introduction

All wastewater treatment plants are designed to produce a final effluent of a specified quality. The quality parameters are usually BOD, COD, suspended solids and ammonia but may also include total nitrogen, phosphorus and a wide range of individually specified substances. Compliance with effluent quality standards is measured in the UK by comparison of measured values with 95%-ile values. Samples for compliance testing are taken at a specified annual frequency which increases with plant size.

The wastewater treatment options under consideration for Guernsey have been selected and compared on their ability to produce an effluent which complies with the standards derived from the EU Urban Wastewater Treatment Directive (UWWTD). The relevant quality parameters, as imposed by UK Regulations, are 25 mg/l BOD and 125 mg/l COD, both expressed as 95%-ile values. Effluent standards are usually set according to the calculated environmental impact of a discharge on receiving waters and the UWWTD standards for marine discharge are not particularly difficult to meet.

Bacterial standards are imposed for discharges into bathing waters and discharges in the vicinity of shellfisheries. These standards require the installation of processes which can achieve disinfection. MBR processes are the only treatment systems which can achieve effluent disinfection without the use of an additional stage employing UV radiation. In the UK, compliance with bacterial standards is only required for certain marine discharges. UV radiation is not effective unless used in effluent that has already been treated to a reasonable standard and effluent which complies with the UWWTD standards is adequate for UV disinfection. Failure of bacterial standards is usually caused by discharges of untreated stormwater.

In the UK nearly all large inland treatment plants must comply with suspended solids and ammonia nitrogen standards in addition to those imposed for BOD and COD. Those plants which discharge into receiving waters which are classified as 'sensitive' by the Environment Agency may also have to meet effluent concentration limits on total nitrogen and phosphorus. At the present time in the UK there are no effluent discharges into marine waters which have to comply with standards appropriate for sensitive receiving waters.

There is no economic method of removing nitrogen from wastewaters other than by biological means. This is achieved by arranging the process so that ammonia is oxidised to nitrate (nitrification) and nitrate is reduced to nitrogen gas (denitrification). The vast majority of plants designed for nitrogen removal are variants of the activated sludge process.

Nitrogen removal is often stipulated along with phosphorus removal and processes which achieve both have become known as nutrient removal plants. Phosphorus can be removed biologically and several activated sludge variants for biological nutrient removal (BNR) have been proposed. The common features are process modifications which allow nitrification and denitrification to proceed to virtual completion and which ensure that nitrate is excluded from the regions where phosphorus removal activity is taking place. Successful biological phosphorus removal therefore depends on effective nitrification and denitrification. Activated sludge process variants which can achieve both nitrification and denitrification are described in the following sections.

4.6.2 Nitrification, Denitrification and Phosphorus Removal

Nitrification is the biological process which converts nitrogen in the form of ammonia into nitrogen in the form of nitrate. The process is performed by naturally occurring bacterial species which can be encouraged to develop in treatment systems of the correct design. Nitrifying micro-organisms are normally present in domestic sewage as a result of groundwater infiltration into sewer systems. Hence, sewage treatment processes receive a continuous inoculation of nitrifiers in the influent wastewater and their presence can be exploited to remove ammonia before effluent discharge. However, the concentration of nitrifiers in sewage is too small to result in any substantial degree of nitrification and it is necessary to modify the design and operating conditions of biological treatment processes so that an adequate population can be maintained.

The bacterial species involved are fastidious in their requirements and much less robust than the species which remove the organic material in wastewater which is measured as BOD. Nitrifying bacteria are very sensitive to the toxicity of many industrial effluents and also to shortages of oxygen and high salinity levels. Nitrification proceeds slowly at the low wastewater temperatures which occur under typical winter conditions but is more rapid at higher temperatures.

Activated sludge plants can be designed and operated so that the nitrifiers can exist in sufficient numbers in the aeration tank along with the other micro-organisms which remove BOD. This is achieved by ensuring that the average sewage retention time in the activated sludge system is high enough to allow the nitrifiers to reproduce. In other words the rate at which the nitrifiers are removed in the surplus sludge must be less than the rate at which the nitrifiers can grow while in the aeration tank.

Biological filters are known to be capable of achieving nitrification if operated at appropriate loading rates and there is a long history of their use for this purpose in the UK. However, the construction of a nitrifying biological filtration process on a 'greenfield' site would be very expensive in comparison to the equivalent activated sludge process. Nitrifying filters have typically been installed as tertiary treatment processes following existing activated sludge plants or biological filters which were originally installed to achieve BOD removal only. The influent to a nitrifying filter would normally contain less than 30 mg/l of BOD.

A typical influent wastewater contains about 30 mg/l of ammonia nitrogen and most activated sludge variants can be modified to achieve effluent ammonia concentrations of 5 mg/l (95%-ile). The standard or default designs of the MBR and the Bio Bubble SBR should achieve this standard without modification. The deep shaft process does not appear to have been installed in the UK to produce a nitrified effluent.

Denitrification is the biological conversion of nitrate to gaseous nitrogen. In instances where effluent quality requirements are particularly stringent, it might be necessary to limit not only the concentration of ammonia that is discharged, but also the levels of nitrate. Nitrate removal can be achieved biologically by the process of denitrification in suitably designed activated sludge plants and by the MBBR design illustrated in Figure 2.3. Nitrate removal is not a practical proposition in conventional fixed-film processes such as biological filters.

If the amount of dissolved oxygen available to micro-organisms in activated sludge aeration tanks is deliberately restricted then a wide range of bacterial species are able to adjust their metabolism and use oxygen contained within the nitrate ion. As a result, nitrogen is released to the atmosphere in the gaseous form. Denitrification is promoted in plants which have to meet a nitrate discharge standard by the use of so-called anoxic zones – an anoxic zone is a deliberately designed feature of an activated sludge process which promotes denitrification by contacting mixed liquor, containing nitrate, with influent wastewater in the absence of dissolved oxygen. The degree of nitrate reduction depends on the quantity of nitrate in the recycled sludge and the availability of a carbon source for micro-organism growth. Wastewater is the most economic source of carbon and hence anoxic zones are usually installed at the aeration tank inlet.

A typical anoxic zone design consists of a separate compartment at the inlet end of an aeration tank as shown in Figure 4.1. Wastewater and recycled sludge are mixed within the zone and the necessary carbon source for microbial growth is provided by the influent wastewater. Nitrate nitrogen enters the zone with the recycled sludge. The nominal hydraulic retention time in an anoxic zone should be about 45-60 minutes based on wastewater flow. During this period all of the nitrate in the recycled sludge stream should be reduced to nitrogen. A recycle ratio of 1.0 (with respect to average wastewater flow) should therefore reduce the total concentration of nitrate nitrogen discharged by about 50%.

