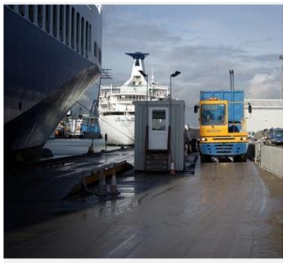
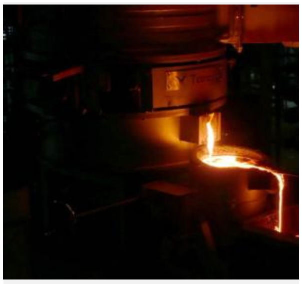
States of Jersey Environment Scrutiny Panel

Review of Ash Disposal Policy and Methods







Report for States of Jersey

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Executive Summary

Introduction

i. Ricardo-AEA was commissioned by the Environment Scrutiny Panel of the States of Jersey ("the Panel") to examine the existing and proposed policy of the Minister for Transport and Technical Services (TTS) on ash disposal, in particular proposals for treatment of air pollution control residues (APCr) and incinerator bottom ash (IBA).

ii. To complete this comprehensive review Ricardo-AEA has carried out a detailed review of relevant documents and examined the existing and potential future ash management options with TTS and the Department of the Environment, through private meetings and public hearings. Ricardo-AEA has also reviewed relevant submissions to the Panel and assessed best practice and available technologies, including new or near-to-market.

iii. The new energy from waste (EfW) facility at La Collette began full scale operation in early 2011 and its construction focused attention on how Jersey deals with the ash residues. The facility can process up to 105,000 tonnes of residual waste per year which could be expected to produce in the region of 20,000 tonnes of IBA and 4,000 tonnes of APCr. The facility is currently operating at an annual throughput of approximately 70,000 tonnes per year, generating around 18,000 tonnes of IBA.

iv. Jersey's current ash management strategy involves landfill disposal at the La Collette reclamation site near the port of St Helier, adjacent to a Ramsar site. This was the strategy for the combined ash stream from the Bellozanne incinerator prior to its decommissioning and now the separate IBA (non-hazardous) and APCr (hazardous) streams from the new facility are disposed in separate, suitably engineered cells. TTS has committed to investigate all alternative options to dispose or treat and recover both IBA and APCr, either on-island or through export.

Incinerator Bottom Ash (IBA)

v. IBA is primarily composed of non-combustible materials such as glass, ceramics and metals plus clinker and ash, is fairly stable and contains very few toxic elements. For at least 10 years a significant proportion of IBA has been processed in Europe to recover metals and manufacture secondary aggregates to product specifications, which is referred to as incinerator bottom ash aggregate (IBAA). Treatment involving crushing, metals recovery, weathering and screening is the only process known to be commercially viable and used for IBA processing. Due to its good cement like properties, IBAA is an excellent substitute for natural aggregates in a range of bound and unbound applications. Application of IBAA in the UK is controlled through site specific risk assessment.

vi. Whilst the Department of the Environment accepts that disposal at La Collette can be regulated to ensure no harm or pollution occurs, both TTS and the regulator agree that IBA recovery is a more sustainable future option if it can be demonstrated to be acceptable using a risk-based approach. TTS has committed to achieve IBA recycling by producing safe IBAA through the following measures. It should also be noted that whilst work is underway to explore IBA recycling disposal at La Collette will continue.

- excluding problematic waste streams such as WEEE and vehicle shredder residues from the EfW facility to maximise the potential for IBA to be recycled;
- carrying out trials to process IBA into IBAA;
- testing IBA and IBAA to ensure engineering properties meet the requirements of appropriate product specifications and using data to support site specific risk assessment to confirm the use of IBAA will not cause harm or pollution;

- undertaking market development to determine what products to manufacture and to ensure demand is available;
- exploring export options for IBAA if production exceeds demand in Jersey; and
- maintaining limited suitable landfill capacity to manage rejects from the process

vii. Batteries are a further potentially problematic waste stream with significant potential to affect IBA quality and there appears to be uncertainty in relation to the current level of separation. TTS does not consider that tyres and treated wood waste affect IBA quality and, as an island community, it is recognised that Jersey may have limited options to exclude such materials. In addition, input waste includes a high proportion of commercial and bulky waste. As such, TTS will review EfW inputs if test results indicate IBA quality is not appropriate for recycling and this is considered appropriate.

Recommendation 1: review measures to exclude batteries to protect IBA quality and consider measures to limit or exclude additional waste streams with the potential to affect IBA quality, such as tyres and treated wood waste, if testing indicates their exclusion would protect IBA quality.

viii. This report reviews TTS' proposals for testing IBAA produced in pilot scale trials and makes recommendations. Market analysis will indicate products that are acceptable in Jersey, for example unbound (e.g. road sub-base) or bound (e.g. in cement or bitumen), thereby determining the products to be manufactured and tested in trials. To make this assessment industry also needs to understand IBAA and review test data. Testing, market analysis and market development are therefore closely linked and identifying and developing acceptable products will be an iterative process.

Recommendation 2a: ensure that trials on the IBA dry treatment process to derive IBAA replicate potential full-scale operations as far as possible; in parallel undertake market testing to determine acceptable products to inform the trials in relation to the products to be manufactured and tested; in parallel commission advisors to scope the risk assessment to ensure appropriate source term data are obtained during the trials.

Recommendation 2b: manufacture trial products from IBAA meeting the requirements of the relevant specification(s); design a sampling and testing programme following best practice and test the products; undertake site specific risk assessment to determine if IBAA products can be used; if results are positive establish a compliance testing regime for the specific acceptable products.

Air Pollution Control Residues (APCr)

ix. APCr is strongly alkaline, which results in its hazardous designation, contains toxic heavy metals and is very soluble in water. There are a number of APCr management options although several technologies are new or near-to-market, which impacts on their risk profile. In the UK, the recent emergence of APCr recovery options followed the implementation of the Landfill Directive in 2002, which restricted landfill disposal of APCr to a limited number of hazardous waste facilities. APCr is also likely to require treatment before hazardous landfill disposal in the near future (except permanent underground storage in salt mines) due to the expected removal of a derogation in relation to meeting Landfill Directive maximum leaching limit values, referred to as the Waste Acceptance Criteria (WAC).

x. Ricardo-AEA has undertaken a comprehensive review of available options and technologies to manage APCr in the short, medium and long-term and confirms that TTS has considered all available options. Ricardo-AEA did not consider that early reports prepared or commissioned by TTS in relation to potential APCr options were comprehensive and stakeholders may previously have understandably concluded from these superseded reports that TTS had not considered all options; this is no longer the case.

xi. A June 2012 TTS position paper confirmed its view that landfill disposal of APCr does not leave a good legacy. TTS' current strategy is APCr 'disposal' in removable bulk bags, indicating its intention to identify alternative disposal or treatment options in the short term to enable this material to be removed from La Collette. The current APCr cell has approximately 6 months' licensed capacity remaining and it takes 3 months and £0.5M to commission a new APCr cell, which TTS has stated it does not want to do. As all alternative options to manage the 'legacy' stored, bagged APCr involve export to disposal, permissions need to be in place by year end 2012 to avoid the need to commission another APCr cell.

xii. A duly reasoned request (DRR) is the first step in seeking permission to export APCr for disposal to the UK or other European Member State. It appears a DRR may have been on hold pending discussion with the Environment Agency to gain an indication of the likelihood of a DRR being successful. This discussion took place in September 2012 and indications were positive so there does not appear to be any reason to withhold the DRR. The Minister for Planning and the Environment has indicated his preference to export to France, however Defra may seek to control export beyond the UK and this may risk further delaying any DRR and consequently export permission. This report has considered delays in seeking a DRR and makes recommendations.

Recommendation 3a: submit a DRR to the Environment Agency to export APCr for disposal in England and Wales with a view of obtaining a decision before the end of 2012. The DRR should cover a period/quantity sufficient to export all 'legacy' cell 33 APCr and new APCr arising in the short term until an alternative recovery option can be fully considered.

Recommendation 3b: in parallel with 3a, if commercially viable APCr management options are available in France that are environmentally and economically preferable to known options in the UK, present evidence to Defra and determine whether export to France is possible; obtain a DRR decision from the French competent authority in the relevant département where the facility is located before the end of 2012.

xiii. TTS' preferred short term option is a DRR for disposal to the Minosus underground storage facility for bagged APCr and new APCr arising within 3 years. Export to a facility for acid stabilisation before non-hazardous landfill disposal will also be considered. Ricardo-AEA considers that either option is proven, robust and available, if a DRR succeeds. The decision process for a DRR is reviewed in this report.

xiv. TTS' preference for a longer term solution on expiry of a DRR is recovery, either with on-island processing or export depending on commercial and environmental considerations. Ricardo-AEA accepts TTS' view that on-island recovery is not viable without a market and crucially treated APCr would supply the same market as IBAA, which may potentially be more acceptable. This highlights the need to understand the available market in determining the long term option.

xv. This report presents an analysis of potential on- and off-island APCr management options across a range of timescales. The analysis, briefly summarised below, was presented at public hearings with both the Minister for Planning and Environment and the Minister for TTS and only one minor point of difference was raised. TTS has also confirmed that the options selected would not change if waste were to be imported from Guernsey in the future.

- **'Legacy' (6-12 months).** The current option is the only certain option but export to disposal is potentially available (pending a successful DRR).
- **Short term (<2 years).** As above, but with an export to recovery option available.
- **Medium term (<5 years).** On-island treatment for recovery as aggregate using accelerated carbonation or plasma arc vitrification is potentially available.
- **Long term (>5 years).** As above, but the current option considered not available.

Partial Glossary of Technical Acronyms

Acronym	Definition	Explanation
ACT	Accelerated carbonation technology	Proprietary technology to treat APCr through stabilisation with liquid carbon dioxide and cement to produce an aggregate. Output currently approved for use as product in block making in UK.
APC	Air pollution control	Gas cleaning system to remove potentially harmful substances from the flue gas.
APCr	Air pollution control residues	Fine, highly alkaline powder captured from the flue gas treatment. Hazardous waste due to alkalinity. Contains higher levels of dioxins and some toxic metals than IBA.
CEN	European Committee for Standardization	European organisation that draws up voluntary European Standards and other technical specifications to remove barriers to trade.
CQA	Construction quality assurance	Confirmation and acceptance of appropriate quality in relation to major engineering elements of construction projects.
DRR	Duly reasoned request	First stage in seeking permission to export waste for disposal to the UK or other European Member State. Not required if the receiving site can recover the waste.
EfW	Energy from waste	Commonly refers to the thermal treatment or incineration of waste using conventional technology e.g. a moving grate with combustion taking place in the presence of oxygen.
IBA	Incinerator bottom ash	Ash that falls under gravity through the combustion grate. Represents 20-25% of input waste. Non-hazardous. Contains non-combustible materials e.g. glass, ceramics, brick, concrete and metals plus clinker and ash.
IBAA	Incinerator bottom ash aggregate	Secondary aggregate manufactured from processing incinerator bottom ash using techniques such as metals extraction, crushing, weathering and grading.
WAC	Waste acceptance criteria	The maximum leaching values for materials destined for hazardous, non-hazardous and inactive landfill as defined in the Landfill Directive.
WEEE	Waste electrical and electronic equipment	Also referred to as e-waste.

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Appendices

1 Introduction

1.1 Scope

Ricardo-AEA has been commissioned to examine the existing and proposed policy of the Minister for Transport and Technical Services (TTS) on ash disposal. In particular Ricardo-AEA is required to examine proposals for the treatment of air pollution control residues (APCr) and incinerator bottom ash (IBA) and apply the information to assist in directing research by the Environment Scrutiny Panel of the States of Jersey ("the Panel") and provide an impartial professional analysis of the evidence received by the Panel in the course of the review.

1.2 Background

In July 2008 permission was granted for a new energy from waste (EfW) project on Jersey as the island aimed to develop a residual waste treatment solution to replace the ageing Bellozanne incinerator. The new EfW facility at La Collette began full scale operation in early 2011 and its construction focused attention on how the island deals with the ash residues, specifically IBA and APCr.

Incineration should not be considered a final solution because it generates solid ash residues in the form of IBA and APCr, the treatment and disposal of which is still a challenge. The new EfW facility represents best available technology, incorporating gas cleaning that enables emissions to meet strict limits established in the EU Waste Incineration Directive (2000/76/EC)[1], replaced by the EU Industrial Emissions Directive (2010/75/EU)[2] (IED). The APCr resulting from the gas cleaning however represents a new hazardous waste stream for Jersey to manage.

The new EfW facility can process up to 105,000 tonnes of residual waste per year which could be expected to produce in the region of 20,000 tonnes of IBA and 4,000 tonnes of APCr. The facility is currently operating below capacity with an annual throughput of approximately 70,000 tonnes per year.

Jersey's ash management strategy has for a number of years involved disposal in lined pits at the La Collette reclamation site near the port of St Helier, adjacent to a Ramsar site. This was the strategy for the combined ash stream from the Bellozanne incinerator prior to its decommissioning and it continues to represent the strategy for IBA and APCr from the new facility at La Collette at this time. Jersey has however committed to investigating alternative disposal or treatment and recovery options moving forward.

Local environmental campaigners had previously objected to the current method of disposal on the grounds of sustainability and potential environmental risks. These concerns are potentially added to by the requirement to deal with APCr from the new EfW facility and a further potential cause of concern is the possibility of generating additional quantities of ash if residual waste is imported from Guernsey for treatment in the future. The Panel invited submissions from members of the public and stakeholders until 1 June 2012.

A number of potential solutions for the management of residues have been put forward, including for IBA processing to recover secondary aggregates or continued controlled landfill disposal on the island and for APCr export for treatment or disposal or the use of vitrification or accelerated carbonation technology (ACT) either on or off island. A combination of short-term (potential export) and long-term (potential on-site treatment) may also be suitable.

[1] http://europa.eu/legislation_summaries/environment/waste_management/l28072_en.htm
[2] http://europa.eu/legislation_summaries/environment/waste_management/ev0027_en.htm

Scrutiny works in the interests of the public by carrying out independent, objective reviews aimed at improving government policies and public services. The Environment Scrutiny Panel is one of five panels made up of States members, who are not ministers or assistant ministers, which carry out detailed investigations into ministers' work, specifically matters of public interest and existing or proposed policy.

1.2.1 Environmental Scrutiny Panel: Ash disposal terms of reference

1. To review the TTS Department's existing Ash Strategy, relevant reports and proposals for the short, medium and longer term disposal of ash from the Energy from Waste Plant.
2. To compare the existing policy and new proposals with best practice methods for ash disposal elsewhere.
3. To consider and evaluate alternative solutions which may offer economic, environmental or other benefits to the Island.
4. To assess any environmental impacts or concerns relevant to current or proposed methods for disposal of ash, including impact on visual or other amenities.
5. To investigate funding implications for the department and the States of alternative proposals for the disposal of ash.
6. To consider the potential effect of any decision by the States regarding the importation of Guernsey waste, and possible further development of the Waterfront area in terms of ash volumes or other implications.

1.3 Approach

Ricardo-AEA's approach to support the Panel's review was structured around the following tasks on which this report is based:

Task 1: **Project initiation meeting, 19 June 2012:** outcomes of this and further meetings are summarised in Section 5.

Task 2: **Review the ash disposal strategy, relevant reports and submissions:** sub-divided into a review of the ash disposal strategy and relevant reports (Section 3) and a review of submissions to scrutiny (Section 4).

Task 3: **Identify and review available ash treatment technologies and strategies:** reported in Section 6, incorporating findings from site visits (task 4).

Task 4: **Support site visits:** refer to task 3.

Task 5: **Support public hearings:** outcomes are reported in Section 5 together with findings from other project meetings

Task 6: **Reporting:** represented by this report, including those sections outlined above, and conclusions and recommendations (Section 7).

2 Waste Incineration Residues

2.1 Introduction

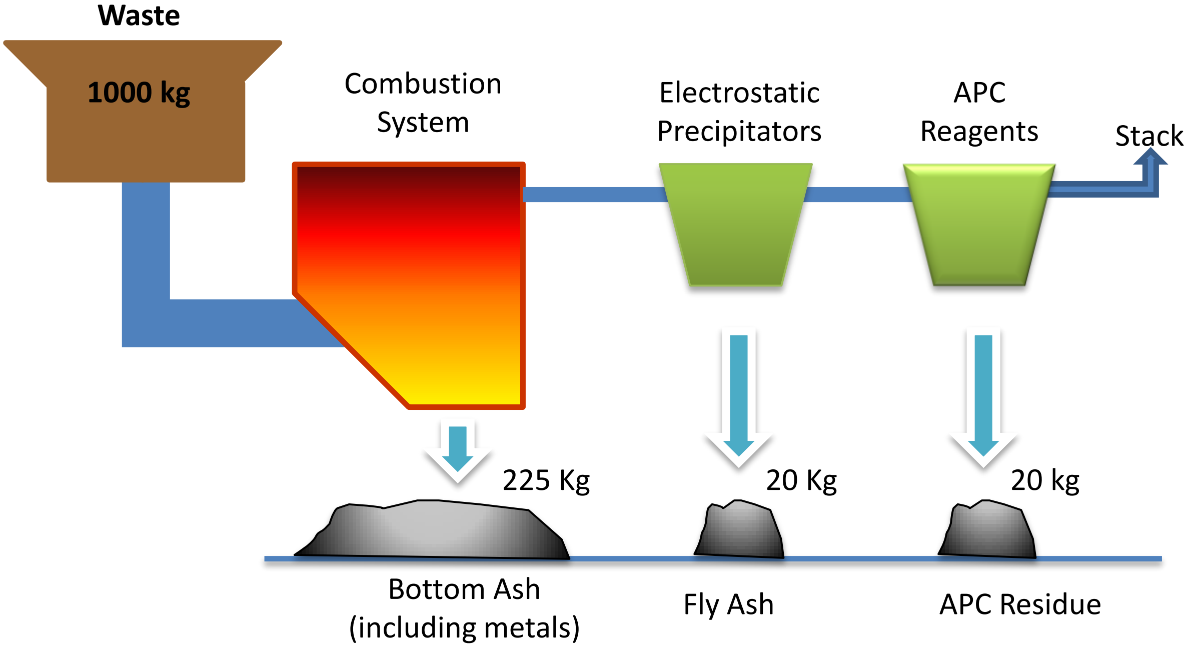
A typical waste incineration process produces 3 forms of residues:

- incinerator bottom ash (IBA);
- fly ash; and
- air pollution control residues (APCr)

Figure 1 identifies the sources of incineration residues. IBA is material discharged from the combustion grate and collected in hoppers below the furnace. IBA represents 20-25% of input waste by weight and contains varying quantities of non-combustible materials such as glass, ceramics, brick, concrete and metals in addition to clinker and ash, depending on the waste being burnt.

Waste incineration processes may also produce fly ash, which is the particulate matter, removed from the flue gas stream prior to the air pollution control (APC) system. Fly ash can also include boiler ash, which is particulate matter removed from the heat recovery systems. The APC system produces APCr, which can comprise scrubber residue and/or bag house filter dust. For the purposes of this report in relation to the La Collette EfW facility it is appropriate to consider APCr to include fly ash.

Figure 1: MSW incinerator residues (source: IEA Bioenergy)



2.2 Incinerator Bottom Ash (IBA)

Any incineration process will produce IBA. After IBA is discharged from the combustion grate in a mass burn incineration facility it is quenched in water before ferrous metal is separated by magnets and potentially non-ferrous metals by eddy current separators for recycling.

2.2.1 IBA Composition

IBA composition is important to consider for its treatment and utilisation. IBA is fairly stable and contains very few toxic elements. It is primarily composed of a mix of ceramics, slags, and glassy material along with some metals.

IBA comprises 15% of material that is unchanged by combustion (10% glass, 2% soil, 2% metals and 1% organics) and 85% ash particles from combustion and melted products. Within IBA oxides of silicon, calcium, aluminium, magnesium ferrous sodium and potassium and sulphates of most elements are found. The incineration process means that some of these mineral phases are thermo-chemically unstable, making IBA susceptible to ageing or weathering by atmospheric water, oxygen and carbon dioxide.

The most abundant crystalline mineral present in IBA is quartz (40-50% wt/wt), with small amounts of lime (12.5-18%) and feldspar (10%)[3]. A typical composition of trace elements found in IBA is shown in Table 1 and presented graphically in Figure 2.