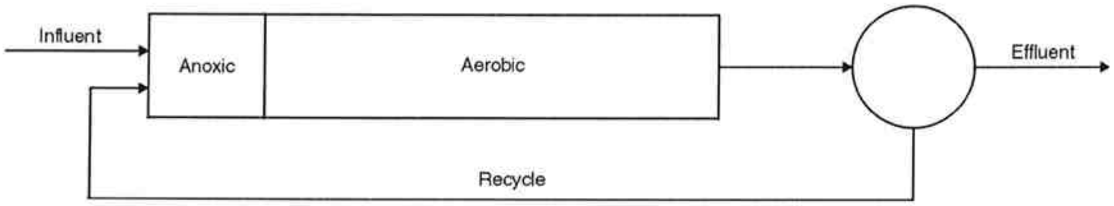

Figure 4.1 Nitrifying Activated Sludge Plant with Anoxic Zone

If the influent ammonia concentration is 30 mg/l and the recycle ratio is 1.0, (both typical values), then the theoretical effluent nitrogen concentration would be 15 mg/l. In practice, it is unlikely that actual performance would match this prediction because of variations in influent wastewater characteristics.

Total nitrogen standards have not yet been widely imposed in the UK but in a few instances the total nitrogen limit is less than that which can be achieved by the simple modification shown in Figure 4.1.

A higher degree of nitrification can be achieved by the process modification shown in Figure 4.2. Mixed liquor is recycled from the outlet of the aeration tank to the inlet without passing through the final tank. Typically, mixed liquor recycles are about 4 times the average wastewater flow. Recycled sludge flowrates are usually equal to average wastewater flow. If the influent ammonia concentration were 30 mg/l, the theoretical effluent nitrate-nitrogen concentration would be 5 mg/l. Plants designed as shown in Figure 4.2 can usually meet effluent nitrogen standards of 10 mg/l but there are few published performance data from UK plants.

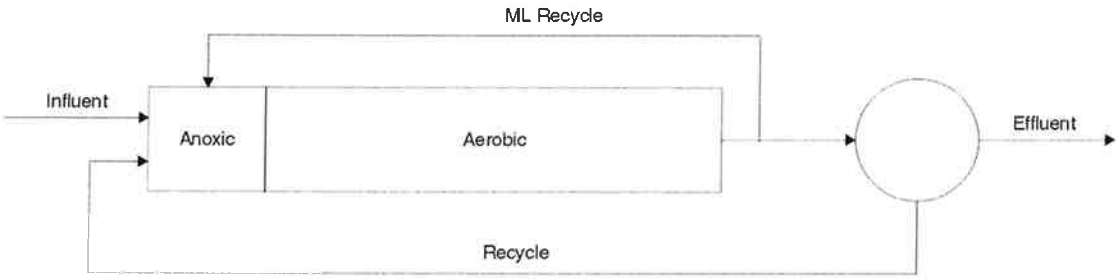

Figure 4.2 Activated Sludge Process with Mixed Liquor Recycle

Activated sludge configurations similar to that shown in Figure 4.2 can be further modified for biological phosphorus removal by the addition of an anaerobic zone and further anoxic zones. The latter are installed to ensure that no nitrate enters the anaerobic zone where it would inhibit the phosphorus removal mechanisms. Figure 4.3 shows a BNR process configuration. This arrangement is often referred to as the UCT process, after the University of Cape Town, where it was first developed.

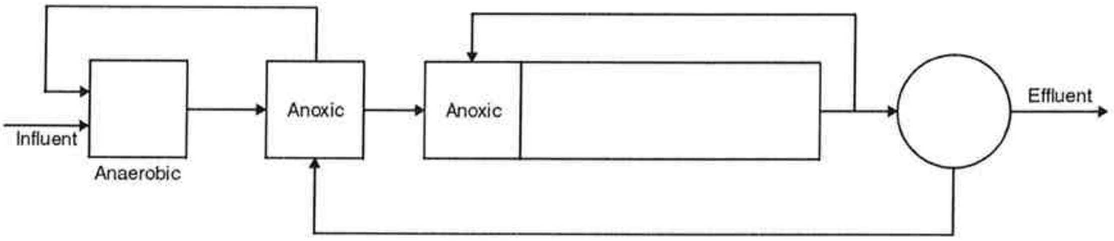

Figure 4.3 Activated Sludge Process Configured for BNR

The design and operating conditions of conventional activated sludge processes, oxidation ditches and SBRs can be modified to achieve ammonia, total nitrogen and phosphorus removal, although it is not usually practical to do this without substantial alterations to existing structures and, for ammonia removal, the installation of additional aeration tank capacity. The ease with which an SBR process can be modified to meet total nitrogen and phosphorus standards probably depends on basic design features. The proprietary variants of the SBR process which involve mixed liquor re-circulation, such as the CASS™ process, are known to be capable of meeting total nitrogen consents of less than 10 mg/l, but no SBRs have yet been installed for phosphorus removal in the UK. MBRs and deep shafts have not been used for total nitrogen and phosphorus removal in the UK and both would need modification to include anoxic and anaerobic zones.

Phosphorus discharge standards in the UK are either 2 or 1 mg/l, depending on the size of the plant. It has been found that most installations cannot reliably meet these standards by biological phosphorus removal alone and chemical addition in the form of ferric salts is used to ensure compliance.

4.6.3 Effect of Toxic Discharges

The biological processes used for wastewater treatment can be affected by the presence of toxic materials in the influent sewage. The effects of such materials range from mild inhibition of the rate of treatment to complete inactivation of the entire microbial population. Most of the materials which can cause toxicity problems are associated with the uncontrolled discharge of industrial effluents to sewer systems. All UK Water Utilities practise effective control of trade effluent discharges by the imposition of consents for flow and quality parameters which must not be exceeded. Charges are levied on traders based on the amount of effluent discharged to sewer. In some instances, traders must pre-treat effluents to comply with the discharge consent. The number of individual chemicals which can cause inhibition and which have been identified in sewage is extremely large and it is impractical to attempt to establish potential toxicity by detailed analysis. Standard, small-scale 'treatability tests' have been devised to determine the likely effect of a particular sewage on biological treatment and these are routinely used by the UK Water Industry. It has been established that:

- There are typical mixtures of domestic sewage and industrial effluents which are received by most treatment plants in the UK. If the list of trade discharges in the catchment does not include certain industries and the proportion of industrial effluent is low, then no inhibition of treatment should occur.

- Household cleaning products which contain bactericides are diluted in domestic sewage to an extent which will not have a toxic effect on treatment. In general, purely domestic sewage does not cause inhibition of biological processes.

- The effluents from many industries are not directly toxic but exert a high oxygen demand. Such industries would include brewing, food processing and services which involve mass catering. These types of effluent should not cause treatment problems if they are allowed for in plant design.

- The wastes from pharmaceutical manufacture (especially antibiotics), the oil, gas and chemical industries, textile and leather processing, (including dyeing), and metal working can cause inhibition to treatment processes if present in wastewater in sufficient quantity.

- Treatment plants which are designed to achieve BOD, SS and COD removal to the standards being considered for Guernsey are much less likely to suffer from inhibition than those designed to achieve nitrification. The micro-organisms which remove ammonia by nitrification are particularly sensitive to the presence of toxic materials. Nitrification can also be inhibited by non-toxic industrial discharges which reduce the available oxygen.

- Properly enforced trade effluent control is an effective means of preventing inhibition of nitrification. There are no design procedures available which can guarantee the performance of nitrifying processes in the presence of inhibitory substances.

It is likely that a survey of trade effluent discharges on Guernsey would reveal a variety of industries which are typical of those found in a catchment serving a population of 75,000. It is therefore unlikely that any of the treatment options under consideration would be adversely affected by toxicity unless there was anything unusual about the type of industries found on Guernsey. However, if effluent quality standards were imposed that included a requirement for nitrification then it is possible that there would be a risk of inhibition from certain industrial discharges. There is no reason to assume that any such risk could not be managed by the implementation of a trade effluent control strategy.

4.6.4 Endocrine Disrupting Chemicals

Endocrine disrupting chemicals (EDCs) is the name that has been given to a range of naturally occurring and synthetic substances which can interfere with the proper functioning of the endocrine (hormone) systems of living organisms. Many of these chemicals are present in sewage and there is concern about their possible effects on the reproductive systems of fish and other aquatic life in receiving waters into which treated wastewater is discharged.

At the present time there is much uncertainty about the effects of these chemicals and how they act in combination. There is also very little information about the extent to which they are removed in conventional sewage treatment processes. Research programmes funded by the UK Water Industry are now in progress. These aim to increase the available information on the fate and behaviour of these substances and make initial estimates of the costs of controlling their discharge from wastewater treatment plants.

The EDCs which have been identified in sewage can be classified into two main groups. EDCs in the first group are of human origin and those in the second group are associated with discharges from certain industries. The EDCs which derive from industrial sources are mainly the intermediate breakdown products which result from the biodegradation of components of specialised detergents, such as those used in textile manufacture. These substances are controllable at source and it is reasonable to assume that their use will be discontinued in the future. Current research is therefore aimed at detailed investigation of the removal of EDCs of human origin in sewage treatment.

The EDCs of human origin with the highest activity belong to a group of substances known as the steroid oestrogens. Four of these substances have been selected for detailed investigation – oestrone, 17β-oestradiol, oestriol and 17α-ethinyloestradiol, because it is likely that they will be the subject of future discharge regulation. It is not considered feasible to control these substances at source since they are either natural excretory products, or are derived from pharmaceutical products which have no effective substitute.

These four steroid oestrogens exhibit various degrees of biodegradability and endocrine disrupting activity. Oestriol is highly biodegradable and is the least potent while 17α-ethinyloestradiol is the least biodegradable and the most potent. The overall activity is also considered to be additive when the different steroid oestrogens are present in combination. Hence, an overall measure of total steroid oestrogen has been proposed which is weighted to take account of the relative activities of three of the substances named previously. Oestriol has not been included because of its low potency.

No definite limits for the permissible concentration limits of total steroid oestrogens in receiving waters have been proposed but the initial indications are a range between 0.1 and 1.0 ng/l, depending on the dilution available in the watercourse. These limits represent extremely small amounts of total steroids – 1.0 kg is 10^{12} ng (nanogram), and as an illustration, one grain of common salt dissolved in about 20,000 m^3 of water would exist at a concentration of about 0.1 ng/l. Highly specialised analytical techniques are required to measure such small concentrations accurately and the costs involved in analysis are a large proportion of the total costs of any research work.

The available information indicates that about 80% of the total steroid oestrogens in wastewater can be removed by conventional wastewater treatment. This information was mostly obtained from plants which produced fully-nitrified effluents, i.e. plants which complied with an ammonia standard in addition to BOD and SS standards. It is reasonable to assume that the degree of removal of the least biodegradable steroid oestrogens would be a function of the retention time in biological processes. Thus, it is likely that the removal in a plant designed to produce a conventional effluent of 20: 30 BOD: SS standard would be less than that achieved in a nitrifying process where the retention time would be greater. A proportion of the total steroid oestrogen load is known to be adsorbed onto sludge solids before it is biodegraded and there is evidence that some of this load is present in the liquors returned from sludge treatment processes. This suggests that the apparent removal achieved by wastewater treatment is partly due to adsorption and removal with the sludge streams. The information currently available does not allow this effect to be quantified.

If it is assumed that the range of total steroid oestrogen concentrations for receiving waters given previously will form the basis of future regulation, then the need for additional treatment at many existing plants will largely depend on the dilution available for the treated effluent. Current predictions indicate that no additional treatment, (beyond that achieved by a nitrifying process), would be required to meet a 0.1 ng/l receiving water limit if the dilution available was about 20:1. If the available dilution was only 1:1, then no additional treatment would be required only if the steroid oestrogen limit was 1.0 ng/l. (These predictions include a margin of safety which is not applied equally to the upper and lower limits).

Wastewater treatment plants with marine discharge of treated effluent are not included in any of the investigations of steroid oestrogen removal being carried out by the UK Water Industry and there is no indication that such discharges would be subjected to limits on steroid oestrogen concentrations in the future. The rapid and large dilution afforded by a properly designed sea outfall would probably, in any event, reduce the steroid oestrogen concentration below any limit currently under consideration, without the need for additional treatment beyond that required by the Urban Wastewater Treatment Regulations.

The existing long sea outfall on Guernsey is believed to have been designed to achieve an initial dilution of at least 50:1, a value which corresponds to best practice. Thus, if the States of Guernsey were to adopt a steroid oestrogen discharge standard based on those currently being considered, then it is likely that this standard would be met by any of the treatment options proposed for Guernsey, providing the effluent was discharged through the existing outfall.