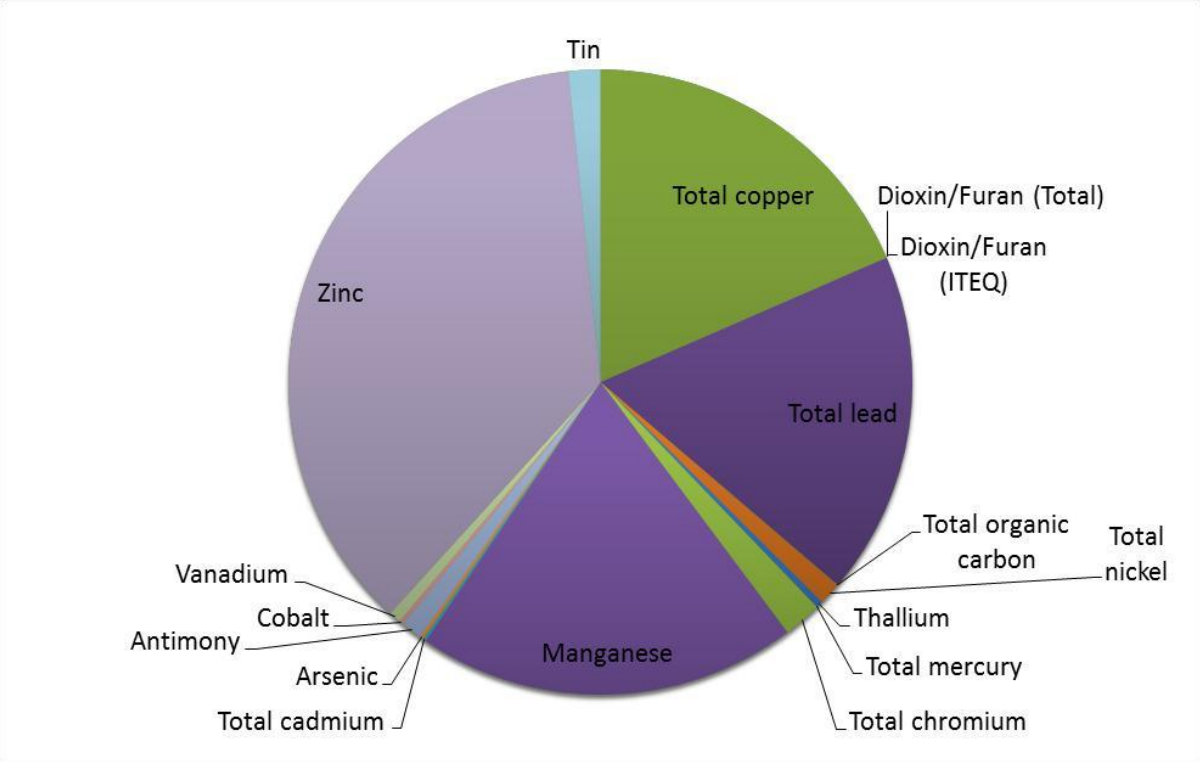
Table 1: Typical trace components of IBA – data table

Component	mg/m^3	%
Zinc	2,688.50	36.61%
Manganese	1,446.00	19.69%
Total copper	1,356.60	18.47%
Total lead	1,306.20	17.79%
Total chromium	145.1	1.98%
Tin	121	1.65%
Total nickel	84.8	1.15%
Antimony	81.2	1.11%
Vanadium	45.1	0.61%
Thallium	27	0.37%
Cobalt	17	0.23%
Arsenic	11.7	0.16%
Total cadmium	12.1	0.16%
Total organic carbon (TOC)	1.4	0.02%
Total mercury	0.5	0.01%
Dioxin/Furan (Total)	0.00053	0.0000072%
Dioxin/Furan (ITEQ*)	0.000094	0.0000013%
Total	**7,344.20**	**100.00%**

* Toxicity Equivalents (TEQ) measured in accordance with an internationally agreed protocol (ITEQ)

[3] *The Management of Residues from Thermal Processes*, IEA Bioenergy http://www.ieabioenergytask36.org/Publications/1998-2001%20Task%2023/Publications/Management_of_Residues_from_Thermal_Processes_-_Main.PDF

Figure 2: Typical trace components of IBA[4]



2.3 Air Pollution Control Residues (APCr)

Any incineration process with gas clean-up technology will produce APCr, a hazardous waste that can only be disposed in specialised landfill sites or storage facilities. APCr is typically a very fine-grained powder, ranging in colour from light to dark grey. The type of incinerator and flue gas cleaning system defines the physical and chemical nature of APCr and its chemical composition also depends on the waste incinerated. APCr is strongly alkaline containing high concentrations of lime and other calcium compounds, and soluble metal chlorides. APCr contains higher levels of dioxins and some toxic metals than IBA (refer to Section 2.3.1). The highly alkaline nature of APCr gives rise to its hazardous designation.

A typical APC system consists of flue gas recirculation (FGR) and selective non-catalytic reduction (SNCR) or selective catalytic reduction (SCR) by injection of aqueous ammonia or dry urea. Acid flue gases are neutralised by semi-dry scrubbing in a solution of lime and water. An activated carbon injection system installed on each stream aims to minimise the flue gas emissions of dioxins, mercury and other heavy metals. After flowing through the gas scrubber, the gases will pass through bag filters to remove particulates, including lime and activated carbon particles. Two types of APC systems are used widely:

- **Dry and semi-dry residue systems.** Slaked lime is injected into the flue gas, either in dry form or as slurry. This neutralises the acidic components in the flue gas and is typically done before removing the fly ash from the flue gas. Fly ash, reaction products and unreacted lime is typically removed in fabric filters. Activated carbon may be injected for dioxin removal and removed together with the fly ash.
- **Wet residue systems.** Fly ash is typically removed before neutralising acidic components. After this, the flue gas is scrubbed in one, two, or a multistage arrangement of scrubbers. The scrubber solutions are then treated to produce sludge and gypsum. Wet systems typically generate more than one residue.

[4] From: *Ballast Phoenix Inch Marshes IBAA Facility Environmental Permit Application Supporting Information*, September 2011, Fichtner Consulting Engineers Limited

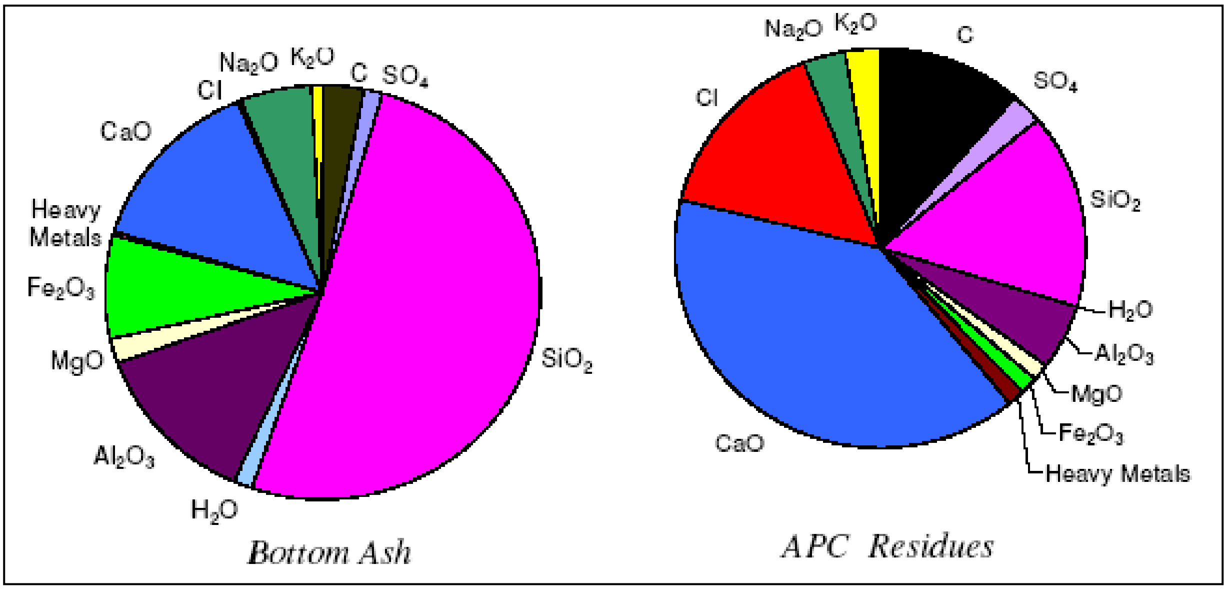
APC treatment at the La Collette EfW facility is a semi-dry system which involves two main stages. In the first stage dry urea is injected into the boiler furnace chambers and acts as a source of ammonia, which is central to SNCR method by which oxides of nitrogen (NOx) will be stripped out of the flue gases. After the flue gases pass from the boiler to the gas cleaning equipment, dry hydrated lime and activated carbon are injected into the duct preceding the bag filter to neutralise acid gases and adsorb (primarily) dioxins, furans, other volatile organic compounds (VOCs) and mercury.

2.3.1 APCr Composition

APCr composition is important to consider for its treatment and utilisation. In the early 1980's, concern over emissions from waste incineration resulted in the development of more efficient incinerator operating conditions and improved APC technologies. This enhanced ability to minimise emissions has resulted in the capture of greater volumes of contaminated residues in modern APC systems[5].

APCr contains toxic elements such as lead, nickel, and mercury as well as elements that are both carcinogenic and toxic such as cadmium, hexavalent chromium and arsenic[6]. In addition, it contains high a concentration of lime with other organic contaminants, which poses a treatment and disposal problem[7] due to high alkalinity. When compared with IBA, as shown in Figure 3, APCr contains a significant amount of calcium oxide, chlorides and heavy metals.

Figure 3: IBA and APCr composition (source: IEA Bioenergy)



APCr is very soluble in water (up to 30%). The most common species measured in leachate from APCr are salts, specifically chloride and sulphate compounds, and other flue gas reaction products. Chlorides alone can account for almost 40% of the weight of the soluble fraction of some fly ash[7]. Accordingly, APCr poses a contamination risk if it is disposed of in such a way that it may come into contact with groundwater.

APCr must be treated if it is to be disposed of as a non-hazardous material and is likely to require treatment in the UK before disposal in hazardous landfill in the near future (refer to Section 3.2.3.2). The composition of APC residue includes the following elements that affect

5 Hester R E, Harrison R M, 1994 *Waste incineration and the Environment*

6 Defra 2004, Draft APC residue case study

7 Lundtorp K, Jensen D L, et al., 2002, *Treatment of waste incineration air pollution control residues with FESO$_4$*

the level of treatment and subsequent utilisation and a detailed list is provided in Appendix 1; data for dry or semi-dry APC systems relevant to the La Collette facility are highlighted.

- **Heavy Metals**
  - Lead (600-7800 mg/kg)
  - Cadmium (20-215 mg/kg)
  - Chromium (11-314 mg/kg)
- **Soluble Salts**
  - Chlorides (111-207 g/kg)
  - Sulphates (2600-14250 mg/kg)
- **Organic Compounds**
  - Dioxins (1256-2598 ITEQ ng/kg)
  - PAHs (270 mg/kg)

3 Review of the Ash Disposal Strategy and Relevant Reports

3.1 Introduction

Table 2 lists the documents that have been received from Malcolm Orbell, Scrutiny Officer and reviewed. A summary and review of the relevant content of the documents is provided in Section 3.2.

Table 2: Strategy and associated documents received

Ref	Document reference
1	*Transport and Technical Services Department. Managing Jersey Energy from Waste Plant Residues. Current Position and Outlook. June 12th 2012.* [Includes the documents referred to as: • Ash Disposal Strategy (reviewed separately; document reference 2) • *Road map for the future management of EfW Ash* • *La Collette EfW Residues: Technical Options & Disposal Sites.* Capita Symonds, April 2011 (reviewed separately; document reference 6)]
2	*Strategy for the Management of Energy-from-Waste Residues.* Transport and Technical Services Department. October 2010.
3	*EfW Residue High Level Review. States of Jersey Transport and Technical Services.* 3 September 2010. Capita Symonds.
4	*Background to the Strategy for the Management of EfW Residues. States of Jersey Transport and Technical Services.* 25 October 2010. Capita Symonds.
5	*La Collette Phase 2 Reclamation Site: Headland Proposals EIA Scoping Report. States of Jersey Transport and Technical Services.* Final Draft 18 July 2011. Capita Symonds.
6	*La Collette EfW Residues: Technical Options & Disposal Sites. A comparison of options for the management of combustion residues from the EfW Plant. States of Jersey Transport and Technical Services.* April 2011. Capita Symonds.
7	*Jersey TTSD EFW Residues Options Review.* 3 October 2011. Fichtner.
8	*States of Jersey Transport and Technical Services. La Collette Waste Management Facility. Baseline Water Quality Review.* November 2011. Capita Symonds.
9	*La Collette Headland Working Plan.* States of Jersey. Version: Final Draft for Consultation. May 2012.
10	*Solid Waste Strategy. Changing the way we look at waste.* States of Jersey. 10th May 2005. Environment and Public Services Committee.
11	*Water Pollution (Jersey) Law 2000.* Revised Edition. 27.800. Showing the law as at 1 January 2009.
12	*Waste Management (Jersey) Law 2005.* Revised Edition. 22.950. Showing the law as at 1 February 2007.
13	La Collette Reclamation Site – Construction, Demolition and Excavation Waste Processing. Working Plan. Version: Consultation Submission. May 2012.

3.2 Summary and Review of Submissions

3.2.1 Managing Jersey Energy from Waste Plant Residues. Current Position and Outlook (TTS, June 2012)

This document appears to have been provided as a summary of the current position in preparation for review by the Scrutiny Panel. The document provided by the Scrutiny Officer contains the following documents; as indicated below the further key documents have been reviewed separately:

- *Strategy for the Management of Energy-from-Waste Residues.* Reviewed separately (refer to Section 3.2.2).
- *Road map for the future management of EfW Ash*. Reviewed within this section.
- *La Collette EfW Residues: Technical Options & Disposal Sites.* Reviewed separately (refer to Section 3.2.6).

The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

> *"1.2 The rigorous flue gas cleaning process generates Air Pollution Control residues (APCr), which is a new hazardous waste for Jersey to deal with.*
>
> *1.3 With the new plant allowing the Incinerator Bottom Ash (IBA) to be separated and with better exclusion of waste electrical goods, the prospect of IBA recycling for use as construction aggregate can now be investigated. Whilst TTS is investigating the chemistry of the IBA from the new plant so that those stabilisation trials can be commenced the challenge of utilising a waste with residual chemical intrusions is not to be underestimated, as any use as a product in the Island must not be a pollution risk.*

This indicates clear intent to investigate IBA recycling, a commitment that was restated in the Public Hearing with the Minister for Transport and Technical Services ("the TTS hearing") (refer to Section 5.6). Ash characterisation, WEEE exclusion and stabilisation trials are essential pre-cursors to IBA recycling, as indicated.

Leaching tests on processed IBA (refer to Section 6.3.3.1) are considered essential and later comments from TTS (refer to Section 5.2) indicated that the above reference to 'investigating the chemistry' did not correspond to the recommended testing approach. The TTS hearing (refer to Section 5.6) elicited that current testing is intended to identify whether IBA is typical of UK IBA so there remains the potential to ensure that leaching tests on IBAA are in-line with best practice. Quantitative site specific risk assessment is also recommended following UK best practice to fully investigate risks from specific IBAA applications in Jersey and the TTS hearing confirmed this would be carried out.

> *1.4 APCr is a hazardous waste and TTS believe that, whilst disposing of the waste at La Collette in sealed lined cells is possible, it is not a good legacy for the future, as the cells will need to be maintained and, possibly, renewed in the long term. An application to export the APC to the UK for appropriate specialist disposal has been made to the Environment Department who will need to seek permission from the UK authorities.*

Consistent with these comments the Department of the Environment (refer to Section 5.4) accepts that the current APCr disposal method is the best practical option for Jersey and is in discussion with the Environment Agency in relation to a duly reasoned request (DRR) application for export to disposal (refer to Section 3.2.6.1). The TTS hearing however indicated that no DRR request has yet been made to the Environment Agency.

> *1.5 TTS is looking at the viability, cost and the potential transferability of* [emerging waste treatment] *technologies to the small scale requirements of our Island.*

1.6 Any option would need to meet the stringent environmental protection standards that TTS adopt and be sustainable in terms of:

- *Compliant with the regulatory requirements*
- *Minimises the risk of pollution*
- *Viable solution in the long term*
- *Minimises land take*
- *Minimises energy consumption for treatment*
- *Economically viable in Jersey*
- *Can be funded within allocated budgets*

1.7 TTS has generated a roadmap of the management options for the coming years.

2.3 The [Solid Waste Strategy (SWS)] *recognised the need to plan for dealing with ash through the 25 year timeframe. Initiatives have been very successful with almost total diversion of display equipment… and significant diversion of other* [Waste Electrical and Electronic Equipment (WEEE)].

2.5 IBA… is targeted for recycling in the SWS subject to cleaner input streams and environmental concerns of the use… as a recycled aggregate, being overcome.

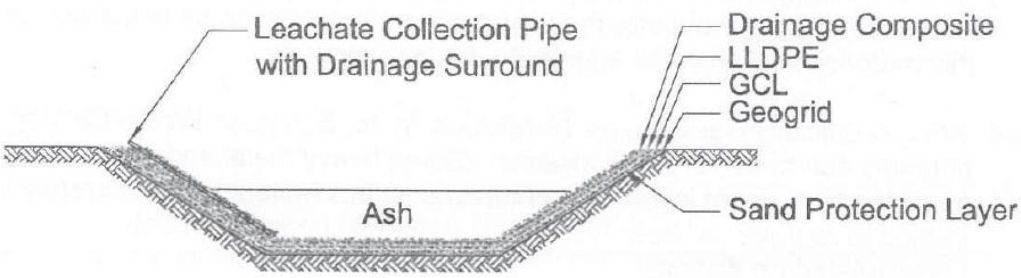
2.6 APCr… must currently be treated to remove its hazardous status or it must be appropriately encapsulated on disposal.

3.1 The Planning Permit for the new EFW was conditional on an ash strategy being produced by [TTS]*. The document essentially formalised the current* [ash] *management processes… and set out a commitment to assessing the feasibility of using IBA as an aggregate either within the engineering of La Collette 2 or within the local construction industry.*

3.3 The current methods of dealing with EFW residues are encapsulation on the La Collette 2 site with the… lined 'cells' being constructed to current good practice standards.

3.4 To progress… a long term and more detailed strategy, TTS have set up a… working group… [that] *is reviewing the available options for managing EFW residues.*

4.1 Chemical properties… have led to policy on disposal practice requiring the encapsulation of ash and a requirement for the disposal cells to be positioned above Mean High Water Spring Tide Level to ensure discontinuity with the marine environment. All the cells in the La Collette 2 site have been constructed in this way. The risk of… dust… is also carefully managed with the use of specialist covered vehicles… and daily cover of deposited ash with a layer of inert soils.



4.2 Once complete, the cells are capped as soon as possible to prevent ingress of rainwater that would then need treatment. Water in the cells from rainfall [is] *disposed of at the Bellozanne Treatment Works.*

> *4.3 In 2011 the department instigated a six month baseline water quality study... The results of this exercise indicated that the cells are doing their job and that there is not a problem with pollutants from the operation.*

The Public Hearing with the Minister for Planning and Environment ("the Environment hearing") (refer to Section 5.5) provided assurance that the regulatory powers are sufficient to deal with the facility and Environment will ensure no harm or pollution arises from ash disposal at La Collette.

> *4.4 For the APCr a special cell has been created to the higher engineering standards required for this hazardous waste. The lining is to a higher specification and includes a clay mat sealing layer and an inbuilt electrical leak detection system. This cell was designed to receive a bulk slurry of APCr but is currently receiving the material in flexible bulk containers to allow the material produced so far to be exported should this be the outcome of the review and the funding and regulatory position allow.*

Landfill cell design at La Collette is addressed in detail in Section 3.2.3.1.

> *4.5 The overall cell construction process is planned to continue in layers to complete a landscape 'headland' with comfortable capacity for the predicted residue outputs for the EFW's 25 year design life. The final headland would be landscaped.*
>
> *4.6 Through robust design and day to day site management TTS is confident that the current system provides an acceptable disposal route.*
>
> *4.7 TTS is committed to ongoing review of recycling treatment and disposal options to see if more sustainable options can be found.*
>
> *5.1 The work to review the current ash strategy was initiated in early 2011 starting with the commissioning* [of the Capita Symonds, April 2011] *report to review the latest technical position and options available. This report also reviewed the potential locations for ash disposal in the Island and concluded that La Collette continues to be the most appropriate location.*

The April 2011 report (refer to Section 3.2.6) is not considered comprehensive, primarily in relation to the site assessment, for example it only considers sites for disposal options.

> *5.2 Clear that IBA, under controlled circumstances, is being treated and recycled as an aggregate in other jurisdictions. APCr is being successfully encapsulated or chemically stabilised to widen the options for disposal and potentially recycled on an experimental scale. The work to develop a new strategy became more focused on whether these options are viable for Jersey, practically, financially and environmentally.*
>
> *5.3 Visits were undertaken… including… "Ballast Phoenix", the Turkeylands IBA site and EFW in the Isle of Man and the "WRG" chemical facility in Leeds, treating APCr to produce a material approved for disposal by normal landfill. The Isle of Man experience has been that it has taken years of trials to produce a recycled IBA aggregate which is yet to be accepted as a product for construction, because of the concerns with potential leaching and water pollution.*
>
> *5.4 The review team also looked at emerging technology… such as… plasma arc furnace to render these residues, particularly APCr, fully inert. Whilst cited as in commercial use in Japan, the process is not economic in the UK for APCr.*
>
> *5.5 Still to assess… a new treatment process for stabilising APCr through carbonation to produce a potentially recyclable aggregate... "Carbon8".*

Ricardo-AEA accepts IBA is commonly treated and recycled as secondary aggregate, as described in this report (refer to Section 6.1). In relation to plasma arc technology, Ricardo-AEA agrees that cost is potentially prohibitive for APCr treatment (refer to Section 6.5.2). In relation to the comment on Carbon8, Ricardo-AEA and TTS visited the first Carbon8 facility in August 2012 as it approached the end of commissioning and the outcome of this visit and discussions are presented later in this report (refer to Section 6.5.1).