The steroid oestrogen limits which may be imposed on the UK Water Industry in the future will be based on concerns about the effect of these substances on the reproductive systems of fish and aquatic life in receiving waters. There is no indication that limits are being considered in relation to any aspect of water use downstream of effluent discharges, including abstraction for potable supply.

5. CONCLUSIONS AND RECOMMENDATIONS

Many of the conclusions of the current report support or modify the conclusions reached in Report UC 6783. The conclusions given below are therefore a modified version of the conclusions given in Report UC 6783 with supplementary information as appropriate.

- The Water Quality Objectives approved by the States of Guernsey can be met by a number of options for wastewater treatment. Some of these options are based on the use of conventional process sequences while others rely on compact plant, which can be installed at sites where construction area is limited.
- A treatment process based on the Bio Bubble SBR would require the greatest land area. The Water Quality Objectives could be achieved by compact plant (lamella + BAF, MBR, lamella + MBBR + DAF, helical lamella + BAF, helical lamella + MBBR + DAF), which only occupy about 8-12% of the area required for the Bio Bubble process.
- The Bio Bubble SBR is the most expensive wastewater treatment option. The oxidation ditch and generic SBR variants of the activated sludge process have the lowest capital cost but have area requirements which are greater than MBR, BAF and MBBR processes.
- The Bio Bubble SBR appears to be available as a standard design which will produce an effluent quality that exceeds the Water Quality Objectives. This results in the high capital cost and high area requirements. The MBR process can also exceed this effluent quality at low capital cost and low area requirement.
- Preliminary treatment processes and stormwater treatment would be required as an addition to all options. The provision of stormwater treatment by conventionally designed settling tanks requires a large land area and could be a problem at a confined site. The cost of preliminary and stormwater treatment is a significant fraction of the total capital costs of wastewater treatment. It is possible that a modelling study of the impact of stormwater discharges would show that the capacity and cost of the storm tanks could be reduced without risk to receiving water quality. The standard Bio Bubble SBR is probably capable of treating 6 DWF without modification. All other treatment options have been assumed to treat 3 DWF.
- A disinfection process would be required as a final stage of treatment unless an MBR process option is selected. A system based on the use of UV irradiation would be cost-effective.
- Sludge disposal by incineration would appear to be a viable option. Disposal by recycling depends on the availability of a sustainable market for the sludge product. If the States of Guernsey were to adopt the standards contained in the UK 'Safe Sludge Matrix', then recycling to certain types of food crop would require enhanced sludge treatment, such as pasteurisation, in addition to anaerobic digestion.
- The capital cost of sludge treatment prior to disposal by incineration is considerably less than the cost of sludge treatment prior to recycling. This is because neither anaerobic digestion nor pasteurisation is required if the sludge is to be incinerated. The extra capital cost of sludge pasteurisation is not particularly significant in comparison to anaerobic digestion but operating costs are likely to be significantly higher.

- The sludge produced by treatment processes which do not include primary sedimentation might not be amenable to anaerobic digestion. If anaerobic digestion is not viable then the agricultural recycling route is unavailable.

- An effective system for odour control is likely to be necessary to minimise environmental impact. The capital cost of an appropriate system depends on the choice of wastewater and sludge treatment processes but could be significant.

- The estimated capital costs of the entire treatment process sequences are in the range £17.2 M to £26.2 M, depending on the selected options for wastewater and sludge treatment. These estimates are likely to be reasonably accurate predictions of relative cost differences but are unlikely to be reliable indicators of total project costs, since several factors which affect construction costs have not been taken into account.

- Many of the treatment processes considered can be re-designed to achieve higher standards of effluent quality. Capital costs would increase significantly. However, the MBR process and the Bio Bubble SBR are capable of achieving a much higher standard than is required by the Water quality objectives without modification.

- If the States of Guernsey were to adopt a steroid oestrogen discharge standard based on those currently being considered in the UK, then it is likely that this standard would be met by any of the treatment options proposed for Guernsey, providing the effluent was discharged through the existing outfall.

- The levels of salinity in the existing sewer system on Guernsey should be determined and any measures required to control salinity to acceptable levels should be implemented.

- An assessment of trade effluent discharges and their likely effect on wastewater treatment will be required if nitrification is to be considered as an enhancement to effluent quality.

- The environmental impact of stormwater discharges should be assessed by a detailed site-specific modelling study.

APPENDIX

DESIGN OF ADDITIONAL TREATMENT OPTIONS AND CALCULATION OF AREA REQUIREMENTS

Assumptions

It has been necessary, for the purposes of this report, to derive the values of some design variables for the new treatment options. The wastewater characteristics used as the basis for these process design calculations are the same as those given in the Appendix to Report UC 6783.

Outline Design of Additional Treatment Process Options

<u>Primary Treatment by Helical Lamella Separators</u>

The total plan area of a helical lamella separator can be conveniently estimated, in the same way as a lamella separator, in terms of the fraction of the equivalent area of conventional primary tanks. If the area required is assumed to be 5% of the area of conventional tanks, (1500 m^2), then:

Total area of lamella separators = 0.05 x 1500 m^2

= <u>75 m^2</u>

<u>Deep Shaft Process</u>

Deep Shaft Aeration Tank

As with a conventional activated sludge process, the aeration tank hydraulic retention time is an important variable for initial design. Deep Shaft processes normally treat crude (unsettled sewage) and a short retention times is adequate to provide the required degree of treatment. An HRT value of 1 h at average flow is appropriate. Thus:

HRT = V / 781 = <u>1.0 h</u>

Hence, V = 781 x 1

= <u>781 m^3</u>

If the deep shaft aeration tank is 50 m deep and the diameter of the shaft is 4.5 m, then the surface area is <u>15.6 m^2</u>.

Degassing tank

A tank aerated by coarse bubbles with a retention time of 1 hour at dry weather flow is required to degas the mixed liquor flowing from the deep shaft aeration tank:

HRT = V / 781 = <u>1.0 h</u>

Hence, V = 781 x 1

= 781 m^3

If the degassing tank is 5 m deep then the surface area of this tank is 156 m^2.

Thus the total net area of the deep shaft aeration tank and degassing tank is approximately 170 m^2.

Final settling tanks

Identical to those for the conventional activated sludge plant in Report UC 6783

Total surface area = 1500 m^2.