> *6.3 With similar principles* [following the waste hierarchy] *applied to the residual ash waste stream itself it makes sense to recycle and minimise what needs to be disposed of. As with any recycling process it is only sustainable if a reliable outlet is available. Aggregates recycling… has grown in recent years but continues to be a challenge as end-users need high quality products. IBA can be recycled as an aggregate following weathering and processing – but the acceptance of the industry to use such a material is currently unknown and time is needed to properly characterise the ash and build the confidence of end users.*

> *6.4 Another fundamental issue… is whether a processed IBA aggregate will be acceptable in Jersey in environmental terms. The current position in other jurisdictions is that aggregates are sanctioned for use subject to a site specific risk assessed process. The Environment Department, as regulators would expect the highest standards of environmental protection in an Island where all areas are sensitive water catchments. The risks might also be managed through use of processed ash in 'bound' aggregates to reduce mobility such as concrete or asphalt, subject controls on the safe end of life disposal of such products.*

Ricardo-AEA accepts comments in relation to the need to develop markets, undertake site specific risk assessment and that bound applications would be expected to mitigate risks in relation to the use of processed IBA through immobilising contaminants. These points were reiterated in the TTS hearing (refer to Section 5.6) but whilst TTS accepted the need for site specific risk assessment, further comments indicated the main UK IBA processor could apply IBAA without site specific risk assessment or restrictions. This is not the case, as described below.

The Environment Agency has published a regulatory position for materials being considered for development of an end of waste Quality Protocol[8], which includes IBA. Whilst an IBA Protocol is under development, the use of IBAA conforming to the relevant publicly available specification is accepted for a range of bound and unbound applications. This is subject to controls including that its use does not, or is unlikely to cause nuisance or harm to human health or the environment and that all controls, including those that do not depend on the status of the material as waste, still apply. This includes for example Pollution Prevention Guideline (PPG5) 'Works and maintenance in or near water'[9]. PPG5 is considered on a site-by-site basis and requires consent for any activities with the potential to affect watercourses or groundwater, for example carried out within 10 metres of a main river or in a groundwater Source Protection Zone, which is pertinent in Jersey. PPG5 is commonly referred to in Quality Protocols and effectively requires a site specific risk assessment.

The regulatory position does however allow the use of IBAA as product in the UK and confirms the Environment Agency is confident that the use of IBAA in defined circumstances does not represent an unacceptable risk. A brief introduction to the concept of end of waste is provided in Section 3.2.1.1.

> *6.5 These applications are relatively new and the science is still developing.*

> *6.6 For APCr the options are… revolving around the potential to export this material for off-island disposal or treatment. Treatment followed by recycling as a bound aggregate may also be possible.*

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[8] http://www.environment-agency.gov.uk/static/documents/Business/MWRP_RPS_017_v15_QP_-_Sept_2012.pdf

[9] http://publications.environment-agency.gov.uk/PDF/PMHO1107BNKG-E-E.pdf

> *6.7 The attraction of off-island disposal of APCr is the potential to leave no legacy of this material in Jersey. If the disposal route involves an environmentally acceptable recycling route the option is more attractive.*
>
> *6.8 The review process is also considering locally stabilising APCr to lessen pollutions risks at the point of disposal.*

Review of the Capita Symonds April 2011 report (refer to Section 3.2.6) identified that APCr pre-treatment with disposal at La Collette had been excluded from the APCr management options considered. The TTS hearing also confirmed that TTS does not want to commission another APCr cell. These comments contradict the above statement that APCr stabilisation and disposal on-island is still being considered.

3.2.1.1 End of waste

Directive 2008/98/EC on waste, referred to as the Waste Framework Directive ("the WFD"), incorporates the concept of end-of-waste by setting out (Article 6) the following cumulative conditions whereby a waste can achieve, after undergoing a recovery operation, non-waste status and thus fall outside the scope of waste legislation, where recovery is defined as (Article 3(15)) *"any operation the principal result of which is waste serving a useful purpose by substituting other materials, or waste being prepared to fulfil that function"*:

> *"(a) the substance or object is commonly used for specific purposes;* [and]
>
> *(b) a market or demand exists for such a substance or object;* [and]
>
> *(c) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products;* [and]
>
> *(d) the use of the substance or object will not lead to overall adverse environmental or human health impacts*
>
> *The criteria shall include limit values for pollutants where necessary and shall take into account any possible adverse environmental effects of the substance or object."*

In relation to paragraph (d) above, in England and Wales the Environment Agency forms a view based on a virgin comparator material, specifically the risk of harm to human health or the environment arising from the use of the recovered product must be no worse than the risk presented by the virgin comparator. This is not the case in other Member States.

The end of waste test in England and Wales, based on case law, requires:

> *"that the holder* [of the waste] *has converted the waste material into a distinct, marketable product, which can be used in exactly the same way as an ordinary* [material]*, and with no worse environmental effects."*

> *7.1 There are opportunities to become more sustainable through recycling and more specialist and emerging technologies.*
>
> *7.2 There are a number of workstreams that must be initiated… analysing the chemical properties of the IBA… is clearly needed to assess its potential for recycling. Research and development into the potential for IBA aggregates to be used by the industry in terms of market acceptance and engineering performance will be a long process. The acceptance by the Environment Department of the use of the treated waste as a product will depend on their views on allowing a product with restricted location use to be marketed.*
>
> *7.3 To set out a programme for these workstreams the Department has produced a 'roadmap'."*

Current Practice	Interim Practice	Medium Term Outlook
APCr – Storage in double lined cell	APCr - Export for disposal/treatment in UK ?	APCr - Export or stabilise for on Island disposal as non-hazardous ?
IBA – Disposal in mono cells where material can be recovered in the future	IBA – Recycling trials and product market testing ?	IBA – Recovery of metal for recycling, aggregate to construction product use and residual to disposal cells ?

The following summarises interpretation of TTS' *Road map for the future management of EfW Ash*. The option to continue to dispose of ash in lined cells appears to be dependent on a 'Headland Application' to be made in Quarter 3, 2012 and preparing a waste management permit or licence (WMP/WML) in parallel. TTS presented an *Ash Strategy Plan September 2012* at the TTS hearing, which appears to be an updated plan focusing on specific options and which is described in Section 5.6.

IBA options are broadly set out as follows:

- IBA characterisation in 2012 and depending on the outcome of the study:
  - secure funding and design and construct maturation facility for IBA recycling to commence by late 2015; or
  - delay maturation trials until 2015/16 to allow further work to reduce the level of contamination in residual waste
- In parallel, starting in late 2012, investigate potential for on-island use of IBAA and achieve market acceptance, ending late 2015 in time for the earliest proposed completion date of the maturation facility.
- In the interim continue to dispose IBA in lined cells and if recycling is carried out in future dispose of the residual IBA that cannot be recycled in the same way from 2016.

APCr options are broadly set out as follows:

- Export APCr from late 2012 until at least late 2016 and potentially beyond depending on the outcome of an ash management review in late 2014 and, if an alternative long term on-island option is approved by the review (as described below), depending on the required time to finalise arrangements for this option. Export preceded by a DRR application.
- Complete a report on stabilisation options in 2012 and, depending on its findings, undertake stabilisation trials, process refinement and field trials to inform the review in late 2014. If this option is selected, design and construct a stabilisation facility for pre-treatment of APCr for on-island disposal, which would commence in late 2016 (estimated overall cost £1.3M).
- In parallel with stabilisation trials, research High Temperature Stabilisation (HTS), i.e. vitrification to inform the review in late 2014. If this option is selected, design and construct a HTS facility for operation from early 2017. The management route for vitrified residues is not specified (estimated overall cost £11M).
- In the interim continue to dispose APCr in lined cells until an export contract can be agreed (estimated late 2012).

Discussions with Tetronics in August 2012 (refer to Section 6) indicate that the £11M cost estimate is double the indicative CAPEX although the basis for the 'overall cost' of £11M is unclear.

"9.1 The States of Jersey approved a land use plan for La Collette which included a headland along the eastern side... designated for the disposal of ash. This was confirmed in the 2002 Island Plan and the new (2011) Island Plan continues to follow this established policy.

9.3 Concern has been expressed about the legacy of the headland… the desirability of limiting the final extent of the headland has been expressed.

9.4 If the most optimistic timescales in the roadmap are achieved for APCr export and IBA recycling the potential residual waste disposal at La Collette could be curtailed [with a] *reduction in height of the headland."*

3.2.2 Strategy for the Management of Energy-from-Waste Residues (TTS October 2011)

The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

"1.1 The overall strategy for the management of combustion residues… is to dispose of them safely within a new headland feature on the eastern side of La Collette Phase 2 Reclamation Area. The use of [IBA] *for engineering purposes (as structural fill) cannot be guaranteed, and further studies based on actual IBA from the new EfW plant will be required to assess its potential for such uses.*

1.4 Until combustion residues from the new EfW plant are available for testing… This strategy will be treated as a 'live' document and both reviewed and amended as soon as combustion residues from the new plant have been tested.

2.1 The Waste Framework Directive requires different waste streams to be kept separate, unless their mixing will reduce the hazardousness of the wastes.

2.2 TTS will therefore keep IBA and APC residues from the new EfW plant separate at all times, and will place APC residues within dedicated cells or areas within cells which will be engineered to a higher standard than is required for the disposal of IBA alone.

3.1 TTS will investigate the benefits of treating at least some of the IBA by conditioning and/or grading, to confirm whether it can be used within the headland feature without undue risk (in the context of site-specific source-pathway-receptor linkages) of generating unacceptable levels of leachate or other environmental emissions either alone (e.g. outside engineered cells) or in combination with clean excavation waste for use as an engineering material.

3.2 TTS will also investigate the potential for developing beneficial uses for IBA and IBA-derived aggregate (IBAA) elsewhere within Jersey.

3.3 TTS will explore with others the scope for State intervention to promote or require the use of IBAA, as a means of stimulating the creation of a market. This will include the possibility of encouraging the use on Jersey of a protocol which is currently under development within the UK, and which is expected to define key uses, and to establish quality and environmental protection requirements for such uses.

5.2 Any... interpretation of risks will take full account of the best data on the water environment around La Collette… assessing the potential cumulative effects of any new emissions in combination with background conditions existing at that time."

The strategy is a very high level document, consistent with TTS' description set out in its June 2012 document (refer to Section 3.2.1, original document paragraph reference 3.1). Notably the strategy makes no commitments in relation to APCr other than its disposal in engineered cells of appropriate design. The document does state commitment to investigate

IBA recycling including through site specific risk assessment and market development, which was restated in the TTS hearing (refer to Section 5.6).

3.2.3 EfW Residue High Level Review (Capita Symonds September 2010)

This document was prepared during construction of the La Collette EfW facility. The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

> *"2.1.1 The purpose of this report is to outline key issues and opportunities relating to the management of residues.*
>
> *2.1.2 Explored by reference to European Union (EU) requirements and UK practice as a basis for identifying those processes which have merit for deployment at La Collette.*
>
> *2.3.1 For each tonne of MSW… it is estimated that the following residues will be generated…*
>
> - *~250kg of non-hazardous* [IBA] *(including a small fraction of boiler ash);*
> - *~20kg of non-hazardous ferrous metals; and*
> - *~40kg of hazardous* [APCr]*.*

IBA plus ferrous metals which would be extracted from IBA therefore amounts to 27% input waste and APCr 4% input waste. This is consistent with common industry assumptions.

> *2.3.4 The management of IBA is fundamental to the successful operation of an EfW plant. This is partly due to the sheer bulk of IBA, but is also related to its physical properties, which means that it can be used as a raw material for producing a secondary aggregate.*
>
> *3.2.2 The Landfill Directive sets out key engineering performance requirements for landfills and how landfills are to be classified.*
>
> *3.3.2 The Directive established three types of landfill, namely:*
>
> - *Hazardous Waste Landfills;*
> - *Non-hazardous Waste Landfills; and*
> - *Inert Waste Landfills.*
>
> *3.3.3 Each class of landfill may only accept waste of the same class for disposal.*
>
> *3.3.4 'Stable Non-reactive Hazardous Waste'… is allowed to be deposited at Non-hazardous Landfills, so long as it is placed in a properly engineered, dedicated and discreet cell… termed 'Mono-Cells' due to the requirement that only one type of waste be placed in the cell.*
>
> *3.4.1 IBA is generally classified as non-hazardous waste… though there are continuing legal and analytical testing debates in relation to this classification. APC residues are generally classified as hazardous waste.*

Ricardo-AEA agrees with this statement and notes that uncertainty over the hazardous or otherwise classification of IBA in the UK requires the testing of IBA from each facility to determine the correct classification.

> *3.5.2 The Landfill Regulations* [require] *that for Hazardous and Non-hazardous Landfills a complete geological barrier must be in place or* [artificially] *established, and that barrier shall consist of a mineral layer. Where such a natural in-situ geological barrier is not present, or less than the required specification, it may be established artificially provided that it meets the requisite permeability and is at least 500mm thick… For both Hazardous and Non-hazardous Landfills a separate artificial basal sealing must be constructed. The sealing liner may also consist of a mineral layer, but its performance must exceed that of the geological*

mineral layer and must be in addition to that layer. A single mineral layer cannot provide both functions.

3.5.4 It is possible to design a sealing system that is less permeable that the Directive requirements using synthetic geo-engineering materials such as an LLPDE membrane or a Geosynthetic Clay Liner (GCL). The advantage of such engineering liners is that they are far smaller in volume that mineral equivalents and thus transportation issues are much reduced. The disadvantage is that they are relatively thin ~20-30mm for a GCL and 2mm for an LLDPE liner. Thus they have a low tolerance to stress imposed by movement or physical damage. In order for such membranes to achieve necessary performance levels over time, careful consideration must be given to their usage in terms of their protection.

3.5.5 In the case of a sealing liner a welded LLDPE or HDPE liner would be a normal engineering response… in areas where the clays [are] lacking. The use of a GCL as opposed to a geological barrier would meet the permeability requirements, though it would not comply with the thickness requirements. The minimum thickness requirements, is principally considered to establish a level of redundancy in the protection system [which] *could be built into a liner system using GCL by incorporating it into a multilayered system.*

3.5.6 UK Regulations take advantage of provisions within the Directive to relax the prescribed engineering requirements where it can be demonstrated to the Regulator, via a risk assessment, that a lesser standard is suitable.

Section 3.2.3.1 provides a high level analysis of La Collette landfill cell design in relation to best practice. The TTS hearing (refer to Section 5.6) elicited opinion that the geology at La Collette is not fully appropriate for landfill, which is consistent with the analysis in Section 3.2.3.1. This situation may support any future DRR application on the basis that Jersey may not have "*necessary facilities in order to dispose of the waste in an environmentally sound manner"* although Jersey might reasonably be expected to acquire them in the future, so the DRR might only be approved in the short term on this basis (refer to Section 3.2.6.1).

3.2.3.1 The Landfill Regulations and Landfill Cell Design

The Landfill Regulations require the mineral layer consisting the landfill base and sides to be at least 500mm thick only in the case of hazardous landfills and in the case of non-hazardous landfills at least 100mm thick. In both cases the permeability (k) requirement is 1.0 x 10^{-9} metres per second (ms^{-1}). For bottom (basal) sealing of both hazardous and non-hazardous landfills the Regulations require an artificial sealing layer and a drainage layer of at least 500mm depth.

Section 3.2.1 includes a diagram showing the non-hazardous landfill cell design, where geogrid is a soil reinforcing layer (permeable); GCL is geosynthetic clay liner which would be expected to comprise bentonite clay (low permeability) sandwiched between layers of geotextile (permeable) or geomembrane (impermeable); and LLDPE is linear low density polyethylene (impermeable geomembrane). This can be described as a composite-liner system, i.e. comprising geomembrane combined with clay.

If the GCL is suitable to represent the required geological barrier and LDPE the bottom liner this liner would only comply with the Landfill Regulations if the GCL is at least 0.5m in depth. Based on paragraphs 3.5.4 and 3.5.5 of Capita Symonds 2010 this does not appear to be the case. Alternatively the underlying material (made ground) should meet the required permeability and be at least 1m in depth. This is also not expected to be the case as the made ground is likely to be of variable material quality and non-engineered.

As such, assuming the GCL is less than 0.5m depth the liner does not comply with the Landfill Regulations and does not represent best practice. Paragraph 3.5.5 suggests that to achieve the same 'redundancy' in the liner the GCL could be applied within a multi-layer liner system; if the meaning of this is a double-liner system for the non-hazardous cell this has not been taken forward in the design.

Alternatively a site specific risk assessment (paragraph 3.5.6) could be carried out to demonstrate a lower standard is suitable; there is no evidence of such an assessment. Figure 4 describes the layers comprising the hazardous (APCr) landfill cell at La Collette following a site visit on 19 June 2012. This can be described as a double-liner system, that is it comprises 2 composite liners.

In the absence of data relating to thickness and permeability, and with the detailed liner design outside of the scope of the review, compliance with the Landfill Regulations cannot be confirmed. It does appear however that the liner design is well thought out and Ricardo-AEA would expect it to have been constructed with full CQA (construction quality assurance). This is confirmed in the draft licence conditions for engineered containment cells which will apply at La Collette, provided by the Director of Environment, which state that the licence holder must submit a CQA Validation Report prior to disposal commencing.

Figure 4: La Collette APCr mono-cell liner design

Top	Drainage fill – aggregate (unknown depth)	
	2x foam layers – for liner protection only	
	LDPE (low density polyethylene) impermeable geomembrane (unknown thickness)	Composite liner
	Clay – low permeability (unknown depth)	
	LDPE	Composite liner
	Clay	
	Geogrid permeable for soil reinforcement only	
Bottom	Made ground (assumed non-engineered)	

> *4.1.3* [Direct disposal] *IBA… is generally disposed of to landfill with little or no processing, as such processing would not deliver a benefit to the landfill operator and would add to the management cost.*
>
> *4.1.4* [Delayed disposal] *Some IBA is currently used in the UK for temporary works at landfills, such as daily cover or haul roads within Non-Hazardous Landfills.*
>
> *4.1.7 Production of* [secondary] *aggregate… removal of any remaining ferrous and non-ferrous items, and other oversize materials. IBA is then conditioned through aging, a process which normally takes at least three months, and is generally achieved by stockpiling IBA at a given moisture content and allowing exposure to the atmosphere* [which] *promotes a number of reactions to take place, including oxidisation, hydration and carbonisation. The aging process improves the structural and chemical durability of the IBA.*
>
> *4.1.9 More energy intensive (and therefore more costly) methods are available to age IBA, involving chemical treatment and forced carbonisation. IBA can also be thermally treated… to vitrify the IBA.*

Ricardo-AEA broadly agrees with the description of processing and weathering (original document paragraph 4.1.7). In relation to paragraph 4.1.9, Ricardo-AEA does not accept that either forced carbonation or vitrification are commercially viable for IBA processing and suggests the cost would be prohibitive. Ricardo-AEA is not aware either technology has been applied to IBA treatment at a commercial scale and suggests forced carbonation would not be capable of treating IBA due technical and handling issues relating to the physical characteristics of IBA.

The Environment hearing (refer to Section 5.5.) identified opinion that ACT and vitrification should be considered for IBA treatment. Ricardo-AEA does not consider this to be appropriate for the reasons set out above. Opinion raised at the TTS hearing agreed with this view on the basis of cost (refer to Section 5.6).

> *4.1.10 Conditioned IBA would need to be subjected to a screening and grading process to produce aggregate to given size distribution, and this would be governed by the particular EN or British Standard specification that was required.*
>
> *4.1.11 Potential contaminant release over time should also be evaluated in the context of the proposed use to confirm IBAA's suitability.*
>
> *4.1.12 IBAA is used as a virgin aggregate replacement, either in part or in full, for a number of bound… and unbound… applications.*
>
> *4.1.13* [Department of Communities and Local Government, 2005] *noted that in appropriate circumstances the use of IBAA in bound and unbound layers is acceptable to the Highways Agency for road construction, via inclusion of IBAA within the relevant Specification for Highways Works clauses.*
>
> *4.1.15 A formal protocol for aggregates produced from IBA is under way... with an estimated publication date of 2012. It may not be possible to issue a protocol at all if full agreement between stakeholders cannot be reached.*

Ricardo-AEA agrees with the above analysis (original document reference paragraph 4.1.10 to 4.1.15). The Highways Agency, amongst other organisations including WRAP[10] and the aggregates industry, has engaged with the Environment Agency in relation to agreeing an end of waste Quality Protocol for processed IBA, indicating its support for the use of IBAA in defined uses. At the time of writing Ricardo-AEA is not confident that the Agency and its partners will publish an IBAA Protocol in the short to medium term, for reasons including the variability of IBA (and IBAA) in the UK, and particularly if unbound uses are included. End of waste positions for IBAA on a site specific basis are considered potentially more achievable.

> *4.1.17 The key to usage of secondary materials is to establish markets. This can be achieved through economic conditions and/or through contractual conditions and specifications for works.*
>
> *4.3.1 In the UK… APC residues are largely either directly landfilled at Hazardous Landfills or subject to some form of pre-treatment. Hazardous waste is now required to undergo pre-treatment to comply with the waste acceptance criteria for Hazardous Landfills, unless it can be demonstrated that there would be no beneficial outcome... such pre-treatment consists of mixing APC residues… with aqueous solutions to make it easier to handle and place the resultant mixture in a landfill.*

Ricardo-AEA agrees with the above analysis (original document reference paragraph 4.3.1) and further outlines the requirements of the Landfill Directive in relation to pre-treatment and waste acceptance in Section 3.2.3.2.

> *4.3.2 Literature indicates that methods using bulk bags… have also been used for APC residues elsewhere within the EU. Bagging… may mean that the pre-treatment requirement for landfilling hazardous waste would be met. It may also be undertaken as a means of controlling and containing waste in cells that are still open.*

A case study is presented in relation to the APC conditioning plant (pre-treatment with water) operated by Grundon Waste Management Limited in Gloucestershire. A paper on vitrification of APCr published by the Department of Trade and Industry (DTI) is also presented. These appendices have been taken into account in Section 6 and are not reviewed in this section.