MBBR

MBBR tanks

The MBBR tank hydraulic retention time (HRT) at average flow is the appropriate design variable. An HRT of 1h at average flow is suitable for production of effluent of the required quality from a settled sewage influent. Thus;

HRT = V / 781 = 1.0 h

Hence, V = 781 x 1

= 781 m^3

If the MBBR is 4 m deep then the surface area is 195 m^2.

DAF clarification

The upward flow velocity is the important design variable for DAF tanks and the calculation is identical to that for primary sedimentation tanks in Report UC6783. An upward flow velocity of 10 m/h at 3 DWF is a reasonable value for a DAF process. Thus:

Upward flow velocity = 1875 / A (m/h)

= 10 m/h

Therefore, total surface area, A = 1875 / 10

= 187.5 m^2 (say 190 m^2).

This area corresponds to 3 rectangular tanks, each with a plan area of about 63 m^2.

Bio Bubble (SBR)

The typical nominal retention time Bio Bubble processes appears to be about 50 h at dry weather flow. Thus:

Nominal retention time = Total volume (V) / DWF

= V / 625 (h)

= 50 h

Thus, V = 50 x 625

= 31,250 m^3

SBR tanks are usually 6 to 7 m deep. If it is assumed that the tank depth is 6 m, then:

Surface area of Bio Bubble system = 31,250 / 6 m^2

= 5210 m^2

No separate final settling tanks are required.

Sludge Treatment Processes

The sequence of processes for sludge pasteurisation is identical to that of sludge treatment option 2 in Report UC 6783 with the inclusion of a pasteurisation process immediately upstream of the anaerobic digester. Thus:

Recycling pasteurised sludge – Gravity thickening, (if primary sludge is present), mechanical thickening of secondary sludge, pasteurisation, anaerobic digestion of mixed sludges, mechanical dewatering of digested sludge.

The following assumptions have been made:

Pasteurisation – mixed primary and SAS feed of 95 m^3/d at 63 kg/m^3, digested sludge production of 95 m^3/d at 45 kg/m^3.

- Retention time assumed to be 1 hour based on 95 m^3/d. Pasteurisation tank volume is therefore 1 x 95 / 24 = 4 m^3.

- Two equal-sized pasteurisation tanks assumed, each 1.5 m in diameter and 2.5 m tall. The tank net area is 3.5 m^2.

In addition heat exchangers are required and the total net area of the pasteurisation plant is estimated to be about 10 m^2.

The net area required for the pasteurisation plant is only a small fraction of the total required for the entire sludge treatment sequence.

APPENDIX VIII

Responses to Consultation with Stakeholder Departments

ENVIRONMENT
A STATES OF GUERNSEY GOVERNMENT DEPARTMENT

Environment Department
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RECEIVED
16 AUG 2007

Our Ref: ED/WSA/LWD

Deputy W M Bell
Minister
Public Services Department
La Charroterie
St Peter Port
Guernsey
GY1 1FH

16th August 2007

Dear Deputy Bell

CONSULTATION ON DRAFT STATES REPORT ON SEWAGE AND WASTE WATER TREATMENT

Thank you for your letter of 11th July enclosing the consultation draft of the proposed Sewage and Waste Water Treatment report and to your further letter of 19th July enclosing an additional section and alternative resolutions. These matters were discussed by the Board at its meetings held on 24th July and 14th August.

Notwithstanding a number of minor comments on the proposed States report which are set out below, the Board's principal concern relates to the way forward. There is clearly a perception that a significant proportion of Guernsey's bathing waters, including West Coast bays, are affected by the sewage outfalls and that, therefore, to protect Guernsey's bathing water quality and to ensure compliance with the European directives, it is necessary to treat the sewage prior to discharge. In this respect, the Environment Department supports the proposal to establish hard facts on which subsequent decisions can be taken. The Department, therefore, supports a proposal which includes a Marine Environmental Impact Assessment and supports the proposal that such a Marine EIA includes, where possible, an analysis of the other essential contributors to sub-standard bathing water quality (paragraph 3.65). The Department's view is that such a Marine EIA is, in any case, a necessary part of a full EIA in respect of sewage treatment.

A company seeking to develop a particular site, for whatever purposes deemed desirable by that company can, of course, carry out an Environmental Impact Assessment of the development proposals on that site. Such a company would amend the specific development proposals in order to mitigate the impacts identified through the EIA. This, however, is very different to an Environmental Impact Assessment used to assist in the development of policy. In order to determine whether or not sewage treatment is the best practical environmental option (in accordance with the control of Environmental Pollution law), it is necessary for the full EIA to compare the proposed treatment against the alternative options, one of which is, of course, to continue existing practices. In order for such a comparison to be made and for the EIA to assist in policy development, it is necessary to understand the environmental impacts of the existing practice. As a consequence, the Marine EIA should be treated as the first stage of the full EIA.

Whilst the Environment Department supports the proposed EIA approach (with the Marine EIA constituting the first phase), the Department is concerned at the site selection approach adopted by the Public Services Department within the States report which appears to pre-empt and potentially stifle a proper full EIA approach.

Whilst proximity to existing headworks may well be a suitable filter to apply to site selection, a properly conducted EIA would assess this filter against other filters for example hydro-geology, topography, landscape, etc. Only by identifying the appropriate filters, evaluating them and applying them in the correct order will the EIA be able to eliminate unacceptable sites and identify preferred sites for further investigation in an environmentally robust way. As a consequence, whilst recognising that the Public Services Department has already identified some key factors which it would wish to take into consideration regarding site selection, the Department believes it is premature to identify and partially evaluate, within the States report, selected sites.

In light of the above, the Environment Department cannot accept the statement set out in paragraph 6.36. The Department can see no justification for arguing that if a Marine EIA is undertaken first, followed by a full EIA in the event that a treatment plant is required, the overall cost and duration of the EIA and pre-project planning would be substantially increased. As set out above, the Marine EIA is the first stage of a full EIA and the process should not be seen as two separate EIAs resulting in additional cost. It would be quite possible to stop the EIA after the first phase if the findings were such that the policy decision could be taken not to treat sewage and hence not to proceed to site identification and selection. In the Department's view, this is not only the most environmentally robust, but also the most efficient and cost-effective way to run the EIA.

In light of the above, the Department's preference would be for recommendation 1 in paragraph 13.1 to read "to direct the preparation of the first phase of a full Environmental Impact Assessment as set out in section 6.3 to section 6.32 of this report (Marine EIA at a budget cost of £600,000 to establish . . . etc." However, on this basis the Department would wish to delete the last sentence of paragraph 6.32 which the Department considers to be inaccurate.

In addition to the fundamental concern as set out above, the Department would also wish to make the following minor observations:

Paragraph 5.16 – This is not an accurate reflection of the States Resolution which was to support high recycling in conjunction with either mass burn incineration or advanced thermal treatment or mechanical biological treatment (including mechanical heat treatment) or any combination thereof with or without modular capacity.

Paragraph 5.18 – This paragraph reflects a trend which the Department has noted over recent months. The Public Services Department appears to believe that it now has the mandate for reviewing all practical options in respect of waste disposal and as a consequence, setting policy. I am advised, for example, that the Public Services Department is now reviewing the potential of export to Jersey. The split in our respective duties has been the subject of previous correspondence and is clearly set out in the relevant legislation. It is the function of the Environment Department to set policy and in order to do so, will evaluate practical options. It is the function of the Public Services Department to ensure delivery of the strategy adopted by the States following recommendation by the Environment Department. The Department would wish to see this paragraph amended to more accurately reflect our respective functions.

Paragraph 5.23 – Water quality is only part of the European Bathing Water Directive which, if adopted in its entirety, would have significant resource impacts for Guernsey. The Department has, at present, no intention of adopting the whole of the European Directive but is minded to adopt the water quality standards of the Directive when assessing local bathing waters.

Paragraph 6.60 "Recycling as fuel or soil conditioner" – It is generally accepted that use of a product as a fuel is not considered to be recycling but is rather considered to be energy recovery.

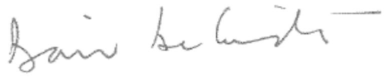
Paragraph 7.5 – It is not necessarily true to say that confirmation of the environmental quality objectives set out in this paragraph would require waste water disinfection. All environmental quality objectives and standards allow for a mixing zone around the pipe discharge (as correctly referred to elsewhere in the report) and it may be possible to define the size and position of the mixing zone such that compliance with the environmental quality objectives and standards can be met without the application of tertiary treatment.

Paragraph 13.1 (i) – Third Bullet Point – Establishing the impact of waste water treatment on the Island's carbon footprint should not feature as part of the marine EIA but rather should feature as part of the full EIA in which the environmental comparison between existing practices and proposed practices (once a preferred site has been identified) is carried out. As such, the third bullet point should also be deleted from paragraph 6.30 and moved across to 6.33 or 6.34.

In respect of section 12, the Department believes that the first box and alternative proposition (i) should clearly state that this would include the first phase of the full EIA namely the marine EIA. In addition, a similar amendment should be made in the second box to proposition (vii).

I should like to take this opportunity once again to thank you for consulting the Environment Department in respect of the proposed States report.

Yours sincerely



Deputy David De Lisle, PhD
Minister, Environment Department

HEALTH AND SOCIAL SERVICES
A STATES OF GUERNSEY GOVERNMENT DEPARTMENT

Our Ref: sk

15/8/07

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RECEIVED 2007

The Minister
Public Services Department
Sir Charles Frossard House
La Charroterie
St Peter Port
GY1 1FH

Dear Deputy Bell

Consultation on Draft States Report - Sewerage and Wastewater Treatment

Thank you for your letters of 11th and 19th July 2007, the appended draft States Report and the initial draft of Section 12 to that Report. The Health and Social Services Department appreciates the very through and comprehensive approach you have taken to researching this complex area.

The HSSD also agrees with your general conclusions:

i. The two short sea outfalls at Creux Mahie (10% of the island's sewage) and Fort George (70 houses) should be connected to the main sewage infrastructure, and the discharge to sea discontinued.

ii. The current programme to upgrade and maintain the present sewage network should be continued.

iii. Investment should be made in upgrading the Belle Greve waste water treatment facility.

iv. Efforts to prevent the contamination of surface water discharge to sea should be maintained or increased and steps to minimise storm water sewage overflows and the number of cesspits in use should continue.

Although the discharge of large amounts of untreated sewage into the Little Russell has an unknown impact on human health locally, the HSSD accepts that this is likely to be small. As a health authority, however, the HSSD believes that such risks should be minimised wherever feasible, and we therefore believe that the need for primary and secondary treatment of local sewage must remain on the States agenda.

The HSSD accepts that in a small island jurisdiction, proven treatment technology should be preferred, and that this is likely to produce large amounts of solid residue in the form of 'sewage sludge'.

To prevent this becoming an environmental health hazard in its own right, there is a need for a solid waste strategy to be finally agreed, and to take account of disposal of 'sewage sludge'.

The original liquid waste strategy document approved by the States in 1997 was a very thoroughly researched document, whilst the 2006 green paper confirmed that nothing has really changed over this period, in particular there is no proven new technology which would offer a viable alternative to conventional sewage treatment.

On this basis, the HSSD would reject the need for extensive further research, particularly a five year marine environmental impact assessment at a total cost of around £600,000. The HSSD believes this would be widely interpreted by the local community, the media and other jurisdictions as merely putting off making a difficult decision.

If indeed it is felt that further information would materially affect the outcome, i.e. where and how to implement sewage treatment, the study should be short-term and tightly focused to assist future technical decisions and provide baseline date to monitor eventual outcomes.

You will recall that in the lead up to the 'Millennium' the need to treat local sewage was identified by a local opinion poll as the development most wanted by most respondents.

We should, therefore, firmly commit ourselves to this course, whilst accepting that this would need to be integrated with a solid waste strategy, and could only proceed when States finances were felt to be sufficiently robust for the necessary capital investment to be made.

Such a decision should only be taken within the context of overall States capital spending priorities, and an assessment of the relative benefit of further sewage treatment against other areas of social and environmental spending, such as education and health infrastructure, improved sea defences, etc.

Yours sincerely

P J ROFFEY
Health and Social Services Minister

COMMERCE AND EMPLOYMENT
A STATES OF GUERNSEY GOVERNMENT DEPARTMENT

Commerce and Employment
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RECEIVED 15 AUG 2007

The Minister
Public Services Department
Sir Charles Frossard House
La Charroterie
St Peter Port
GY1 1FH

14th August 2007

Dear ~~Deputy Bell~~ Bill,

CONSULTATION ON DRAFT STATES REPORT – SEWERAGE AND WASTEWATER TREATMENT

Thank you for your letters dated the 11th July 2007 enclosing the draft report on Sewerage and Wastewater Treatment, and the 19th July 2007 giving details of the Public Services Department's recommended option, and of two alternative strategies.