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10 http://aggregain.wrap.org.uk/

3.2.3.2 Landfill Directive Requirements for Pre-treatment and Acceptance

The Landfill Directive categorised landfill sites as hazardous, non-hazardous or inactive and set maximum leaching limit values, referred to as the Waste Acceptance Criteria (WAC) for the different categories. The Directive requires waste to be treated before it is accepted at a landfill site. In relation to hazardous waste WAC largely consist of numerical limits for leachable substances and organic content, along with standards for physical stability[11]. Most waste can be treated to meet the WAC but under defined circumstances WAC derogations can be sought, for specific hazardous waste including APCr, allowing it to exceed the WAC levels by up to three times. The derogation is used as a short term measure pending development of new treatment methods to avoid problematic wastes.

The Environment Agency issued a regulatory position statement in June 2008 stating that the derogation on organic limits was no longer available. In 2010 Defra's Hazardous Waste Strategy stated that the inorganic content derogations must also end in a phased process to coincide with development of alternative treatment. Since November 2010 the Environment Agency has not accepted any applications to vary permits to allow the '3xWAC' derogation in relation to inorganic content and the limited number of permits with such derogations will be phased out over time. Since this time any waste that cannot meet WAC has been considered a problematic waste, that is, where no treatment technology is available to allow it to meet WAC limits, and can in these 'exceptional circumstances' be landfilled.

Ricardo-AEA would not expect the Environment Agency to consider APCr a problematic waste given available treatment methods (refer to Section 6), including a number that enable treated APCr to meet end of waste criteria. As such, the position in the UK for new facilities is considered to be that pre-treatment to meet WAC is required. The Agency allows 'strictly temporary' storage 'under conditions that protect the environment and human health', where there are 'specific and verifiable plans to develop alternative treatment'. This is consistent with current operations in Jersey. Sites for permanent underground storage are not subject to generic hazardous WAC but instead rely on specific acceptance criteria designed to suit the circumstances of the site.

> *5.7.1 The potential environmental impact, principally on the water environment, from using of IBA for engineering… could be assessed in two stages:*
>
> - *Stage 1: analysis of the leaching potential of IBAA using published data and empirical analysis for IBAA sourced from offsite EfW plants. If these tests indicate that IBAA is suitable for proposed engineering use; then*
> - *Stage 2: analysis of leaching potential for IBAA manufactured from IBA sourced from La Collette EfW facility to verify this material's similarity to other IBAA.*

The proposed stage 1 testing may not be appropriate considering TTS' assessment of the type of waste treated at the EfW facility (refer to Section 3.2.10, original document reference paragraph 5.2.1). Although progress is reported in relation to the exclusion of wastes such as WEEE and vehicle shredder residues from the EfW, input waste will continue to include commercial and bulky waste and other waste streams such as tyres and treated waste wood. Ricardo-AEA suggests testing should follow the intention of stage 2 but rather than comparing the leaching characteristics to other IBAA the intention should be to develop a source term for a site specific risk assessment for applications of IBAA in Jersey.

> *5.7.3 Stage 2 should not start until the… facility is fully commissioned, optimised and operating under normal conditions.*

Ricardo-AEA understands and agrees with the basis of this comment to ensure 'stage 2' testing results are representative of long-term operations however in addition to the absence of any definition of 'normal operations' a number of issues suggest that it may be appropriate

[11] http://www.environment-agency.gov.uk/business/sectors/37223.aspx

to establish a testing programme in the short term. The TTS hearing (refer to Section 5.6) confirmed initial testing is underway and Ricardo-AEA considers it may be appropriate to commence the testing programme now in view of the following:

- The EfW facility is fully commissioned and optimised.
- The initial testing underway is intended to identify if Jersey IBA is 'typical' (refer to Section 5.6) before commencing processing trials and IBAA testing. If the results are significantly different to typical IBA 'stage 2' testing can be delayed.
- Vehicle shredder residues, considered high risk in terms of IBA quality, will be excluded from the EfW from January 2013 before 'stage 2' testing is intended to start.
- TTS has confirmed (refer to Section 5.3) that shredded bulk waste removed from a La Collette landfill cell will be slowly added to the input waste for approximately 12 to 18 months. This may not represent 'normal operations' but TTS indicates that this is not expected to impact on IBA quality (refer to Section 5.6) and the significant timescale for this operation may represent an unacceptable delay for progressing 'stage 2' testing.
- TTS has confirmed (refer to Section 5.6) that input of tyres, treated wood waste, poorly sorted household waste and to some extent high risk waste such as batteries is considered 'normal operations' and is not expected to significantly affect IBA quality. This view should be established by the current testing.
- TTS outlined a strategy to review results and where they indicate IBA quality is not suitable steps will be taken to exclude additional waste streams that may represent the cause. This iterative approach appears to be appropriate, particularly in an island context where alternative options to thermal treatment to manage streams such as tyres and treated waste wood may not be commercially viable.

Overall, the 'stage 2' testing would establish 'worst case' results which, if demonstrating the use of IBAA is acceptable, should enable recycling to start. There is a risk that the results, through the risk assessment process, indicate unacceptable risk and therefore this IBAA characterisation testing and risk assessment may need to be repeated but the testing that is underway appears to be intended to mitigate this risk.

> *6.1.1 The key question for the use of IBA in landfill engineering* [is] *whether use in an unbound form would be appropriate from a chemical perspective. This is pertinent as use of IBAA would generally be external to any landfill sealing system.*
>
> *6.4.1 Given the small volume and high cost of treating APC residues… it is concluded* [they] *should be landfilled at La Collette, and that the void should be maximised for APC residues and other problematic wastes through the exclusion of other less problematic wastes such as IBA. Additionally, due to the hazardous classification of APC residues, co-placement with other hazardous wastes should be explored, including co-placement with asbestos waste if it would assist in the placement and consolidation of such waste".*

The conclusion that APCr should continue to be landfilled is poorly justified but is not further discussed as this view appears to have been superseded by later reports and comments.

3.2.4 Background to the Strategy for the Management of EfW Residues (Capita Symonds October 2010)

This document was prepared during construction of the La Collette EfW facility. The report principally deals with projected ash volumes and capacity in the headland for this material. Detailed analysis of this content has not been undertaken as it is outside of the scope of the review. The relevant content of the report in relation to treatment and use of ash also duplicates the report reviewed in 2.2.3 therefore this content has not been summarised and reviewed again. The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

> *"2.1.1 This report* [sets] *out the background to the draft strategy for the management of combustion residues from the* [EfW] *plant.*
>
> *2.1.2 The strategy is required… to discharge one of the pre-commencement conditions attached to the planning consent.*
>
> *2.6.1 IBA is…classified as non-hazardous waste when it first arises. At that stage it is not inert, and has the potential to generate environmentally damaging leachate. Some examples of IBA which generates gaseous emissions (including hydrogen) have also been recorded, particularly in the USA, and it is important that the combustion process at the new EfW plant does not leave unburned fractions which will then decompose, generating gas.*

There have been cases of hydrogen evolution from concrete products where IBAA has been used as aggregate. This is related to the presence of aluminium, not unburned fractions, as indicated. A 2009 case in the UK investigated by the Health and Safety Executive (HSE)[12] involved foamed (aerated) concrete including IBAA. Flammable hydrogen gas was evolved from a reaction between the cement/concrete mixture and aluminium in the IBAA. The application was in a confined space and sparks generated during setting caused an explosion. HSE issued precautionary advice in relation to using IBAA but did not take any action requiring the removal of IBAA from concrete products. The case emphasises the importance of good aluminium removal, the presence of which can also cause swelling and a decrease in mechanical properties due to hydrogen generation.

> *2.6.5 After IBAA has been produced, its potential to release contaminants over time should be evaluated in the context of any proposed use. It cannot simply be assumed that once conditioned it is inert."*

3.2.5 La Collette Phase 2 Reclamation Site: Headland Proposals EIA Scoping Report (Capita Symonds October 2010)

The document states that it was prepared prior to full operation of the EfW and in advance of an Environmental Impact Statement (EIS). It is not clear if an EIS or Environmental Impact Assessment (EIA) was prepared at a later time and none has been reviewed. The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

> *"1.1.1 This document is a Scoping Report, submitted in advance of an Environmental Impact Statement… in support of a Planning Application for the construction and long-term care and maintenance of a headland feature on La Collette Phase 2.*
>
> *2.2.1 A headland on La Collette Phase 2 Reclamation Site… is considered the most appropriate current solution for the management of residues generated from the new EfW Plant.*
>
> *2.2.6 TTS requires a suitably engineered cell for disposal of APC residues to be available when… the EfW Plant comes on stream (i.e. before planning permission is received for the headland feature as a whole). TTS have proposed Cell 33 as a suitable cell.*
>
> *2.2.8 Whilst Cell 33 will be used to store the initial APC residues… it is not large enough to enable disposal of APC residues throughout the life of the EfW Plant. The headland is therefore proposed to enable the long-term disposal of both IBA and APC residues in appropriately engineered cells on La Collette.*

[12] http://www.hse.gov.uk/construction/liveissues/foamedconcrete.htm

> *2.2.14* [A] *feasibility study has recently been completed which considers a number of solutions for management of combustion residues from the operation of the new EfW Plant at La Collette.*
>
> *2.2.15 Disposal of IBA and APC residues (as opposed to re-use) off the island were not considered as an option due to the requirements of the Basel Convention.*

This view is considered to be wrong and has now been superseded (refer to Section 3.2.1, original document paragraph reference 1.4).

> *2.2.16 The feasibility study identified that the preferred option… in the immediate future is to dispose of unconditioned IBA and untreated APC residues, either at La Collette or within an alternative site on Jersey.*
>
> *2.2.17 La Collette was identified as the most viable location for the long-term disposal of IBA and APC residues.*
>
> *2.2.18 The headland proposal application will include… Preparation of a series of suitably engineered cells for the disposal and encapsulation of… wastes* [including] *IBA and APC residues from… the new EfW Plant* [and] *Temporary cover of the wastes sufficient to avoid release of, for example, dust.*
>
> *2.2.19 The headland [engineering] is likely to include:*
>
> > *i) Creation of a 'bottom level' leachate liner and drainage system across the base of the proposed headland (effectively 'capping' the existing cells beneath the proposed location) using an appropriate liner system which will include a mineral layer combined with LLDPE (the exception being the existing Cell 33 which already has a double LLDPE liner with an intervening leak detection layer)*
> > *iii) Collection of leachate during the construction period*
> > *iv) Creation of specific engineered cells within the footprint of the 'bottom level' to enable… e.g. … IBA to be separated from APC residues*
> > *v) Filling of the cells with waste suitable to the level of engineering provided*
> > *vi) Provision of a leachate storage tank… prior to tankering off site*
> > *vii) Provision of a dust suppression mechanism throughout the construction*
> > *viii) A programme of temporary cover to be progressed over the headland cells as the filling is progressed*
> > *xi) Permanent capping of… cells… as soon as possible upon completion*

Table 4.1 of the Capita Symonds report describes the proposed scope of the EIA and includes consideration of potential risks to health, fauna and flora, water quality, soil and air from exposure to ash. Appendix 3 of the Capita Symonds report confirms that the single ash stream from the animal by-products incinerator and the separate IBA and APCr streams from the clinical waste incinerator will be co-located with the APCr in the hazardous cell.

3.2.6 La Collette EfW Residues: Technical Options & Disposal Sites (Capita Symonds April 2011)

The relevant content of the report in relation to the generation, treatment and use of ash in part duplicates earlier Capita Symonds reports which have been reviewed in Sections 3.2.3 and 3.2.4. Duplicated content has not been summarised and reviewed again. The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

An overall observation is that the report does not appear to clearly establish the timescales over which each ash management option is being considered. Conclusions in relation to the preferred option may be different with appropriate consideration of timescales, particularly in relation to work which TTS has committed to and Capita Symonds refers to in other reports, for example IBA characterisation and on-island aggregates market development (refer to Section 3.2.1).

> *"1.2.5 IBA which has simply been conditioned is referred to as conditioned IBA, whereas material which has gone through a further round of processing to remove oversize items and as much of the remaining ferrous and non-ferrous residues as possible, and to grade it so that it has a known and predictable mixture of particle sizes, is known as IBA aggregate, or IBAA.*
>
> *1.2.8 Whereas it is possible to combine APC residues with cement to form a cementitious material in which the hazardous elements are bound, and therefore either non-leachable or leachable at a greatly reduced rate, the technology for doing this is still in the development stage, and is not commercially widespread.*

Since the date this report was issued the Carbon8 process has become commercially available. This involves accelerated carbonation and cement binding (refer to Section 6.5.1).

> *2.1.1 There are two potential management options applicable to both IBA and APC residues:*
>
> > *a) some form of treatment to reduce the material's potential to pollute the environment, and/or to make it more suitable for some form of beneficial use; and*
> > *b) safe permanent disposal by landfilling (or land raising).*
>
> *2.1.2 Under the requirements of the Basel Convention, EfW residues could only be* [exported] *for disposal if no viable option for disposal was available on Jersey. Since alternative options are currently available, off island disposal is not considered within this report. There are no such constraints on sending EfW residues off island for recovery."*

	Potential Management Options	
	IBA	***APC Residues***
Treatment	(1) TTS to export IBA for conditioning and re-use outside Jersey, by third parties. (2) TTS to retain IBA on Jersey for conditioning and re-use.	(5) TTS to export APC residues for recovery treatment and re-use outside Jersey by third parties. (6) TTS to retain APC residues on Jersey for treatment and re-use.
Disposal	(3) TTS to supply IBA to third parties for them to dispose* of it on Jersey, without pre-conditioning. (4) TTS to dispose* of IBA at La Collette, without pre-conditioning.	(7) TTS to dispose of untreated APC residues in an engineered landfill cell on Jersey.

*Note: *'disposal' includes the potential for use (without treatment) for example in quarry restoration or creation of a landform*

> *"2.1.4 Options 1 to 4 in particular are non-exclusive. It is* [possible] *that all four options might be implemented simultaneously. It is more likely that one or both of Options 1 and 2 might be used in combination with one or both of Options 3 and 4.*
>
> *2.1.5 Option 4 has been made site-specific (to La Collette) for two main reasons.*
>
> > *a)* [The] *Ash Strategy (which has been accepted by the Minister of Planning and Environment) identifies land raising at La Collette using IBA as the main management option for the EfW residues, subject to the granting of planning permission.*
> > *b) There is no viable alternative site to La Collette for disposal in the short term.*

The Department of the Environment has confirmed that land raising at La Collette was considered at the time by TTS to be an acceptable way forward, being a process with which they were familiar, on a site already in their control. The works to create ash pits above the level of the sea wall reflect a development framework for the La Collette site ratified by the States Assembly in 2000 (P.96/2000), rather than any formal planning permission.

> *2.1.6 Because the quantities of APC residues are much smaller… the working assumption is that at any one time, only one of the three options (options 5 to 7) will be pursued."*

The IBA options considered appear to be comprehensive. Fichtner (refer to Section 3.2.7) considered additional IBA options, e.g. stabilisation before disposal at La Collette, however Ricardo-AEA does not consider these represent appropriate options for separate consideration. The following APCr management options that were excluded by Capita Symonds may however be relevant for consideration; both options were considered in Fichtner's report which also reviewed the APCr treatment options on the basis of individual technologies:

- TTS to export APCr for disposal with or without pre-treatment at the place of disposal
- TTS to retain APCr for treatment and disposal at La Collette

Exports of waste for disposal are prohibited with limited exceptions and it is anticipated this forms the basis of decision to exclude the option of export for disposal. Ricardo-AEA does not consider this to be appropriate and TTS' current opinion is also not in-line with this advice.

On 18 July 2012 the Environment Agency's International Waste Shipments Team confirmed to Ricardo-AEA that APCr export for disposal is a potential management option but would require a DRR. The Environment Agency's advice is included in Figure 5 and interpretation provided below. It is also noted that the TTS 'roadmap' (refer to Section 3.2.1) and Ash Strategy Plan September 2012 define a DRR being prepared prior to APCr export.

Figure 5: Environment Agency advice on ash export to UK

From: Technical Advisor, International Waste Shipments Team

Date: 18 July 2012

"Hazardous and non-listed waste imports from UK Crown Dependencies are subject to the written notification consent procedures of the WSR (EC/1013/2006) [Waste Shipments Regulation]*. APCRs and IBAs would both fit into these categories.*

Imports of waste for disposal require the submission of a duly reasoned request from the Government body representing the UK Crown dependency. The DRR outlines the reason why it is necessary to dispose of the waste and what technical capacity and facility are available for environmentally sound management of the wastes exist on-island, if any. Following the DRR process, written notification consent will be required for the shipment of the waste to the UK – An assessment of the facility intended for disposal or recovery of the waste and the technology employed will be conducted at this stage.

Imports of APCR and IBA wastes for recovery are allowed, subject to separate written notification consents being in place."

3.2.6.1 Regulation of Waste Exports for Disposal

Article 41 of the Waste Shipments Regulation confirms in relation to imports of waste for disposal that:

> *"1. Imports into the Community of waste destined for disposal shall be prohibited except those from:*
>
> *(a) countries which are Parties to the Basel Convention;*
>
> *4. The countries referred to in paragraph 1(a)… shall be required to present a prior duly reasoned request to the competent authority of the Member State of destination on the basis that they do not have and cannot reasonably acquire the technical capacity and the necessary facilities in order to dispose of the waste in an environmentally sound manner."*

Article 49 specifies additional obligations in relation to the protection of the environment, which although not specifically referenced in Article 41 Paragraph 4 might reasonably be expected to be considered by the Environment Agency in relation to the requirements of this Paragraph 4. Article 49 states:

> *"1. The producer, the notifier and other undertakings involved in a shipment of waste and/or its recovery or disposal shall take the necessary steps to ensure that any waste they ship is managed without endangering human health and in an environmentally sound manner throughout the period of shipment and during its recovery and disposal. In particular, when the shipment takes place in the Community, the requirements of Article 4 of Directive 2006/12/EC and other Community legislation on waste shall be respected."*

Directive 2006/12/EC (the Waste Framework Directive) was repealed on 12 December 2012 by Directive 2008/98/EC (the revised Waste Framework Directive). Article 13 (Protection of human health and the environment) of the revised Waste Framework Directive corresponds to Article 4 of the repealed Directive, and states in respect of the Environment Agency's obligations that:

> *"Member States shall take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment and, in particular:*
>
> *(a) without risk to water, air, soil, plants or animals;*
> *(b) without causing a nuisance through noise or odours; and*
> *(c) without adversely affecting the countryside or places of special interest."*

Article 46 of the Waste Shipments Regulation confirms in relation to imports of waste into the Community from overseas countries or territories that Title II shall apply. Title II confirms that shipments of IBA and APCr shall be subject to the procedure of prior written notification and consent ('amber' listed waste) if destined for disposal or recovery operations, where the following classification applies:

> **APCr** European Waste Catalogue (EWC) code 19 01 07*; Basel Convention code A4100; WSR List A Waste (Annex VIII to the Basel Convention)
>
> **IBA** EWC code 19 01 12; Basel Convention code Y47; WSR List A Waste (Annex II to the Basel Convention)

Ricardo-AEA suggests that further dialogue with the Environment Agency would be pertinent to determine whether a DRR may succeed. This recommendation is made without the benefit of knowing what discussions Capita Symonds held with the Agency in the preparation of the report. Discussion should address how the Agency would determine if APC can be managed on-island without risk of contravening Article 13(c) of the revised Waste Framework Directive. For example, whether the Agency would consider the visual or amenity impacts of the headland or the potential risks to the Ramsar site to be grounds for accepting a DRR; and what factors the Agency would consider relevant to determine the potential for Jersey to acquire the means to manage residues in a more environmentally sustainable manner.

2.2.1 The approach that was adopted to appraisal was to consider whether each option is consistent with [the] *Ash Strategy… and then to consider the strengths, weaknesses, opportunities and threats (SWOT) associated with each option… to allow issues of practicality and likely cost to be considered alongside more directly environmental ones.*

2.2.5 The disposal of unconditioned IBA and untreated APC, either at La Collette or within an alternative site on Jersey [are] *the current preferred* [options]*."*

The following review highlights significant issues in the SWOT analysis that contribute to the selection of the preferred management options. The issues are not weighted and the analysis is fully qualitative therefore Ricardo-AEA cannot determine how competing issues have been resolved to reach the overall conclusion.

- **Option 1: IBA export for conditioning and reuse**
  The conclusion that the option is not economically or environmentally viable or sustainable appears to be strongly influenced by the burdens associated with shipping. In life cycle assessment of waste management options transport commonly represents a limited share of the environmental burden therefore further justification of this conclusion is required. Potential changes in landfill tax are also cited as a reason for economic uncertainty however Ricardo-AEA considers landfill tax policy to be established and not a cause of uncertainty. Ricardo-AEA considers it correct to consider the threat that the third party relationship may break down, requiring an alternative option (e.g. with a change in the UK regulatory position) but that this risk may be mitigated contractually.

- **Option 2: IBA conditioning and reuse on Jersey (TTS)**
  The conclusion is that without detailed testing of IBA the viability of this option cannot be considered and it is therefore ruled out. The current lack of a market for IBAA in Jersey is also noted in reaching this conclusion. Both issues are relevant and the roadmap indicates the market review and acceptance would not be completed until late 2015 (refer to Section 3.2.1) so this option may subsequently become valid but it is not clear whether it would be considered an option in the longer term.