The Commerce and Employment Department has given the matter consideration, and has in particular taken into account its responsibilities towards the Island's industries, in the first instance tourism but also other outward-facing exporting industries including the financial services sector, for which the international reputation of the Island as a responsible community is a matter of considerable importance.

With this in mind the Department is of the view that the concerns often expressed regarding the Island's current methods of wastewater disposal are unlikely to diminish in the future, and therefore it is likely that from time to time these methods will be the cause of adverse publicity for the Island. In addition it can be expected that particular pressure groups, which may well have significant public support, will from time to time orchestrate publicity campaigns that draw attention to the Island's current wastewater disposal methods. Indeed, if any such adverse publicity or any of these campaigns were to be taken up by a newspaper at a national level, the result could be highly damaging to the Island's reputation and especially, in the first instance, to the visitor industry.

The inescapable fact is the principle, which appears to be universally accepted, that responsible, developed communities such as Guernsey should not dispose of "raw" sewage directly into the sea. It seems highly unlikely that, whatever the scientific evidence, Guernsey would ever be able to put together a convincing case for a derogation from this principle. Therefore, and with the success of the Island's industries in mind, it is important that the Island takes positive steps to move towards the installation of, at least, a full secondary treatment wastewater disposal plant.

The Department is of course acutely aware of the significant costs of the installation of such a plant, and agrees that an acceptable method will need to be devised for meeting these costs. To achieve this the Department would be in favour of following the "user-pays" principle, with the costs generally being met through a supplement on the water charge, with adjustments taking into account the position of particular industries or circumstances. It is understood that arrangements of this nature operate successfully elsewhere.

Finally, the Department is of course also conscious of the fact that in the near future the Island faces significant challenges in the implementation of possibly two phases of the zero-ten taxation strategy.

The Department considers however that, given the considerable time that it will take to plan, procure and construct a treatment plant, an immediate commitment to do so should not require the imposition of any additional waste disposal charges until after the community has had time to adjust to the effects of the full implementation of the zero-ten strategy.

Yours sincerely

Stuart Falla
Minister

FWS 56.

CULTURE AND LEISURE
A STATES OF GUERNSEY GOVERNMENT DEPARTMENT

Culture and Leisure
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RECEIVED

The Minister
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Sir Charles Frossard House
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GY1 1FH

25 July 2007

Dear Deputy Bell

Consultation on Draft States Report – Sewerage and Wastewater Treatment

Thank you for your letter of 11 July re the above and the opportunity to comment upon the report.

There are a number of comments that the Culture and Leisure Department would like to contribute to the consultation exercise.

Reference is made to the possibility of building a wastewater treatment plant on the area of land at La Ramee which is designated as the site for a third golf course. Even if it were possible to buy the entire land area designated, currently in multiple private ownership, the total holding is only just large enough to accommodate an eighteen hole course and therefore would not be able to include the proposed treatment plant. I would suggest that this site be removed from the report.

I have attached here a brief report from Dr. Heather Sebire, the States Archaeologist, with her comments on the various sites under consideration.

The Department is aware of the considerable interest from many parties in providing a suitable solution to the lack of treatment currently. Those who spend their leisure time either on or in the sea have frequently questioned the method of disposal and would prefer a long term solution to the issues that they associate with the current treatment method.

Yours sincerely

Deputy Peter Sirett
Minister

POLITICAL RESPONSIBILITIES
Arts, Liberation Celebrations, Lottery, Sports and Recreation, Historic Sites, Liberation Religious Service, Museums Service

CULTURE AND LEISURE
A STATES OF GUERNSEY GOVERNMENT DEPARTMENT

Public Services Department

Sewerage and Wastewater Treatment

Response to Draft for consultation- July 2007

Section 9 Potential treatment Sites

Archaeological and Historic Sites issues

Site 1: Area adjacent to Belle Greve Headworks

As stated in the policy document this area is in close proximity to Le Chateau de Marais a scheduled ancient monument. It would be undesirable to develop such a large area of the marais for the following reasons:

- Le Chateau de Marais (GU128) dates from the 12th century and may for a time have been the island's most important strongpoint. A little to the west, where the bowling hall now stands, is the remains of a medieval rabbit warren or 'garenne' (GU223). It is likely that more traces of the medieval use of the marais survive in the proximity of these monuments, since they clearly indicate a focus of activity.

- A significant number of prehistoric artefacts were also found during excavations at Le Chateau de Marais, these indicate that the site - which would have been a natural 'hougue' or mound prior to the medieval construction - was used in the late Neolithic and early Bronze Age periods (Barton 1980, 657). It is quite probable that at this time the flooded marais was valued for hunting and that such islands provided gathering points or temporary camps from which to venture into the marsh. Similar environments, such as the Somerset Levels, have revealed that prehistoric people built wooden trackways to facilitate the crossing of wetlands and that this very wetness can preserve these tracks into modern times. Since we know that prehistoric people were using the area around the marais, it is not unreasonable to postulate that they might have constructed tracks here too. There is a slightly elevated area on the western edge of the proposed development area and this is the kind of place where prehistoric people might have stopped to produce stone tools, this would be evidenced by flint chippings and discarded tools. Part of a polished stone bracelet from the Neolithic period was found during excavations.

- Due to the nature of the underlying deposits (originally waterlogged) it is highly likely that valuable evidence of the palaeoenvironment survives in the area. This would be greatly affected by any works that changed the level of the ground water on the site.

Alternative Site 2: Artificial Headland at Hougue a la Perre

Archaeological Considerations

- Although the pre- Martello tower was demolished in 1905 the seaward side of the hougue remains of interest as the remains of the existing fort (built prior to 1680, GU514) were further reinforced by the German occupying forces in the 1940s (resistance nest Gemaeuer MGU824).
- An attempt to landscape any new construction here to appear as a mock fortification would not be in keeping with conservation principles and would be undesirable unless not doing it greatly compromised the economic good it produced.
- Reclamation of the intertidal zone and beyond is also an issue as archaeological deposits are likely to survive in submerged areas. There may also be historic wreck in the area of the suggested development.

Alternative Site 3: Belle Greve Vinery

Archaeological Considerations

- Belle Greve Vinery was intensively used by the glasshouse industry from the nineteenth century until the 1980's. Today it lies largely derelict. This does not preclude the survival of archaeology. Two sizeable parts of the site were never part of the glasshouse complex and have been undeveloped since at least 1787 (Fig.1). In addition, although the glasshouse cultivation will have disturbed the archaeology, there will probably be some intact deposits surviving below cultivation levels. Recent archaeological excavations at Route de Carteret, where there had been a similar intensity of glasshouse cultivation, revealed undisturbed medieval and prehistoric layers.