  The threats *'Risk of environmental damage through mismanagement remains on Jersey'* and *'TTS retain threat of long term liability associated with material misuse'* are not considered valid as the material would be only be used if risks were shown to be acceptable through site specific risk assessment and would be applied in a controlled manner within construction contracts. An alternative market may be as engineering material at other sites assessed in the report which would represent a more contained application requiring more limited market development work.

- **Option 3: Untreated IBA disposal on Jersey (third parties)**
  Conclusion suggests disposal could be carried out at alternative (private) sites to La Collette and refers to the site appraisal in relation to the validity of other sites. The strengths appear to be underrepresented in comparison to option 4 which is the equivalent technical option at an alternative site, for example 'established process and technology' should also be valid. The threat *'Risk of environmental damage through mismanagement remains on Jersey'* is not considered valid as use would be at a single regulated site. A weakness that is not considered is the longer transport distance on potentially unsuitable roads to the disposal site compared to La Collette.

- **Option 4: Untreated IBA disposal at La Collette (TTS)**
  This option is in place and the analysis is considered appropriate.

- **Option 5: APCr export for treatment and reuse**
  The failure to identify any strengths or opportunities for this option is potentially misleading. To be consistent with other options the potential for this option to enable the recovery of APCr should be recognised. In recognition of the apparent political will to manage APCr in a more sustainable way without the legacy of retaining untreated

APCr in Jersey, this option may be considered economically and environmentally more sustainable in comparison with the alternative option to meet this objective by treating and reusing APCr on Jersey. The lack of any timescale to the analysis is pertinent as the commercial viability of APCr treatment options is changing rapidly, for example with the commissioning of an accelerated carbonation process in the UK with the outputs satisfying end of waste criteria for aggregate.

- **Option 6: APCr treatment and reuse on Jersey (TTS)**
  Similar to option 5 the failure to identify any strengths or opportunities for this option is potentially misleading and the potential for this option to enable the recovery of APCr should be recognised. Similar to option 5 the lack of any timescale to the analysis is pertinent as the commercial viability of APCr treatment options is changing.
- **Option 7: Untreated APCr disposal on Jersey (TTS)**
  The conclusion that this represents the preferred option does not appear to be strongly supported by the analysis. A weakness that is not shared by the alternative options is that this option fails to either reduce the hazardous properties or recover value from the APCr. The identified threat refers to TTS liability but this requires more explanation in relation to the type of liability if APCr is disposed without pre-treatment. It would also be appropriate for weaknesses to include proximity to the Ramsar site. As previously mentioned a gap appears to be consideration of pre-treatment prior to disposal.

The appraisal of sites only considers disposal options, on the basis that recovery options are unproven. As described above, the lack of any timescales is pertinent in relation to the commercial viability of recovery options for both ash streams and the appraisal may need to be revised in view of the currently emerging or near-to-market solutions described above; sites may be suitable for recovery options whereas they are not considered appropriate for disposal.

The detail of the site appraisal process is not considered to be within the scope of Ricardo-AEA's review and the following summary and review therefore focuses on the overall scope and conclusions from this section of the report.

> *3.1.3 "Six of the eight sites which have been assessed are former or current quarries on Jersey. The other two sites are the former mushroom tunnels, and La Collette itself. The eight are as follows:*
>
> *a) Western Quarry;*
> *b) La Saline (TTS Stone Processing depot);*
> *c) La Crete Quarry;*
> *d) Simon Sand Lagoon;*
> *e) La Gigoulande;*
> *f) Ronez;*
> *g) Former mushroom tunnels; and*
> *h) La Collette.*
>
> *3.2.3 The matrix identifies La Collette as the most viable disposal site."*

The Capita Symonds analysis in Figure 3.2 is high level with a series of unknown factors and assumptions which introduce considerable uncertainty and could potentially expose the analysis to criticism. Factors are not weighted and timescales are not considered. Review may be appropriate to confirm significant unknown factors, for example timescales for site availability; capacity; and water resource issues.

There appear to be scoring inconsistencies. In relation to the criterion 'Receptors', all sites are considered 'possibly suitable, subject to further work' whereas the descriptions range from sites with no apparent sensitive receptors (Western Quarry, La Saline and La Crete Quarry) to La Collette which is within 300m of a Ramsar site. The meaning of the criterion 'Future' is not explained but appears to duplicate the criterion 'Ownership' although there is no explanation why all sites with the exception of La Collette have different outcomes against these two criteria.

3.2.7 EFW Residues Options Review (Fichtner October 2011)

The following summary of relevant statements in the document includes reference to the paragraph numbers in the original document for ease of reference.

> *"1.1 Typically bottom ash is now recycled for use as aggregate. This requires the ash to be 'matured' to reduce leachable levels of metal salts and then processed to produce a graded product. The aim… was to identify and assess the opportunities that would improve the way in which these materials are managed on Jersey. The assessment has been made based on a forward timeline of five years.*
>
> *1.2.1 Bottom Ash*
>
> - *Continue with the current practise* [sic] *in the immediate short term*
> - *Plan and carry out maturation trials… to assess the quality improvements that can be achieved by processing the bottom ash… in a comparable manner to that seen at a UK commercial facility*
> - *In the event that the ash achieves a quality suitable for general use, review the opportunities for recycling and/or use by third parties*
> - *Review the opportunities for a limited re-use of bottom ash on a risk-assessed basis with the Environment Regulator in the event that… quality is not sufficient for general re-use*
>
> *1.2.2 APC Residue*
>
> - *Continue with the current practise* [sic] *in the immediate short term*
> - *Seek a Duly-Reasoned-Request from the Environment Regulator for the shipping… to the UK for disposal*
> - *Review the conveying systems for discharging from the APC silo to ensure this is compatible with the preferred transport option*
> - *Carry out... tendering… for the transport and disposal*
> - *Monitor the development of technology and review the economic basis for treatment… on Jersey in the event that a treatment technology becomes proven.*
>
> *2.1.2 Commercial*
>
> - *Transport to UK of bottom ash is £100/t*
> - *Transport to UK of APC residue is £99.5/t… by tanker… and £65/t… in bulk bags*
>
> *2.1.3 Bottom Ash*
>
> - *…cell construction costs are £20/m^3*
> - *Density… 850 kg/m^3*
>
> *2.1.4 APC Residue*
>
> - *Phosphoric stabilisation uses 5% H_3PO_4 solution (by mass) added in a ratio of 60:40 (residue: acid)*
> - *Cement stabilisation uses cement and water in a ratio of 2:1:1 (residue: cement: water)*
> - *Hazardous cell construction costs are £52.40/m^3*
> - *Density… 600 kg/m^3*

The following provides a summary interpretation of the assessment matrix, which forms the appendix. The options are comprehensive, although a number are readily discounted, e.g. IBA stabilisation before disposal at La Collette, and address the gaps identified in Capita

Symonds' analysis (refer to Section 3.2.6). 'Traffic light' colour coding consistent with Fichtner's approach and reflecting the report's recommendations is applied in this review.

Costs of each option are considered in the matrix and have been reviewed in general terms. The matrix confirms that stabilisation reduces environmental risk (leachability) but leachate must be disposed; and reuse of IBA as aggregate requires risk assessment and a market.

Options considered for IBA treatment and disposal on Jersey are:

- Landfill disposal of untreated IBA at La Collette (engineered cells) – ['do nothing']:
  - IBA is not classified inert waste and requires containment
  - Continuity depends on life of the La Collette headland
  - Continue whilst feasibility of recycling is trialled
  - £27/t [nil CAPEX potentially considers no new cells required in 5 years but this may not be realistic]
- Stabilisation (maturation) and landfill disposal at La Collette (inert landfill):
  - No commercial plants (not required); considered offers no benefit for disposal
  - Continuity depends on life of the La Collette headland
  - £32/t [infrastructure specifies inert waste disposal facilities only although these are in place therefore assumed £600K CAPEX is for maturation pad etc.]
- Stabilisation (maturation) (TTS) and reprocessing (TTS)
  - Typical for UK plants and permitted in Jersey; consider feasibility
  - £32/t
- Stabilisation (maturation) (TTS) and reprocessing (third party)
  - Typical for UK plants and permitted in Jersey; consider feasibility
  - £24/t
- Stabilisation (maturation) (third party) and reprocessing (third party)
  - Typical for UK plants and permitted in Jersey; consider feasibility
  - 25/t [£600K CAPEX included but unclear why as analysis indicates no infrastructure required; potential to reduce £/t]

Options for IBA export to UK are as follows. In all cases environmental risk passes to the point of disposal but high costs and/or risk of DRR means no further action recommended:

- Non-inert landfill
  - No commercial facilities export IBA for disposal
  - DRR required but unlikely given on island waste handling capabilities
  - Increasing landfill tax with no cap; gate fees will increase as capacity falls
  - £236/t [assumes no CAPEX]
- Inert landfill following reduction of leachability
  - No commercial facilities export IBA for disposal
  - DRR required but unlikely given on island waste handling capabilities
  - Gate fees will increase as capacity falls
  - £132/t [£600K CAPEX included but unclear why as analysis indicates no infrastructure required; if stabilisation in export country potential to reduce £/t]
- Recycling following reprocessing
  - Many commercial plants export IBA to third party for processing and recycling
  - Requires political agreement
  - Risk depends on UK assessment of quality and potential rejection
  - £110/t [assumes no CAPEX]

Options for APC disposal on Jersey are as follows. In all cases continuity depends on the life of the La Collette headland:

- Landfill disposal of untreated APC at La Collette (engineered cells) – ['do nothing']:
  - Long-term environmental risk to store next to RAMSAR; leachate containment
  - Storage in bags could allow later treatment if suitable technology
  - Options for sites should be reviewed with European sites taking bagged APCr for land restoration projects [likely to be unacceptable for Jersey]

- £162/t [nil CAPEX potentially considers no new cells required in 5 years but this may not be realistic; cell 33 has limited further capacity for bags]
- Stabilisation (aqueous phosphoric acid; H_3PO_4) and landfill disposal:
  - Mix with 5% H_3PO_4 to 30% moisture content to reduce leachability; may include initial washing; difficult to do well; continuous cleaning & maintenance
  - Not used in UK; comparable process uses acid waste
  - Treated APC typically still hazardous but lower risk (leachability); leachate containment; if washing stage effluent requires treatment and disposal
  - £226/t (higher cost without being non-hazardous)
- Stabilisation (cement addition) and landfill disposal:
  - Washed, dried, mixed with acid then cement and water to produce concrete type product to reduce leachability for landfill
  - Used by UK waste management companies e.g. WRG
  - Can achieve non-hazardous waste characteristics; effluent disposal; possible issues with long-term breakdown of material
  - Volume of waste increased significantly [unclear how much relative to bags]
  - Should be considered where economically viable
  - £268/t
- Stabilisation (thermal treatment; sintering) and landfill disposal:
  - Reduce leachability through oxidation and combust toxic organic compounds
  - No commercial operations
  - Requires permitting an unproven facility for hazardous waste
  - Release of combustion gases from combustion unit
  - Costs unknown; estimated prohibitively high

Options for APC treatment and reuse on Jersey are as follows. All require a new permit for a hazardous waste treatment facility. With the exception of washing and neutralisation there is risk of achieving suitable quality material using unproven technology and high risk that the material will be landfilled, so continuity depends on the life of the La Collette headland, and these should only be considered in the future if suitable technology becomes proven:

- Washing and neutralisation (sulphuric acid) and recovery (gypsum substitute):
  - Washed, centrifuged, mixed with acid, pressed and marketed (or landfill)
  - Future Industrial Services (FIS), Knowsley
  - Washings to sewer likely to impact on emission limits; significant risk with the sewage works and receiving waters
  - Continuity risk depends on re-use options for gypsum and unlikely to be viable unless off-taker is identified; proportion likely to be landfilled
  - £228/t
- Plasma vitrification for recycling/incorporation into recycled aggregate:
  - No UK commercial facility only demonstration (e.g. Tetronics); Bordeaux plant vitrifies electrostatic precipitator (ESP) fly ash but not from comparable system
  - Emissions to air and water
  - Limited outlet for material in Jersey given glass supplies demand; material is comparable to glass; still contains contaminants which is likely to affect popularity [long-term aggregate demand likely but dependent on acceptance]
  - £547/t
- Accelerated carbonation using CO_2 to produce carbonate salts:
  - Carbon8 commissioning first plant, Grundon has taken a shareholding
  - High risk of achieving suitable quality material may change as Carbon8 comes into operation
  - Costs unknown
- Stabilisation (thermal treatment; sintering) for use in concrete blocks or aggregate:
  - No commercial facility; work completed (in part) by Sheffield University
  - Product less attractive for reuse than stabilised IBA
  - £422/t

Options for APC export are as follows. For all options the responsibility for waste transfers to the point of disposal (or treatment); disposal options require a DRR but precedent that Isle of Man (SITA) exports APC to UK for disposal:

- Disposal in French landfill or German salt mine facility (bulk bags):
  - Likely to be more expensive than UK option as less spare lorry capacity
  - French regulations concerning APC import are very dissuading
  - EU option most likely German salt mines or Danish land recovery facilities
  - £389/t (gate fees and taxes likely to increase)
- Disposal at UK hazardous waste facility e.g. Minosus salt mine (bulk bags):
  - £245/t (gate fees likely to increase as void space decreases and UK legislation becomes more stringent)
- Treatment (waste acid neutralisation) and disposal (tanker transfer):
  - Mixed and neutralised with acid waste for landfill (Veolia; WRG; SITA)
  - Potential loading facility for tankers if bulk bags cannot be received
  - £245/t (gate fees likely to increase as void space decreases and UK legislation becomes more stringent)
- Washing and neutralisation (sulphuric acid) and recovery (gypsum substitute):
  - FIS Knowsley permitted for recovery; [notification] required [not DRR]
  - FIS Knowsley currently diverting to landfill; capacity linked to limited operations so availability and gate fee may be more at risk
  - Highly dependent on product market being available
  - Potential loading facility for tankers if bulk bags cannot be received
  - £250/t

Ricardo-AEA considers that as a result of this report TTS has been provided with a comprehensive analysis of the potential options that are currently available. Ricardo-AEA largely agrees with the recommendations presented (original document paragraph reference 1.2.1 and 1.2.2) with the following clarifications. In relation to IBAA export, Ricardo-AEA does not consider rejection on the basis of quality is a risk if IBAA meets the relevant publicly available product specification and if a contract for use in the intended application is in place. Ricardo-AEA suggests export to UK is unlikely to be viable on the basis of cost, but export to Guernsey should be viable.

In relation to APCr, 'carry out… tendering… for the transport and disposal' should be broadened to refer to treatment and recovery as well as disposal; there is no reason for a procurement exercise to exclude recovery options at the outset and these may be economically advantageous if avoided landfill costs offset processing costs.

The following describes suggested changes in relation to the 'traffic light' coding assigned to specific options for APCr management. No changes are suggested in relation to the IBA options. A summary of the Fichtner and suggested alternative classifications is then provided in Table 3.

3.2.7.1 Conservative APCr Recommendations

- Landfill disposal of untreated APC at La Collette (engineered cells) – ['do nothing']. This option is coloured 'amber' but Ricardo-AEA considers 'green' may be appropriate, at least in relation to this option continuing to be used in the immediate short term. This analysis is supported by the Department of the Environment's assessment that the current option poses no risk to the environment and can be regulated and that the design of cell 33 represents the best practical option for Jersey.
- Accelerated carbonation using CO_2 to produce carbonate salts. This option is coloured 'red' but Ricardo-AEA considers 'amber' may be appropriate. After the Fichtner report was completed, Carbon8 commissioned a facility and confirmed the Environment Agency's view that the processed material satisfies the requirements of the end of waste test (refer to Section 6.5.1). Considering potential OPEX (£100/t) and CAPEX (£1M) annualised costs are considered likely compare favourably with

washing and neutralisation processes (around £230-250/t). Risks associated with the novel process suggest this option should not be considered 'green' at this stage.

- Plasma vitrification for recycling/incorporation into recycled aggregate. This option is coloured 'red' but Ricardo-AEA considers 'amber' may be appropriate. No UK facilities treat APCr but Tetronics does have UK facilities treating other difficult waste streams and has a considerable track record of APCr treatment in Japan. Peterborough Renewable Energy Ltd (PREL) has also signed a Technology Licence Agreement with Tetronics to use the technology to treat APCr at EnergyPark Peterborough. Fichtner states that demand for the residue is satisfied by glass but this is slightly misleading; although a vitrified material, the residue could be used as secondary aggregate and the Environment Agency considers that the processed material satisfies the requirements of the end of waste test (refer to Section 6.5.2). Costs remain a significant issue and suggest this option should not be considered 'green'.

3.2.7.2 Optimistic APCr Recommendations

- Washing and neutralisation (sulphuric acid) and recovery (gypsum substitute). This on-island option is coloured 'amber' but Ricardo-AEA considers 'red' may be appropriate. This is on the basis of market uncertainty in relation to use of gypsum substitute in Jersey and the likelihood that outputs would require landfill disposal. 'Amber' classification for the same technical option but in relation to export is considered appropriate based on the likelihood of an available market.

- Disposal at UK hazardous waste facility e.g. Minosus salt mine (bulk bags).
- Treatment (waste acid neutralisation) and disposal (tanker transfer).

Both options are coloured 'green' but Ricardo-AEA considers 'amber' may be appropriate on the basis that disposal options require a DRR. Ricardo-AEA supports the process of seeking a DRR for export to disposal in the short to medium term however there is considerable uncertainty as to whether the Environment Agency will accept the request. Fichtner cites the Isle of Man precedent but the decision will depend on local factors so caution is appropriate.

Table 3: Summary classification of ash management options

Ash	Option	Location	Fichtner recommendation	Ricardo-AEA opinion
IBA	Disposal	Jersey	Landfill disposal of untreated IBA at La Collette (engineered cells) – 'do nothing'	
			Stabilisation (maturation) and landfill disposal at La Collette (inert landfill)	
		Export	Non-inert landfill	
			Inert landfill following reduction of leachability	
	Recovery	Jersey	Stabilisation (maturation) (TTS or third party) and reprocessing (TTS or third party)	
		Export	Recycling following reprocessing	
APCr	Disposal	Jersey	Landfill disposal of untreated APC at La Collette (engineered cells) – 'do nothing'	
			Stabilisation (aqueous phosphoric acid; H_3PO_4) and landfill disposal	
			Stabilisation (cement addition) and landfill disposal	
			Stabilisation (thermal treatment; sintering) and landfill disposal	
		Export	Disposal in French landfill or German salt mine facility (bulk bags)	
			Disposal at UK hazardous waste facility e.g. Minosus salt mine (bulk bags)	
			Treatment (waste acid neutralisation) and disposal (tanker transfer)	
	Recovery	Jersey	Washing and neutralisation (sulphuric acid) and recovery (gypsum substitute)	
			Plasma vitrification for recycling/incorporation into recycled aggregate	
			Accelerated carbonation using CO_2 to produce carbonate salts	
			Stabilisation (thermal treatment; sintering) for use in concrete blocks or aggregate	
		Export	Washing and neutralisation (sulphuric acid) and recovery (gypsum substitute)	

3.2.8 La Collette Waste Management Facility. Baseline Water Quality Review (Capita Symonds November 2011)

Detailed review of this document is outside of the scope of the review. The following analysis briefly summarises relevant points from the executive summary of the report. It should be noted that findings relate to the impacts arising from historical inert waste and ash waste deposits and should not be correlated with any impacts of current activities relating to the disposal of ash arising from the La Collette EfW facility.

The report presents findings from a 6-month baseline water quality monitoring survey around La Collette. Background to La Collette operations confirms:

> *"Since 1995* [La Collette] *has received a mixed waste stream with inert materials deposited behind the rock armour wall below the mean High Water Spring Tide level (11 m above* [Admiralty Chart Datum]*), and incinerator ash residue (predominantly bottom ash) placed in 4 – 5 m deep lined cells above the spring line."*

Monitoring of 42 sampling locations, including ash cells, with analysis for 75 determinands based on their association with prior activities was carried out. The report confirms in relation to the potential impacts of leachate on surrounding water quality:

> *"Basal elevations of lined ash cells is approximately 1 m (or more) above the highest groundwater level recorded. Assessment of leachate volumes within the ash cells suggests hydraulic containment (over three levels of cells) is performing within climatic expectations, suggesting that liners are performing to engineering expectations without a loss of leachate to underlying inert waste / groundwater. Comparison of groundwater quality to ash cell quality further supports this."*
>
> *Beyond the rock armour wall average concentrations of organic hydrocarbons… nitrates, phosphates and the majority of heavy metals did not exceed water quality standards. Average copper concentrations marginally exceeded the water quality standard* [WQS] *at two isolated seawater monitoring points… although the reason for this marginal local effect is unknown it is not regarded as a matter for concern for the sensitive receptors.*
>
> *Widespread* [WQS] *exceedence in respect of iron and ammonium is noted... This may be potentially influenced by the natural granodiorite geology (in the case of iron) or a wider water environment impact from surrounding anthropogenic activities (in the case of ammonium), in combination with a small diffuse contribution from the WMF. However this cannot be confirmed.*
>
> *Heavy metal concentrations* [in ash cell leachate] *were found to be similar in scale to that which may be associated with an urban run-off. Widespread exceedence of water quality standards for arsenic, copper and nickel was noted, with only occasional cells recording exceedences for chromium, manganese and iron. Ammonium concentrations varied over several orders of magnitudes. Anthracene and benzo(a)pyrene levels marginally exceeded the water quality standard, however concentrations of other organic contaminants (phenol, naphthalene and BTEX) were generally below water quality standards.*
>
> *Water quality in the sea surrounding the site was found to be generally of a quality that would not be of concern for the sensitive receptors that in the area. The evidence examined would suggest that the ash cells are effective in containment of the low level contaminants in the cell water."*

3.2.9 La Collette Headland Working Plan (States of Jersey May 2012)

This document provides guidance to the operator (TTS) at the headland site to ensure that the conditions of the waste management licence are met. Detailed review of this document is outside of the scope of the review. The following analysis briefly summarises relevant points from the report and includes reference to the paragraph numbers in the original document for ease of reference.

> *"1.1.1 The Headland is principally designed to provide a final disposal facility for… residues* [from the] *Energy from Waste (EfW) plant at La Collette. The Headland will be built up over time through an arrangement of newly constructed engineered containment cells designed to accommodate these EfW residues.*
>
> *1.1.3 The Site is being formed through the creation of discrete engineered containment cells… designed to contain wastes… to prevent pollution of the environment beyond the cells.*
>
> *Table 2.2 There shall be no treatment of EfW residues waste apart from bagging and wrapping.*
>
> *2.6.2 No hazardous waste will be treated at the facility without approval from the Department of Environment.*
>
> *2.7.1 The following waste types will not be accepted at the site: Wastes that are in a form which is either sludge or liquid.*

This restriction appears to rule out the use of options to condition APCr using a washing process prior to landfill disposal at La Collette.

> *3.4.1 All lagoons for the temporary storage of leachate extracted from engineered cells will be appropriately constructed including appropriate CQA procedures… will have appropriate freeboard for the designed capacity… Monitoring is intensified follow periods of heavy rain.*
>
> *4.8.7 The two options available* [for daily cover] *are:*
>
> - *OPTION A – …in addition to the IBA being consolidated into layers after each day of tipping, a continuous layer of sand will be spread and compacted onto the IBA layer at the end of each day as further protection from IBA being scoured by the wind.* [or]
> - *OPTION B – …an acrylic polymer modified water spray will be applied to each consolidated IBA layer at the end of each day.*
>
> *4.9.1 APC is discharged… into flexible intermediate bulk containers (dumpy bags) of a capacity of approximately 2m^3. The bags have sift resistant seams* [and] *a lace closure lid. After filling the bag at the EfW the lid is laced closed.*
>
> *4.9.2 Each bag has integral lifting straps.*
>
> *4.9.6 If a bag is dropped in location of final placement and is damaged (split etc.) it should be left as is. Other intact dumpy bags should be placed tightly around the damaged bag to contain the APC.*
>
> *4.9.9 The system above for the EfW APC residue will also be followed both the IBA and APC generated by the operations of the Bellozanne Clinical Waste incinerator… which are bagged at source."*

3.2.10 Solid Waste Strategy. Changing the way we look at waste (States of Jersey May 2005)

The following analysis briefly summarises relevant points from the report and includes reference to the paragraph numbers in the original document for ease of reference.

> *"1.0 (6.1 3) The Committee will ensure removal of the electronic/electrical waste components from the material delivered to the Energy from Waste plant, thus reducing the amount of hazardous constituents appearing in ash. This will allow the bottom ash to be recycled as construction aggregate.*

1.0 (6.1 4) The Committee will ensure that fly ash and flue gas treatment residues [combined as APCr] *are disposed of safely in managed landfill in accordance with best practice.*

1.3 The Basel Convention… requires signatories to handle and dispose of their waste in an 'environmentally sound manner'. In general terms this provides that jurisdictions should deal with their own wastes within their own boundaries, unless it is 'not possible for them to do so'. It seems unlikely that Jersey could argue that this exemption applies, as Jersey has successfully dealt with the bulk of its waste for decades. The Waste Management (Jersey) Law 2005 has just received approval from the Privy Council, and will allow the Convention to be extended to the Island… this will permit the export of certain forms of hazardous waste that Jersey does not have the capacity to deal with.

4.1 Approximately 70% of the residue sewage sludge… is dried after the completion of the digestion process [and] *recycled as an agricultural fertilizer. If the land bank is unavailable… the pellets will be diverted to the Energy from Waste plant.*

4.5 Currently the residue from the fragmentising plant, which is a mixture of plastics, rubber, insulation and some embedded metals, is returned to the Energy from Waste plant for incineration…

The [EfW] *bottom ash… contains a proportion of metals* [which] *passes through the plant without treatment… inappropriate metal objects can cause severe problems within the plant and hazardous components (e.g. cadmium and lead) from electrical and electronic goods contaminate the ash. A metal separator removes large ferrous and non-ferrous materials from the bottom ash.*

4.9 Removal of electrical and electronic goods… increases recycling rates [and] *removes many of the hazardous contaminants from the residual waste stream, allowing bottom ash from the Energy from Waste plant to be recycled as an aggregate.*

5.1 Dependent on composition, bottom ash… can be recycled as aggregate, because it is inert and contains limited amounts of hazardous components. Any ferrous metals it contains could be recovered.

5.2.1 The waste burnt at the Bellozanne incinerator is different from… most UK municipal plants because shredded industrial and bulky waste (such as electrical goods, tyres, and carpets) is added to the municipal solid waste in Jersey. An investigation into the composition of the bottom ash… carried out in 2002, suggested that, although total concentrations of constituents were generally within the range of values of other UK MSW bottom ashes, the variability of the waste is the main factor affecting ash quality. Electronic goods and commercial waste contribute to high levels of lead, copper, zinc, mercury, nickel, zinc and antimony, so that they exceed the landfill waste acceptance criteria for hazardous wastes, under certain pH conditions… This supports the case for responsible and careful segregation of wastes containing high levels of toxic materials. The reuse and recycling of electrical and electronic goods will reduce the amount of heavy metals appearing in ash, allowing the bottom ash to be recycled as a secondary aggregate.

6.2 The intention is to continue with the disposal of… solid hazardous waste in secure pits, in the short term. If no suitable site can be identified in the Island when La Collette is full, it may be necessary to export this waste to secure sites overseas. Alternative treatment systems of [APCr] *will continue to be evaluated and will be adopted, if they can demonstrate environmental benefit.*

> *6.3 Long-term options for the treatment of* [APCr] *will be considered, such as continued disposal in sealed pits, export to disposal facilities in Europe or in-Island treatment.*
>
> *6.4 The Committee will ensure that* [APCr is] *disposed of safely, in managed landfill, in accordance with best practice.*
>
> *Appendix B* [In relation to] *The Waste Electrical and Electronic Equipment Directive, End of Life Vehicles Directive, and the Disposal of Fridges Regulation… The main benefit of implementing such legislation in Jersey will be a reduction of hazardous materials going through the incinerator, from fragmentiser residues and from waste electronic equipment. Electronics are thought to be responsible for a large proportion of the mercury, lead, and copper in incinerator emissions, as well as a source of chlorine through PVC. Copper is a catalyst in the formation of dioxins, and its removal from the incinerator feedstock provides the double effect of removing the catalyst for dioxin production, as well as heavy metals in the ash or air emission control systems.*

Detailed analysis of each relevant point is not provided as opinion in relation to ash disposal has evolved since the Strategy was published. The Strategy does confirm a commitment to remove WEEE from the EfW facility to allow IBA to be recycled. TTS has more recently confirmed vehicle shredder waste will be excluded on completion of a revised scrapyard contract (refer to Section 5.3) and this supersedes the Strategy comment (original document paragraph reference 4.5). No commitments are made in relation to excluding other materials with the potential to affect IBA quality, for example batteries, tyres and treated wood waste although TTS (refer to Section 5.6) does not consider this adversely affects IBA quality.

The APCr disposal option is identified as landfill according to best practice. The Strategy does not consider APCr export for disposal to be a viable option. The Strategy does commit to evaluating alternative APCr treatment systems which will be adopted if they demonstrate environmental benefit.

3.2.11 Water Pollution (Jersey) Law 2000

This document has not been reviewed within the scope of this review.

3.2.12 Waste Management (Jersey) Law 2005

This document has not been reviewed within the scope of this review.

3.2.13 La Collette Reclamation Site – Construction, Demolition and Excavation Waste Processing. Working Plan. (May 2012)

This document has not been reviewed within the scope of this review.

4 Review of Submissions to Scrutiny

4.1 Introduction

Table 4 lists members of the public and organisations that made submissions to the Panel. A summary and review of the relevant content of the submissions is provided in Section 4.2. Section 4.3 provides a summary of the responses including simple statistical analysis.

Table 4: Submissions received

Ref	Reference for individual or name of organisation	Description (where relevant)
1	Private individual 1	
2	Private individual 2	
3	Private individual 3	
4a	Private individual 4	Letter to the Chief Minister, 7 March 2012
4b		Response from the Chief Officer, TTS, 23 April 2012
5	Private individual 5	
6	Private individual 6	
7a	Save Our Shoreline (SOS)	Report entitled "*TTS (Transport and Technical Services) and SOS work together to find a solution to Jersey's ash problem - and TTS Minister gives a promise on Guernsey's waste*", Spring 2012.
7b		Petition to States Members, 26 April 2012.
7c		Report entitled "*What really happened at EfW*", 26 April 2012.
8	Private individual 7	
9	Private individual 8	
10	Save Our Shoreline (SOS)	Additional submission entitled "*Ash Disposal. Management of solid residues from incineration*".
11	Marine Biology Section, Société Jersiaise	
12	Jersey One World Group and Jersey Chamber of Commerce Sustainable Business Forum	
13	Private individual 9	

4.2 Summary and Review of Submissions

4.2.1 Private individual 1

"We should, I believe, ensure that our current fly ash disposal methods do not result in future environmental problems.

There are several processes which enable… fly ash and rendered inert, for example by… treating by vitrification.

The problem, as always, is the cost.

I am surprised that metal [is] still being disposed of by land reclamation."

Comments focus on fly ash (APCr), which the respondent is aware is not inert, and ensuring current disposal practices do not cause environmental problems. The respondent is aware of APCr treatment options, described in Section 6, but introduces the issue of cost. The last statement from the extract has been interpreted in the summary as a request for metals to be recycled from ash (IBA) before disposal.

4.2.2 Private individual 2

"Minimise amount of ash produced, since it is toxic. Household recycling… should be compulsory".

"Ash should be made into construction materials… It should not be buried in the environment where its toxins then leach into the groundwater… The lined pits where it is currently buried have already been breached and ash is now polluting the sea at high tides. Jersey must learn from past mistakes and do better".

"It should not be made into a headland. This is highly toxic material, containing carcinogens, such as dioxins... Future generations should not have to deal with our toxic problems".

"Only when we have an acceptable policy for dealing with our own ash, should we even begin to consider dealing with others' (i.e. Guernsey's) rubbish."

Comments show awareness of a number of relevant issues including toxicity of ash, although comments are not specific to APCr and IBA. The respondent strongly agrees with recycling to minimise ash quantity and the recycling of ash in construction materials. The respondent states a belief that current practice has led to pollution and this requires alternatives to landfill disposal. Independent of this the respondent does not want ash to be used in the headland due to the 'legacy' and strongly agrees that Guernsey waste should not be accepted until the ash disposal policy is 'acceptable'.

4.2.3 Private individual 3

"If Jersey does not know what to do with it, what will happen if we take on Guernsey's waste?"

The comment has been interpreted in the summary to mean that Guernsey waste should not be accepted until there is an acceptable ash disposal policy.

4.2.4 Private individual 4

The respondent presents a letter that he wrote to the Chief Minister in March 2012 and which includes his opinion on the disposal of ash. The letter primarily relates to the importation of waste from Guernsey. The respondent states that his letter was subsequently passed to TTS but that at the time of writing he was yet to receive a reply. A reply from TTS to the respondent is however included in the submission from the Scrutiny Officer and has also been reviewed.

4.2.4.1 Letter to the Chief Minister, 7 March 2012

> *"After incineration, the residue of toxic ash has to be catered for… If it is re-exported to Guernsey… the transport of this material may be subject to international rules that may well change over time and this eventuality should be covered in any agreement.*
>
> *Should the ash remain in Jersey, the present method of stockpiling it in concrete silos may be acceptable but what happens when the present facility can take no more? That problem will have to be solved but the addition of the Guernsey ash will bring that time and cost nearer".*

Comments show awareness of the toxicity of ash and international legislation governing the shipment of waste, in the context of returning ash to Guernsey. Ricardo-AEA is not aware that there is or has ever been a policy to stockpile ash in concrete silos in Jersey, as mentioned in the response. The respondent appears concerned that accepting Guernsey waste will shorten the life of disposal facilities and the implications of this.

4.2.4.2 Response from the Chief Officer, TTS, 23 April 2012

> *"It is very unlikely that the ash from Guernsey waste would remain in Jersey. Whilst it is always possible that international regulations regarding the shipment and transport of waste may change in the future a good record of responsible ash shipment and management would be used in mitigation if external pressure were to be used to prevent the shipment of ash."*

These comments have not been included in the summary of submissions to scrutiny.

4.2.5 Private individual 5

> *"I can't believe that the States are not recycling our waste ash. The States have to learn from previous poor decisions.*
>
> *Surely when this Incinerator was being planned let alone being built the most important item on the agenda should have been how the waste was to be disposed of safely and at the least risk to the environment.*
>
> *I feel very let down that… the States… have not been recycling this dangerous waste.*
>
> *We cannot bury it or build a headland from it, this is totally out of the question.*
>
> *If we do accept to take the waste from Guernsey [they] must then take back there recycled waste."*

The response presents a strong view in favour of recycling ash and opposing the disposal or use of ash to create a headland. The last statement from the extract agrees strongly with the need to return ash to Guernsey if Guernsey's waste is imported. The respondent also states that a method for safe ash disposal with least risk to the environment should have been determined before the La Collette EfW was operational; Section 3 presents a review of available documents reporting work undertaken to support the ash disposal strategy both before and after the La Collette EfW was operational.

4.2.6 Private individual 6

> *"Would it not be possible to use the "ash waste", mixed with crushed granite, cement or old crushed bricks… to make more bricks or blocks?"*

The respondent comments that the use of ash mixed with primary or recycled aggregates should be considered; this is included in options reviewed in Section 6.

4.2.7 Save Our Shoreline (SOS)

4.2.7.1 Report entitled "TTS (Transport and Technical Services) and SOS work together to find a solution to Jersey's ash problem - and TTS Minister gives a promise on Guernsey's waste", Spring 2012

This report includes a number of links, which as they form part of the opinion presented have also been reviewed at the relevant point in the document. Text that has been extracted from the links is clearly identified as such. The views of SOS have been fully taken into account in the summary in Section 4.3 but where the opinion is repeated within or between Sections 4.2.7 and 4.2.10 only one instance is recorded in the summary.

> *"We believe that the current method of burying [the ash] in lined pits at La Collette is no longer acceptable. The prospect of an ever growing 'artificial toxic headland at La Collette as planned by TTS is a path that in our opinion would be a dreadful legacy for our children and grand-children to deal with in future years as well as being yet another terrible blot on the coastal landscape, already irrevocably scarred."*

The following text is extracted from the linked document entitled *"Save Our Shoreline, July 2011. Proposed new artificial 'headland' at La Collette"*.[13]

> *"An artificial 'headland'… at La Collette… to a height of 20 metres above the height of the present reclamation… would be over a period of years…* [TTS'] *answer to disposing of toxic ash produced by the incinerator. The plan would entail the building of superfilled ash cells to form a large artificial 'headland' which would screen the fuel farm from view from the east but would not screen the incinerator.*
>
> *Our concerns… are the impact on the marine environment, from possible leachate escape beneath the pits..., run off of leachate from rainwater, and wind blown ash into the Ramsar area. The visual impact of this project will also need to be carefully assesed, as will the possible dangers to the workforce in handling this toxic material and its possible effect on the flora and fauna that inhabit the area now and that will inhabit the finished 'headland'.*
>
> *Assured that T&TS now follow standards of 'best practice'.*
>
> *The Executive Summary* [Capita Symonds, April 2011] *considered off island disposal and concluded "Disposal off Island has not been considered as viable alternatives are available. As such, off Island disposal is unlikely to be permitted due to the requirements of the Basel Convention. The UK extended its ratification of the Basel Convention on the Transboundary Movement of Waste to include Jersey in 2007."*
>
> *SOS accept that we as an island are responsible for disposal of our ash. We ask if other options have been considered? One such option to explore may be to vitrify the ash to make them inert, and use the blocks in a positive way."*

The following text is again extracted from the core document.

> *"TTS have given SOS an assurance that the APCr residues… will now not be buried in lined pits at La Collette as previously planned. New ways are being sought to deal with both components of the ash, preferably on island. This includes the larger volumes of bottom ash… TTS have also given SOS an assurance that Guernsey's waste will not be imported unless either the ash component is shipped back to Guernsey after incineration, or TTS are able to deal with it safely using new technology.*

[13] http://www.jerseyinperil.com/july11.html

> *SOS have been looking at options for treating the APC residues… including plasmafication… and also an innovative new treatment using liquid carbon dioxide which turns the fine ash into small solid balls which do not leach the heavy metals which are 'captured'. Both processes mean that the ash could be re-useable as aggregate.*
>
> *A plasma plant could cost up to £5m according to the Minister* [for Transport and Technical Services]*, but SOS believe that an Accelerated Carbonation Technology (ACT) plant would cost less.*
>
> *TTS have promised to look into this method… patented by UK company Carbon 8* [and] *licenced by the UK Environment Agency and is currently being used in Brandon, Suffolk, as the local authority's preferred option. The facility is very modest in size and uses little energy, unlike plasma technology.*
>
> *We agree with the Minister that whichever technology is chosen, all options must be looked at and only the best solution used."*

The following represents a transcript of the relevant sections of interviews carried out by an independent journalist and referenced on the SOS website. The title of each interviewee is provided, followed by relevant comments.

Chief Officer TTS:

> *"What we're looking at is a possibility that Guernsey's waste comes here but their ash either goes back to the UK or back to Guernsey for treatment.*
>
> *The [APC residues] will probably initially be exported to UK for either treatment or storage in a salt mine with potentially an on-site solution in Jersey in a few years time… we're looking at recycling bottom ash on both islands."*

SOS Co-ordinator:

> *If Guernsey wants to send their waste* [to Jersey] *they have to be responsible for receiving the ash back… We can't be dealing with their ash as well if we can't already find a solution for our ash… The plan is that they will form an artificial headland made of superfilled cells one upon the other and this will be cells full of toxic, hazardous waste lined with butyl liner and sand which we are very much opposed to but they've already started it.*
>
> *At the moment we don't know what the effects will be* [on the Ramsar site]*. We're worried about heavy metals leaching off the bottom of the pits."*

The SOS Co-ordinator raises concerns over potential pollution and comments on alleged breaches of ash cells in 2009. As this alleged event pre-dates the EfW facility at La Collette it is not within the scope of this review.

Deputy Rob Duhamel, Planning and Environment Minister:

> *"I have to look to following environmental best practice and principles… When the States made the decision about an incinerator they didn't actually look at the full life cycle costs and one of the biggest elements that was left out was that were no monies put aside for proper environmental ash remediation methods. These things are now being considered at the insistence of the environment department.*
>
> *The vitrified ash can actually be used for landfill and trench-fill.*

4.2.7.2 Petition to States Members, 26 April 2012

No relevant content was identified in this report which relates to the cooling water discharge permit at the EfW facility at La Collette.

4.2.7.3 Report entitled "What really happened at EfW", 26 April 2012

No relevant content was identified in this report which relates to health and safety and leachate issues during construction of the EfW facility at La Collette.

Comments show awareness of a number of relevant issues. The respondent strongly agrees that ash should not continue to be used to form a headland, citing a legacy issue and visual impact, which in the respondent's opinion is already a significant detrimental issue. The respondent mentions ash toxicity and the role of the headland to screen the La Collette industrial area but does not confirm whether this is considered beneficial.

In relation to environmental impacts there appears to be a conflict between acceptance of assurance that TTS now follows best practice whilst outlining concern in relation to potential harm to human health (workforce) and pollution of the aquatic environment and ecosystems caused by the escape of leachate, contaminated rainwater and windblown ash. Available documents reviewed in Section 3 appear to address these issues, specifically:

- **Pollution.** Section 3.2.8 presents a summary and reviews a November 2011 report on water quality monitoring that concluded the water quality in the sea surrounding the site was generally of a quality that would not be of concern for the sensitive receptors with results indicating the ash cells provide effective containment.
- **Human health.** Section 3.2.9 presents a summary and reviews the May 2012 La Collette headland working plan. This document relates to the current process to licence operations at the site, as described in Section 5.4, representing the regulation of the site to ensure operations are carried out without endangering health or the environment. Scope includes control of leachate and dust.

The respondent accepts ash should be managed on island but asks (July 2011) if TTS has considered other treatment options. Section 3 summarises TTS documents that considered treatment options and which date from September 2010 (refer to Section 3.2.3) with a more detailed assessment of technical options completed in April 2011 (refer to Section 3.2.6). Both documents pre-date the respondent's question. The respondent cites TTS assurances that APCr will 'not be buried in lined pits' and Guernsey's waste will not be imported unless the ash is returned or treated using new technology. The respondent describes vitrification and carbonation technologies, both described in Section 6.

4.2.8 Private individual 7

> *"Perhaps you may look around to see what is happening in Europe and how it is dealt with there."*

The comment proposes a review of ash management strategies in Europe; the technology review in Section 6 considers ash treatment technologies that are available globally.