- Although subject to land drainage since the medieval period, the low lying nature of the area which in its natural state would be marais (marsh) means that it is frequently wet. Currently a significant part of the site is flooded. Wet soil conditions are of special archaeological interest since they can preserve organic materials. This means that artefacts and structures made of wood or other organic materials can survive for several thousand years. In addition, environmental material such as pollen, seeds and insect remains can survive; this is of value in building up information about the way the landscape would have looked at different points in the past. So the wet conditions prevailing on parts of the site increase the possibility of finding surviving archaeology. However a consequence of further drainage would be the destruction of organic deposits, not only on Belle Greve Vinery, but potentially in the surrounding area. Of course, drainage also has implications for natural history.

- Part of an ancient wooden canoe was found at La Route des Coutanchez, about a kilometre to the west of the site, this had been preserved by the wet conditions (De La Mare SGRT 1909, p20). This discovery also shows that the marais contained navigable streams extending inland for some distance. An exploratory 10m bore made near to the Red Lion, a little to the south of the area, revealed the existence of peat deposits. Peat is an excellent preserver of past environmental information, as well as of artefacts, human and animal remains.

Known features of historic interest:

- There are no scheduled ancient monuments on the site, but there was once an 18th century Martello Tower (GU515) beneath what are now States of Guernsey Housing Authority flats. It was destroyed when the flats were built in 1958. In addition, the marais has a network of drainage conduits dating from the medieval period (Hocart R, in Barton SGRT 1980, p695). The two channels crossing the site roughly west to east, coming together to the west of the water-filled quarry and then continuing as a single channel emptying into Belle Greve Bay, may well be the original medieval drain known as La Tonnelle d'Orgueil.

Alternative Site 4: Longue Hougue Reclamation

Some archaeological recording has already been carried out at Longue Hougue before the reclamation completely covered the existing land surface. A survey of sites nearby was also carried out.

Longue Hougue – Existing Reclaimed Area
Sites and monuments recorded within 500m of Longue Hougue – existing reclaimed area development

GU137	Mont Crevelt Fort
GU138	No 3 Pre-Martello Tower
GU140	De Lisle Brock Memorial Stone
GU141	Obelisk South Side
GU142	Drinking Fountain
GU222	Spur Point Battery
GU501	Milestone II, Grande Maison Road, St. Sampsons
GU663	Spur Point, St. Sampson
GU664	Spur Point, St. Sampson
GU665	Mont Crevelt
GU666	Mont Crevelt
GU783	Wn. Simsonhafen (WW11)
GU834	Wn. Richardseck (WW11)
GU836	Krevelberg (WW11)

Alternative Site 5 Longue Hougue South (Vivian)

See above but there is also an issue with the covering of more of the St Peter Port gabbro (geological deposit).

Alternative Site 6 West of La Ramee

The field systems in the area of the Ramee farm are at least 250 years old and it is likely that archaeological deposits survive in this area of high landscape character. If an underground water treatment plant was built below ground the natural ground water would be disturbed along with the removal of a substantial section of the historic landscape.

Conclusions.

The ideal site from an archaeological viewpoint would be the existing reclamation sites at Longue Hougue or Longue Hougue South.

Heather Sebire
States Archaeologist
July 2007

(NB The Policy Council supports the proposals.)

(NB The Treasury and Resources Department supports the proposals.)

The States are asked to decide:-

III.- Whether, after consideration of the Report dated 29th August, 2007, of the Public Services Department, they are of the opinion:-

1. To direct the preparation of an environmental impact assessment as set out in sections 6.30 – 6.33 of that Report [Marine EIA] at a budget cost of £600,000 to establish:

   - the impact of current methods of wastewater disposal on the marine environment;

   - the causes of poor bathing water quality;

   - the potential effect of wastewater treatment on the Island's carbon footprint.

2. To direct the Treasury and Resources Department to take account of the costs of the Marine EIA when recommending to the States, Cash Limits for the Public Services Department for 2008 and future years.

3. To allocate priority within the limited financial resources available for wastewater services to those measures necessary to sustain and develop the existing sewerage network, including measures to reduce ingress of saline and surface water.

IN THE STATES OF THE ISLAND OF GUERNSEY ON THE 31st OCTOBER, 2007

The States resolved as follows concerning Billet d'État No XXI dated 28th September 2007

PUBLIC SERVICES DEPARTMENT

BELLEGREVE WASTEWATER DISPOSAL FACILITY INTERIM WORKS

I.- After consideration of the Report dated 22nd August, 2007, of the Public Services Department:-

1. To vote the Public Services Department an additional credit of £1,270,000 to complete the Phase I interim works as set out in that Report, such sum to be charged to its capital allocation.

2. To authorise the Treasury and Resources Department to transfer an appropriate sum from the Capital Reserve to the capital allocation of the Public Services Department in respect of these works.

3. To delegate authority to the Treasury and Resources Department to approve acceptance of all tenders in connection with these works.

PUBLIC SERVICES DEPARTMENT

WASTEWATER CHARGES

II.- After consideration of the Report dated 22nd August, 2007, of the Public Services Department:-

1. To agree in principle to the introduction of Wastewater Charges as outlined in that Report.

2. To direct the Public Services Department to consult with the Treasury and Resources Department and the Law Officers of the Crown with regard to the introduction of the necessary legislation.

3. To direct the Public Services Department to undertake the additional work needed so as to report back to the States with firm proposals.

4. To direct the Treasury and Resources Department to take account of the fees raised from Wastewater Charges when recommending to the States* Cash Limits for the Public Services Department for 2009 and subsequent years.

PUBLIC SERVICES DEPARTMENT

SEWERAGE AND WASTEWATER TREATMENT

III.- After consideration of the Report dated 29th August, 2007, of the Public Services Department:-

1. TO NEGATIVE THE PROPOSITION to direct the preparation of an environmental impact assessment as set out in sections 6.30 – 6.33 of that Report [Marine EIA] at a budget cost of £600,000 to establish:

   - the impact of current methods of wastewater disposal on the marine environment;

   - the causes of poor bathing water quality;

   - the potential effect of wastewater treatment on the Island's carbon footprint.

2. To allocate priority within the limited financial resources available for wastewater services to those measures necessary to sustain and develop the existing sewerage network, including measures to reduce ingress of saline and surface water.

K H TOUGH
HER MAJESTY'S GREFFIER