4.2.9 Private individual 8

> *"What is the nature of the toxins in the ash? How harmful are they? How long do they take to break down?*
>
> *Apparently it is possible to make the ash into blocks for house building, but without knowing the nature of the toxins in the ash, it is hard to know whether that would be storing up trouble for the future.*
>
> *Otherwise, I would recommend recycling the ash… using it to make blocks, or any other suitable recycling. Or use it to build a headland, provided again there won't be future problems from the toxins. Finally, the least useful option is to bury it.*
>
> *If the* [EfW] *Plant has spare capacity, it would make sense to take waste from Guernsey, provided the problem of the ash has been resolved satisfactorily."*

The respondent raises concern in relation to ash toxicity and the need to know the nature of the ash before potentially using it in blocks. The respondent is the only one that accepts use of ash to build a headland provided there will be no future problems. The respondent would also accept Guernsey waste if the ash issue is resolved.

4.2.10 Save Our Shoreline (SOS) additional submission entitled "Ash Disposal. Management of solid residues from incineration"

> *"An ash management strategy needs to be in place along with the understanding of the physical and chemical properties of the materials and any regulations governing their disposal.*
>
> *The key questions here are: Is the material a hazardous waste? Is the material acceptable for landfill?*
>
> [APC residues] *will not be permitted to landfill once the WAC are implemented.*
>
> *Methods of treating APC residues are solidification, stabilisation and thermal treatment. Solidification involves the encapsulating of the residues in cement to reduce leachability. Stabilisation consists of adding reagents that react with the soluble hazardous components reducing their solubility. Thermal treatment results in the formation of an inert glassy material, however this process has drawbacks such as being expensive and energy intensive and releases mercury, zinc and lead.*
>
> *La Collette is not suitable for the landfill of APC residues. The best long-term solution would be to stabilise the APC and reuse as an aggregate."*

SOS comments are additional to those reviewed in Section 4.2.7. The respondent states the need for an ash management strategy (this has been in place since October 2011) and an understanding of the ash properties. TTS has confirmed testing will be carried out and some testing is already underway, as described in Section 5.3. The respondent mentions options to treat ash (refer to Section 6), is pragmatic in assessing vitrification as being expensive and energy intensive, and states a preference of APCr stabilisation for reuse as aggregate.

4.2.11 Marine Biology Section, Société Jersiaise

> *"Société Jersiaise would like to highlight primary importance of preventing toxic materials from the incinerator enter the islands terrestrial or marine environments…*
>
> - *Every effort should be made to divert waste containing serious pollutants such as batteries from the EFW.*
> - *All waste output from the EFW should be cleaned as effectively as possible to remove toxins such as heavy metals.*
> - *Non toxic waste ash should, if possible, be recycled into a useable material such as building aggregate. If ash containing potential harmful pollutants was also to be locked into aggregate its final point of use should be noted and appropriate disposal enforced at end of life.*
> - *The MBS is not against the importation of waste from Guernsey on the condition that they would accept a representative proportion of the waste products back after incineration and commit to dealing with them in an environmentally sound manner.*
>
> *It is essential that Jersey's waste solution removes the need for further land reclamation* [in addition to the La Collette footprint].
>
> *Any long term solution to Jersey's waste problem must have the protection of the island's marine and terrestrial environment at its core. Damage to these will also have knock on effects for tourism, aquaculture and other core local industries."*

The comments mention an overriding need to protect the terrestrial and marine environment and again mention ash toxicity. A pragmatic control over ash quality through removal of wastes such as batteries is mentioned. The May 2005 Solid Waste Strategy (refer to Section 3.2.10) appears to support this although batteries were not specifically mentioned, the focus being predominantly on WEEE.

The second statement from the extract is interpreted as a need for effective EfW gas cleaning, which is in place, as described in Section 2.3. The comments support the use of ‘non-toxic’ ash as aggregate or all ash if the pollutants are locked into the aggregate and the point of use is noted for end of life disposal. The respondent would also accept Guernsey waste if the ash was returned and appropriately dealt with. Finally the respondent states strongly that no land reclamation in addition to the La Collette footprint should take place.

4.2.12 Jersey One World Group and Jersey Chamber of Commerce Sustainable Business Forum

“Of prime concern now is to do all possible to control the dangers of toxic materials from the plant entering the environment… concentrate on ash disposal and the limitation of harm to the environment

Vital… to do all that is possible to... prevent as much as possible of waste of a toxic nature, e.g. heavy metals entering the stream thus removing as much as is practical in the way of pollutants from the residual ash. This will then leave a residual product capable of use as aggregate for road building etc. with minor pollutants locked into the same.

If… we [Jersey] are to import waste from Guernsey… the same rules should apply… negotiate to return the appropriate proportion of the residual to them for their use.”

The respondent focuses on the need to protect the environment and mentions ash toxicity. A pragmatic control over ash quality through the prevention of ‘waste of a toxic nature’ from entering the EfW is proposed before using ash as aggregate. The respondent would accept Guernsey waste if the ash was returned.

4.2.13 Private individual 9

“I am astounded that the subject of what to do with the 'toxic ash' was not discussed to conclusion before the signing of the contract to build the incinerator at La Collette.

What is being incinerated that contains toxic materials?

Do not burn toxic materials, break them down into component parts and sell them.”

The respondent strongly suggests that the method for ash disposal should have been determined before the La Collette EfW was built; Section 3 presents a review of available documents reporting work undertaken to support the ash disposal strategy both before and after the La Collette EfW was operational. Control over ash quality through the prevention of toxic materials from entering the EfW is proposed.

4.3 Summary of Responses

With the exception of SOS comments, respondents generally refer to ‘ash’ rather than its components, whether referring to IBA, APC, fly-ash or other terms. This may indicate a lack of understanding, particularly in relation to the new EfW facility where different ash streams are produced and segregated. The reasons for this lack of understanding are not known. The percentage of respondents that ‘strongly agree’ or ‘agree’ with each statement is presented in Table 5 in relation to 12 responses with the SOS responses (refer to Sections 4.2.7 and 4.2.10) being considered as a single response for purposes of this summary.

A strong theme is the acceptance of ash as recycled aggregate (58% of respondents). Consistent with this 50% of respondents strongly agree that ash should not be used to build a headland. Respondents are also strongly aware (50%) of the potentially hazardous nature of ash but comments are overall pragmatic in proposing management options.

Table 5: Summary of responses

Ref	Issue	Strongly Agree	Agree	Total	% (of 12)	Disagree
Current ash disposal methods						
1	Ensure current disposal doesn't cause future environmental problems; concern of existing problems (including visual); learn from past mistakes	2	1	**3**	**25%**	
2	Assured TTS now follows best practice	-	1	**1**	**8%**	
Future ash disposal/recovery methods						
3	In future ash should not be buried/used ('legacy') in headland; concern of risk to environment (including visual) and human health (including workforce)	6[1]	-	**6**	**50%**	1[2]
4	No land reclamation in addition to La Collette	1	-	**1**	**8%**	
5	Ash should be recycled/made into construction materials (including without creating a legacy)	2	5	**7**	**58%**	
6	If ash containing potential pollutants is used in aggregate note point of use for end of life disposal	-	1	**1**	**8%**	
7	Aware of cost as an issue	-	2	**2**	**17%**	
8	Remove toxins such as heavy metals from ash	1	1	**2**	**17%**	
9	Metal content of ash should be recycled	-	1	**1**	**8%**	
10	La Collette is not suitable for APC disposal; landfill not permitted once WAC implemented	-	1	**1**	**8%**	
11	All treatment technologies should be considered; consider what is happening in Europe	-	2	**2**	**17%**	
12	Appropriate ash 'disposal' method should have been determined during planning of EfW	2	-	**2**	**17%**	
Ash quantity and quality						
13	Divert wastes such as batteries from EfW	1	-	**1**	**8%**	
14	Minimise quantity of ash through waste recycling	1	-	**1**	**8%**	
Ownership						
15	Jersey is responsible for managing ash on-island	1	-	**1**	**8%**	
16	Ensure acceptable ash policy before accepting Guernsey waste; or return ash to Guernsey	2	5[3,4]	**7**	**58%**	
17	If ash is exported to Guernsey potential change in international laws should be covered in agreement	-	1	**1**	**8%**	
Awareness of ash characteristics						
18	Aware of hazardous ('toxic') nature of ash			**6**	**50%**	

1 One respondent stated that TTS had given its assurance that disposal of APCr in lined pits will not happen.
2 Less preferable to recycling but more preferable to disposal (without land reclamation) provided there are no ‘future problems from the toxins’.
3 One respondent caveated the requirement to send ash to Guernsey by stating a commitment to deal with it in an environmentally sound manner should be made.
4 One respondent stated that TTS had given its assurance that Guernsey’s waste would not be imported unless the ash is returned to Guernsey or new technology is in place to deal with it.

5 Review of Outcomes of Departmental Meetings and Public Hearings

5.1 Introduction

To support the review Ricardo-AEA attended the following meetings, the outcomes of which are summarised in the following sections.

- Meeting with representatives of TTS, 20 June 2012
- Meeting with representatives of TTS, 26 July 2012
- Meeting with representatives of Department of the Environment, 26 July 2012
- Public Hearing, Minister for Planning and Environment, 21 September 2012
- Public Hearing, Minister for Transport and Technical Services, 21 September 2012

5.2 TTS, 20 June 2012

Ricardo-AEA met with the TTS Assistant Director – Solid Waste. The Scrutiny Officer was in attendance. TTS led a tour of the EfW ash handling plant and La Collette site prior to discussing documents available to support the review.

TTS identified a landfill cell containing shredded bulky waste and confirmed the intention was to remove the material and treat through the EfW facility after full acceptance at a rate of approximately 50 tonnes per day (tpd). This is intended as a pragmatic measure to maintain feedstock consistency and therefore control emissions and volumes of APCr. TTS confirmed annual throughput is currently approximately 70,000 tonnes per year.

TTS stated the future strategy for IBA management was disposal in a ‘super cell’. APCr was currently being deposited in flexible industrial bulk containers (IBCs) in cell 33 with bags stacked 2 high. TTS stated cell 33 was designed to UK hazardous waste landfill standards, being double lined with electrical leak detection. Cell 33 construction was discussed and is described in Figure 4. TTS stated there was a strong political will to export APCr in the future and the stacking of bagged APCr could facilitate its later removal.

TTS also stated that lime for APC is imported from Buxton and tankers return empty, giving a potential transport option. TTS estimated transfer and transport costs at around £100/t. TTS stated the APCr silo has a capacity of 27-28 tonnes, being consistent with a tanker load or a 40-foot lorry trailer could carry 24 bags (24 tonnes). TTS stated that permits for cells at La Collette were in progress and planning and EIA decisions might require an export option.

TTS described potential IBA testing using Professor Keith Knox who carried out similar work on IBA from the Isle of Man, and using the same method and determinands etc. Testing would determine chemical composition and ‘worst case’ leaching using lysimeter tests.

5.3 TTS, 26 July 2012

Prior to meeting Department representatives Ricardo-AEA met the aggregates recycling operator at La Collette and with responsibility for ash handling (“the operator”). The Scrutiny Officer was in attendance. The operator described and demonstrated a trial to screen IBA to separate metals rich fractions which had been demonstrated to the Scrutiny Panel on the previous day. The result of the trial showed apparently considerable quantities of metals that can be separated by screening larger size fractions. Ricardo-AEA is not clear whether the trials were supported by TTS or would potentially lead to larger scale operations to recover metals.

Ricardo-AEA met with the TTS Director of Operations and TTS Chief Officer. The Scrutiny Officer was in attendance. TTS commented in relation to the IBA trial being carried out by the operator that everything was an option. TTS also confirmed that IBA testing was in progress with Knox Associates (refer to Section 5.2). TTS stated its intention to develop a Ballast Phoenix type operation at La Collette in the future and stated its belief that the use of IBA as aggregate would only be viable in a blend (e.g. with recycled aggregate).

TTS confirmed that scrapyard waste would be dealt with through a new contract to depollute, crush and export end of waste vehicles thereby removing scrapyard waste from the EfW input before IBA recycling would be considered. TTS stated that it would not discount IBA export for recovery. TTS also commented in relation to the older, shredded bulky waste (refer to Section 5.2) that this was high chlorine, low CV material and whilst it is being treated the EfW input would probably not be considered ‘steady state’ or ‘normal operations’. TTS stated that it may take around 12 to 18 months to deal with this material and lime input may be up to double that required under ‘normal operations’.

TTS discussed APCr acid washing processes, stating that Jersey would not import acids for this type of processing and that acid washing as pre-treatment for landfill would not deal with the legacy issue. In addition TTS commented that leachate would have to be managed. TTS also stated that it would not rule out APCr export for disposal and that it was pursuing this option in relation to the Minosus facility.

5.4 Department of the Environment, 26 July 2012

Ricardo-AEA met with the Director of Environment and Deputy Chief Officer, Department of the Environment (“the Director of Environment”), the Director, Environmental Protection (regulatory remit), the Principal Planner (planning and EIA remit) and Business Manager. Malcolm Orbell, Scrutiny Officer was in attendance. The Head of Waste (including permitting) was unavailable.

The Director of Environment confirmed Environment has a remit for environmental policy, excluding waste policy which is within TTS’ remit, and is a consultee in the EIA process. He further confirmed Environment has opportunities to influence TTS at the planning and permitting stages to ensure issues are dealt with appropriately and the Director, Environmental Protection confirmed Environment seeks to be involved early in the process e.g. during EIA pre-scoping whilst maintaining a balance between influencing and regulation.

The Principal Planner stated that the Environment Minister’s concern was whether there had been sufficient consideration of alternatives for ash disposal. The Director, Environmental Protection stated that he considered the Strategy (refer to Section 3.2.2) to be ‘lightweight’. The Director of Environment stated that alternative options depend on environmental, economic and export realities; in relation to export Jersey has the finance, resources and land to deal with ash appropriately on island. Environment does however propose to meet the Technical Advisor to the Environment Agency’s International Waste Shipments Team (refer to Figure 5) to discuss what information the Agency would require to consider a DRR encompassing APCr and potentially the likelihood of a DRR being approved. The Director, Environmental Protection confirmed the precedent of the Isle of Man DRR to export APCr to UK.

The Director of Environment also confirmed a DRR was accepted to ship hazardous waste to the UK following implementation of the Waste Management (Jersey) Law 2005. The Principal Planner commented that it was difficult to see why Capita Symonds ruled out export of APCr for disposal (refer to Section 3.2.5, original document paragraph reference 2.2.15).

The Director of Environment commented in relation to existing ash streams the need to ensure they are dealt with in an environmentally sound manner. The Director, Environmental Protection stated that the regulator is happy that the current option poses no risk to the environment and can be regulated and that the APCr cell design is the best practical option for Jersey. He also stated that sampling in line with Water Framework Directive requirements is in place, inferring this provides confidence that any pollution would be picked up. The Director, Environmental Protection stated a full year of monitoring has been completed at La Collette including tidal flow, drainage, off-site biota etc.

Permits are being produced with the EfW permit prioritised and La Collette to follow, in close liaison with the monitoring strategy to be agreed by Environment. The Director of Environment confirmed the 2005 law has a transitional period such that facilities including the headland are deemed lawful until the licence is determined. The Director, Environmental Protection confirmed Environment commented on the scope of the ash characterisation trials. The Director of Environment confirmed that should Guernsey waste be accepted the ash would likely have to be retained as the regulator must be assured that sustainable methods are applied in the receiving jurisdiction.

5.4.1 Meeting with the Environment Agency, September 2012

Following the meeting with the Department of the Environment on 26 July 2012, and consistent with the stated commitment, Ricardo-AEA understands that a meeting was held in Jersey in September 2012 between the Department and the Technical Advisor to the Environment Agency's International Waste Shipments Team. The following summarises the outcomes of the meeting reported by the Department of the Environment in relation to the DRR application.

The regulator emphasised that it was important from an Island perspective to ensure that all hazardous wastes included on the DRR request (not just APCr) were fully categorised and that the request adequately explained and answered all relevant arguments under the guiding principles for DRRs in the UK Plan for Shipments of Waste, as a poor application could have resulted in an immediate refusal. The full list of reasons given in the DRR application in respect of APCr was as follows:

- It is recognised that the incineration residues from the new La Collette EfW plant, IBA and APC, should not be co-disposed and that the highest engineering standards of containment cells must be applied to provide environmental protection.
- The best practice engineering standards required by the EC Landfill Directive and particularly requirements for a natural or artificial geological barrier as part of the hazardous landfill site containment cells is not feasible in Jersey where indigenous clay for use in engineering is not available [refer to paragraph 3.2.3.1].
- More sustainable options should be given precedence over the disposal of APC residues in landfill. Given the lack of any geological layer, (which may result in a legacy for future generations of reconstructing cells when polymeric liners reach the end of their design life) the acceptability and sustainability of land filling hazardous waste at La Collette is in doubt.
- The relatively small waste input compared to the wastes available to an EC Landfill Directive compliant hazardous waste landfill in the UK is an economic factor.
- There are a number of emerging technology options for the increasing quantities of APC residues being produced at EfW plants in the UK including recovery options. These may be more sustainable solutions for Jersey either by export for recovery or by developing local on Island facilities [refer to Section 6.4]

The Department of the Environment stated that it will take time to fully assess and choose a more sustainable option, noting that TTS' 'Road map for the future management of EfW Ash' sets out the options for APC and IBA ash from the plant. The Department of the Environment confirmed that a DRR period of 5 years has been chosen because this is the time period within which the review and investigations of any capital funding application/approval into the viability of other treatment techniques for APCr can be carried out.

5.5 Public Hearing, Minister for Planning and Environment, 21 September 2012

This section presents comments and issues arising from the hearing that are considered important to the outcome of the review. This section does not represent the minutes of the hearing. A summary of the most significant issues is provided in Section 5.5.1. Unless IBA or APCr is specifically referred to the responses refer to both ash streams. In attendance were:

Deputy Robert Duhamel	Minister for Planning and Environment
Deputy John Young	Chairman Environment Scrutiny Panel
Deputy Steve Luce	Vice Chairman Environment Scrutiny Panel
Connétable Phil Rondel	Member Environment Scrutiny Panel
	Chief Executive Officer, Department of the Environment
	Director of Environment
	Business Manager, Department of the Environment
	Head of Waste Regulation, Department of the Environment
	Scrutiny Officer, States Greffe
	Environment Panel Advisor, Technical Director Ricardo-AEA

- Current option is disposal at La Collette to build a headland. This is at the bottom of the waste hierarchy and not best practice. Environment will ensure no harm or pollution; regulatory powers are sufficient to deal with the facility. Regulatory role is confined to technical details to ensure no harm; policy remit does not extend to waste. No problem with hill for amenity and separation from fuel farm; problem is what's in it.
- The Minister stated he is always open to move to more sustainable options in accordance with the hierarchy. When the EfW project was agreed the Minster was aware it would need more sustainable elements in the future and recognised there would be further review; ash management was always seen as temporary.
- The whole ash management strategy is still to be considered; there are no current applications to determine. The Chief Officer confirmed pre-application discussions in relation to future ash solutions are on-going. Future options for IBA depend whether TTS or an operator makes an application via Environment to process or export.
- Also consider overall waste management principles; preferable to introduce up-front sorting, specifically metals, to prevent the problem. Environment has a section that encourages TTS in relation to recycling but limited powers. Need better schemes to encourage public to exclude materials.
- The Minister agreed that removing WEEE and vehicle shredder waste is part of the solution; can invoke powers to review the waste strategy for specific waste streams.
- Stated CCA [chromated copper arsenate] treated wood is being burned and there is no recycling scheme to stop mercury getting into the waste stream. TTS should work to take batteries out and Minister is encouraged by the makings of a battery recycling scheme. Maybe add more materials e.g. tyres where there are other recycling routes.
- TTS is undertaking short-term trials on IBA weathering for secondary aggregate. Minister does not consider this technology is formerly established; is undecided if it is best available. Involves open-air treatment near the harbour. Minister supports trials but would be more supportive if there was a comprehensive review of all technologies; Minister cited vitrification, ACT and metal washing techniques.
- Regarding criteria to enable Environment to judge if IBA is appropriate quality for reuse the Minister stated IBA must be stable to ensure hazardous components don't present leaching problems. Officers stated TTS trials will consider what leachable components are present after maturation; important as water resource is protected.

- When asked would Environment expect TTS to present outcomes of a site specific risk assessment, including comparison with acceptable threshold levels, the Minister replied ‘absolutely’; expect TTS to take a risk-based approach. The Director of Environment stated TTS would confirm leaching potential where used and show risk assessment results; work together to demonstrate limited risk to environment.
- When asked if TTS had considered all ash management options the Minister stated a missing option is upfront sorting which should be at the forefront to achieve better ash quality. The Minister appeared to suggest this might negate the need for treatment but later stated if IBA is non-hazardous officers could consider treatment on Jersey.
- The Minister did not identify a preferred APCr option; stated try to achieve best available option in line with the waste hierarchy, i.e. recovery preferred. Would support option of German salt mines if this was a recovery process, as this is further up the hierarchy. Stated caution over salt mine storage as storing APCr in an inert state or recovering value makes better sense. Ruled out storing in tunnels in Jersey.
- The Minister stated ‘in-ground, in-situ’ plasma arc is high on his list of APCr options. When asked about infrastructure (including APC) the Minister accepted this was required, and that there are aqueous acid and APCr outputs. Considers vitrification is an option for APCr in cell 33 as TTS has indicated 12-18 months remaining capacity in cell 33. Changes if Guernsey waste accepted, but not aware of TTS discussions.
- The Minister stated costs should be considered in-line with BATNEEC (best available technology not entailing excessive costs) but suggested Jersey can afford the best treatment possible; agreed with current option may eventually need another site.
- The Minister stated any DRR would be in his name. Officers stated they have a working relationship with Environment Agency. Minister stated have to show incapable of dealing with material on-island and is not sure this applies. The Chief Officer stated the Environment Agency does not consider the current option is a long term solution and DRR may be possible for APCr; confirmed in principle discussions have started.
- Discussion of DRR and export permissions. The Minister cited uncertainty over the process Jersey must subscribe to, i.e. independent or as UK. Stated law suggests Jersey can enter import/export agreements for disposal or recovery with any Basel signatory if ensuring no harm or pollution. The Minister did not consider UK would take into account visual impact.
- Officers implied Environment Agency agreed but advice, to be corroborated, was that Defra required permission to be sought from, and go through, UK as primary signatory and would only consider export beyond UK if no environmentally or financially sustainable options. Cited precedent of oil export to Belgium following Defra agreement on appropriate destination.
- The Minister stated in negotiation over offers from a number of French companies for export options from disposal in ‘lined pits’ to recycling (‘remediation’); stated preferred due to proximity. The Minister appeared to infer DRR process depends on destination but officers confirmed DRR is required for export to disposal to any Member State.
- The Minister confirmed it will be a commercial decision to treat waste in Jersey or export; also depends what makes sense in environmental terms. The Minister Stated Environment and TTS coming closer together on export and remediation.
- Regarding the current option the Minster agreed that not leaving a legacy is sound advice and environmentally responsible.
- The Minister stated he cannot see any economic or environmental advantages of importing Guernsey’s waste; is neutral, not opposed.
- In relation to exporting ash to Guernsey the Chief Officer stated the Waste Law sets out grounds for objection, which for export includes breach of the Basel Convention.

5.5.1 Summary of Significant Issues

1. Regulatory powers are sufficient to deal with the current ash disposal facility to ensure no harm to human health or pollution of the environment.
2. Current solution was always considered temporary; open to more sustainable options in accordance with the waste hierarchy including on-island treatment or export.
3. Encourage up-front sorting and recycling, including of metals, batteries and tyres to achieve better ash quality.
4. IBA weathering may not be best available technology; consider ACT and vitrification.
5. Take a risk-based approach to IBA use, including using site specific risk assessment.
6. Recovery of APCr is preferred; supports on-island vitrification including for 'legacy' APCr in cell 33 and considers this is achievable within remaining lifetime of cell 33.
7. DRR for APCr export to the UK may be possible but permission from Defra may be required for export beyond the UK.

5.6 Public Hearing, Minister for Transport and Technical Services, 21 September 2012

This section presents comments and issues arising from the hearing that are considered important to the outcome of the review. This section does not represent the minutes of the hearing. A summary of the most significant issues is provided in Section 5.6.3.

Deputy Kevin Lewis	Minister for Transport and Technical Services
Deputy John Young	Chairman Environment Scrutiny Panel
Deputy Steve Luce	Vice Chairman Environment Scrutiny Panel
Connétable Phil Rondel	Member Environment Scrutiny Panel
Deputy John Le Fondré	Assistant Minister for Transport and Technical Services
	Chief Officer, Department of Transport and Technical Services
	Principal Engineer, Department of Transport and Technical Services
	Senior Consultant, Fichtner Consulting Engineers
	Scrutiny Officer, States Greffe
	Environment Panel Advisor, Technical Director Ricardo-AEA

5.6.1 Incinerator Bottom Ash (IBA)

- Regarding whether TTS' stated commitment to IBA recycling, including IBA processing trials, market development and site specific risk assessment (SSRA), was still the position, the Minister replied 'absolutely'.
- Asked if implementing measures to exclude WEEE and vehicle shredder waste had delayed IBA processing trials and testing, the Chief Officer stated TTS had known scrapyard residues would cause problems and the regime will change by 1 January 2013 [to exclude shredder residues from EfW]. Maturation trials have started but by January TTS hopes IBA quality will be better, allowing successful trials and recycling. The Minister stated the start of the new scrapyard contract was the time to start tests.
- The Chief Officer estimated vehicle shredder residues at 30 tonnes per week [approximately 1,500tpa]. Stated it represents a high risk to IBA but not high capacity.
- The Minster confirmed TTS wants to make IBA as clean as possible, including minimising inputs such as batteries and shredder residues. Stated several parishes have recycling schemes, most have recycling points and TTS encourages recycling.

- The Chief Officer stated the disappointing uptake of recycling does not contaminate IBA, specifically the quality of household metals are easily separated. EfW needs to cope with some element of batteries etc., within the waste acceptance criteria.
- The Minister stated that IBA market development has not started but positive in principle discussions indicate industry is willing to work with TTS to determine if material has the possibility for reuse. The Chief Officer confirmed quarries are interested in working with TTS on IBA but need to present the product.
- The Chief Officer stated the policy of a major UK IBA processor [Ballast Phoenix] is to exclude IBAA use near SSSI's etc. as a precaution; appears to suggest general acceptance of IBAA use and no need for SSRA. Stated bound IBAA e.g. in concrete or asphalt is different and may be easier to use.
- The Chief Officer confirmed bulky shredded waste was stockpiled at La Collette and TTS is working through it, i.e. input to EfW. High chlorine content requires more lime for treatment but does not impact on IBA or delay testing. If IBA is not good enough from January, TTS will find the cause and remove from the waste stream. Will test and build in contingency to ensure quality is well within limits.
- The Chief Officer stated significant testing of ash from the old plant showed it was not suitable and indicated data may help identify problems. Also stated IBA trials have been inconclusive but showed quality very dependent on waste in.
- In terms of additional factors, the Chief Officer mentioned batteries, as the main source, and demolition waste as Jersey accepts more than UK facilities, for example due to the type of UK contracts. Confirmed tyres and treated waste wood are burned but don't affect IBA to the detriment of recycling. The Senior Consultant, Fichtner stated treated wood is likely to affect APCr quality.
- The Chief Officer stated IBA processing is a standard process, indicating it is not easy but is known and proven. £1M plant with some processing in a building. Would need a licence. Did not consider there to be restrictions on heap sizes when weathering. The Senior Consultant, Fichtner stated heap size is governed by practicalities of large plant used.
- The Chief Officer confirmed IBA will be weathered outside. The Senior Consultant, Fichtner stated this requires a leachate drainage system and treatment. The Chief Officer stated leachate would be recycled onto the IBA with excess to sewer. The Principal Engineer stated leachate from pits currently goes to sewer (<1% input) and quality akin to road runoff.
- The Chief Officer confirmed TTS has had discussions with Environment officers; open to options and TTS needs to prove IBA is safe, repeatable and is a viable product with a market. Will replace low quality aggregate, preferably on-island. Could consider export for reuse, e.g. excess from local market, but heavy and must process locally.
- Regarding time required for maturation the Chief Officer referred to a 3-4 week process. Commenting on a possible longer time (3-6 months) the Chief Officer accepted this could be a problem for treating the current 18Ktpa IBA at La Collette.
- The Minister confirmed preference to process into product locally and gave assurance TTS will progress IBA processing until they succeed.
- The Principal Engineer outlined current testing. Started IBA characterisation testing with Knox Associates in August to allow trials to start with confidence IBA is typical. IBA falls into UK range, based on Environment Agency study that identifies a range of pollutants. Will consider leaching before and after processing to derive risk assessment source term, then engineering tests. Trials pilot a miniature version of the typical process, e.g. only grading occurs after weathering. Present results to quarries.
- The Principal Engineer stated Knox Associates test is bespoke, developed for Isle of Man IBA, but indicated based on CEN tests. Confirmed a risk assessment model has

been proposed by Knox Associates. Jersey is almost entirely sensitive receptor and using IBA as unbound fill will be onerous.

- In response to the view of the Minister for Planning and Environment that APC and vitrification represent options for IBA, the Chief Officer stated the issue was cost; the Principal Engineer adding vitrification would cost £500/t for aggregate worth £10/t.

5.6.2 Air Pollution Control Residues (APCr)

- Regarding options considered by the review [refer to Table 6] the Chief Officer stated TTS had considered all these options. TTS' Advisor stated opinion that export to ACT should be classified 'amber' [potentially available, keep under review].
- Regarding the timescale for the 'temporary arrangement', the Chief Officer stated the current option is not temporary but was agreed with the regulator as final. When the plant was specified it was not appropriate to recycle APCr but this ability is changing. Stated the export option was later explored but there were previously no DRR as TTS didn't envisage APCr being different to fly ash from the old plant, which was managed locally.
- An *Ash Strategy Plan September 2012* was tabled and referred to in the subsequent discussions summarised below. Although updated and focused on specific options, the plan is generally consistent with the relevant sections of the roadmap (refer to Section 3.2.1). The plan states APCr disposal at La Collette will end around the end of 2013 dependent on a DRR and commercial negotiations. Potential APCr recycling off-island and on-island is identified from late 2013 and mid-2014 respectively. The potential for IBA recycling is shown from late 2014; 1-year earlier than the roadmap.
- The Chief Officer suggested a DRR for 3 years then consider on-island processing or export to recovery. The Minister stated on-island treatment or export is a commercial and economic decision.
- The Chief Officer stated the only 'instant' solution is salt mine disposal or acid washing. The potential use of a long-term DRR should be an environmental and economic decision; want to move up the hierarchy and recycle, and export would ideally be to recovery. Also stated there may be pressure on salt mines in the future. Comments inferred salt mines were the preferred short-term option and the Chief Officer confirmed TTS had investigated viability and costs, but no negotiation yet.
- The Chief Officer stated TTS has been waiting for a DRR since Christmas, indicating that Environment was asked to apply for a DRR but has not done so. Confirmed had DRR discussion with the Environment Agency together with Environment.
- The Chief Officer considered ACT scalable and usable in Jersey, with significant potential based on good science and Environment Agency approval. Indicated vitrification on-island would not be considered. Also stated on-island ACT is pointless without a market and TTS' Advisor highlighted the market would need to accept IBAA and treated APCr and may not have capacity for both; IBAA may be more acceptable.
- The Chief Officer stated TTS does not want to commission a new APCr cell at La Collette; and also stated that the cost of ash cells was such to question its viability. Indicated that the geology at La Collette is not fully appropriate for landfill. The Principal Engineer stated cell 33 has licensed capacity until spring 2013 otherwise a new cell will be required, which would take 3 months to construct. Stated a third layer could be added but this would require temporary cover. This indicates a DRR decision needs to be confirmed by Christmas.
- The Minister confirmed it was the intention to import Guernsey's waste. Jersey would be paid to take the waste and for the extra power generated by the Jersey Electricity Company (JEC). Stated discussion was on-going and ash would not necessarily be returned to Guernsey but tied into the final solution; would not return IBA but stated could return IBAA. The Chief Officer stated negatives are limited to extra wear on the plant but there are many advantages of working with Guernsey, including political.

Stated Guernsey waste is similar to UK waste due to recycling and the Senior Consultant, Fichtner stated it would be unlikely Guernsey's waste CV would be outside the plant's operating range.

- The Minster confirmed he is working with the Minister for Planning and Environment and the officers are in constant communication. Minister wants the cleanest, greenest environmental solution.

5.6.3 Summary of Significant Issues

1. Committed to achieve IBA recycling using the known and proven process used in the UK to produce safe IBAA, including through control of EfW inputs, processing trials, engineering property tests, market development and site specific risk assessment.
2. Indicated battery recycling is carried out and that limited household waste sorting and recycling and the treatment of tyres, treated waste wood and, in the short term, shredded bulky waste from La Collette, will not affect IBA quality. Indicated EfW inputs can be reviewed if tests indicate the required IBA quality cannot be reached.
3. IBA maturation trials and characterisation testing has started, using a bespoke leaching test apparently based on CEN methods, to confirm if Jersey IBA is 'typical' before trials start. Will test better quality IBA from January 2013, following exclusion of vehicle shredder residues.
4. Indicated maturation pile dimensions are unknown until the process is optimised but anticipate 3-4 week maturation. Indicated pilot trials have started but unclear if pile sizes replicate a potential full-scale process to ensure similar conditions.
5. Positive discussions with quarries on accepting IBAA but need to present the product. Accept unbound IBAA use may be challenging, and bound IBAA use easier, but indicated opinion that IBAA use is generally accepted in UK. Would consider export of IBAA which exceeds the capacity of the local market.
6. All APCr management options have been considered. Indicated preference for 3-year DRR for export to UK salt mines, including cell 33 'legacy', then on-island processing or export to recovery, based on commercial and environmental considerations.
7. Indicated a preference for ACT for on-island treatment and considered ACT is potentially available as an export option. Stated APCr treatment on island is pointless without a market and highlighted that IBAA will supply the same market and may be more acceptable than treated APCr. Consider vitrification on-island is not viable.
8. TTS does not want to commission another APCr cell therefore a DRR decision is needed by Christmas, as identified in the ash strategy plan presented. The plan also identifies the end of APCr disposal at La Collette by end 2013. The geology at La Collette is also stated as not fully appropriate for landfill.
9. Intention to import Guernsey's waste, but this would not change the future approach to ash management.
10. Indicated the regulator has not acted on a DRR request made in December 2012.

6 Review of Available Ash Treatment Technologies and Strategies

6.1 Introduction

Ricardo-AEA has identified and reviewed technologies for treatment of ash residues that are currently available or near-to-market. IBA and APCr are considered in turn including a review of ash composition and characteristics; a review of generic treatment technologies; and a review of proprietary technologies.

In the UK, in 2002 the Environment Agency reported[14] that 79% of IBA was disposed in landfill sites and 21% was processed for use in construction. The report noted that at this time IBA reprocessing was in its infancy in the UK, with only 4 of 11 incinerators sending all or part of their IBA to ash processors, but was long established in the Netherlands (100% recycled), Denmark (70%), France (50%) and Germany (50%). The report also confirms that in 2002, 100% APCr was disposed in landfill, either directly (88%) or following treatment to neutralise and solidify other waste streams.

6.2 IBA Treatment and Reuse

Following quenching and extraction of ferrous and non-ferrous metals (refer to Section 2.2) and the removal of large objects by screening, the remaining IBA can be processed into a secondary aggregate. Processed IBA, commonly referred to as IBA aggregate (IBAA) has good pozzolanic (cement-like) properties so can act as an excellent substitute for natural aggregates. IBAA can be used in road sub-base, bulk fill, asphalts, foamed concrete and cement or hydraulically bound materials.

The Highways Agency in the UK accepts the use of IBAA as an aggregate for bound and unbound layers in road construction. The Environment Agency in England and Wales also supports the use of IBAA and is in the process of gathering evidence in relation to the standards the material meets; markets it may be able to exploit; and crucially any potential impacts on human health and the environment[15]. The aim is to demonstrate that end of waste criteria can be met such that IBA can be considered to be fully recovered and used as a quality product. However, as discussed in Section 3.2.3.1, Ricardo-AEA is not confident that the Agency and its partners will publish an IBAA Quality Protocol in the short to medium term as a generic England and Wales regulatory position.

In the UK the Environment Agency requires comprehensive testing to demonstrate that potential risks to the environment from the use of IBAA (including blends if appropriate) in specific applications are no worse than those posed by the virgin material that it replaces (refer to Section 6.3.3.1).

In the UK, secondary aggregates must comply with the same requirements as primary materials. IBAA can be used as a secondary aggregate fully compliant with the relevant European and British standards as well as sections of The Highways Agency Specification for Highway Works (SHW). The suitability of IBAA is demonstrated by its use in a number of significant projects including alterations to M25 Junction 28 (20,000t); M6 Toll Road

[14] *Solid Residues from Municipal Waste Incinerators in England and Wales*, May 2002, Environment Agency.
[15] http://www.environment-agency.gov.uk/business/topics/waste/114416.aspx

(30,000t); Docklands Light Rail (30,000t); Felixstowe Docks (50,000t); Heathrow Terminal 5 (5,000t)[16]; Olympic Logistics Centre (10,000t); and M25 Junction 29-30 widening (40,000t)[17].

It is important to note that stabilization of IBA does not necessarily remove its toxicity. Its use may create a new pollution source somewhere else, which will have an environmental impact in the long run. The environmental impact in the designated application determines whether the IBAA can be utilised.

6.2.1 Reprocessing to Secondary Aggregate

The following sections describe common IBA processing stages to manufacture a secondary aggregate meeting the relevant standards or specifications for the intended application. In its broadest sense this type of processing is commonly applied by all companies known to be carrying out IBA reprocessing (refer to Section 6.3). The process described is a dry treatment process.

In an internal guidance document, the Environment Agency[18] describes a wet IBA treatment process, which it states is less common and in addition to crushing, sieving and metals separation includes washing to aid organics and fines removal. The process results in wash water requiring treatment and disposal. Ricardo-AEA is not aware of any processes operating wet IBA treatment and does not recommend this is considered in Jersey.

6.2.1.1 Crushing

Crushing is a general pre-treatment technique for reuse applications and is undertaken to refine the particle size distribution of the IBA, making it more usable in construction materials. During crushing, IBA is sometimes washed with a leachant to remove (leach) some of the heavy metal components. The timing of crushing is critical and should be carried out before weathering; crushing after weathering changes the characteristics of IBAA by breaking the carbonated surfaces of the ash and potentially negating the benefits of carbonation.

6.2.1.2 Maturation or Weathering

Weathering is carried out by exposing stockpiles of IBA to the atmosphere for an extended period after which it is ready for processing. Weathering or ageing is a general pre-treatment technique for re-use applications as opposed to disposal requirements for landfilling[19]. IBA leaving the combustion process is unstable and exposure to the atmosphere can result in significant stabilisation reactions. The principal reactions that take place are hydration and carbonation which reduces the pH of IBA and removes soluble salts.

The time required to stabilise the ash residues depends upon the stockpile conditions and ash composition. Periods of 3 to 6 months are often necessary before weathering reactions produce significant changes in IBA characteristics[20] although the Environment Agency[18] refers to a typical 6 to 12 week process. The weathering allows the soluble salts (potassium K, sodium Na, chlorine Cl, nitrate NO_3) to be quickly washed off (leached) and removed. The rate of influx of CO_2 (carbonation) then controls the calcium Ca, magnesium Mg, sulphate SO_4 and possibly iron Fe crystal structure and their physical properties. After weathering the secondary phases produced are predicted to be similar to alkaline or volcanic soils.

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[16] http://www.lambeth.gov.uk/NR/rdonlyres/38088A24-4327-4F11-B07C-DF0C4E1800CF/0/IncineratorBottomAshbriefing.pdf

[17] http://www.ballastphoenix.co.uk/ibaa-case-studies/001-use-of-ibaa-as-a-constituent-in-a-cbm-(cement-bound-material).html

[18] *Storing and treating incinerator bottom ash* Quick Guide 384_12, version 1, issued 25/05/2012, Environment Agency.

[19] *The Management of Residues from Thermal Processes*, IEA Bioenergy http://www.ieabioenergytask36.org/Publications/1998-2001%20Task%2023/Publications/Management_of_Residues_from_Thermal_Processes_-_Main.PDF

[20] D.S Kosson, B.A. Clay, H.A. van der Sloot and T.T. Kosson *Utilisation Status, Issues and Criteria Development for Municipal Combustor Residues in the United States*, Studies in Environmental Science Volume 60, 1994, Pages 293–303.

6.2.1.3 Screening or Separation

There are 3 basic elements to the separation process:

- removal of ferrous material;
- removal of non-ferrous metals; and
- separation of oversized particles

Weathered IBA is fed into an enclosed building where it is processed by a series of screens and conveyors, together with magnets and eddy current separators, to recover metals for recycling and grade the material according to particle size. This process will also generate a small amount of reject material (fines) which will be disposed of to a non-hazardous landfill. The separated grades of aggregate are stockpiled for collection and use.

6.2.1.4 Applications

IBAA can be incorporated into relatively low grade unbound applications such as bulk fill, hydraulically bound or bound applications, specifically:

- **Unbound:** bulk fill (e.g. embankments, structural fill, backfill with capping); sub-base (roads, car parks, paved areas, industrial flooring); pipe-bedding (EN13242; EN13285; SHW Series 500/600/800).
- **Hydraulically bound material (HBM):** base, sub-base or capping layer, blended with a hydraulic binder (e.g. cement, steelmaking slags, lime) (EN13242; EN15368; SHW Series 800; EN14227-1/2/3/5).
- **Bitumen bound:** foamed bitumen asphalt, binder course, base (EN13043; SHW Series 900).
- **Cement bound:** foamed concrete, low strength concrete (EN206-1; EN8500-1/2; EN12620) lightweight blocks (EN771-3/4; EN13055-1).

There may need to be a protective layer between the ash and soil if it is used unbound to prevent unwanted leaching. IBAA can be applied at 100% (e.g. foamed concrete) or blended with secondary aggregates (e.g. foamed bitumen asphalt) to improve the quality of the final material.

6.2.1.5 Benefits

IBA possesses similar properties to natural aggregates and offers significant environmental and social benefits:

- Reduced quarrying of primary aggregates resulting in an overall reduction in energy consumption when extracting, processing and transporting aggregate.
- Additional tonnages of ferrous and non-ferrous metals recovered for recycling.
- Avoids landfilling of IBA, meaning only a very small percentage of the residual waste is not put to beneficial use.
- Relatively low carbon footprint owing to relatively low density, lower energy required for production compared to primary aggregates and sourced close to market.

The main public concern related to the use of IBAA appears to be the dioxin content of IBA and the effects of exposure. A 2003 AEA Technology study however reported that the concentration of dioxins present in IBA samples for which information was available fell within the range of rural and urban soils[21]. As such the risks arising from the dioxins present in the IBA are likely to be low.

[21] *Environmental and Health Risks Associated with the Use of Processed Incinerator Bottom Ash in Road Construction*, October 2003, AEA Technology National Environmental Technology Centre http://www.metrovancouver.org/services/solidwaste/planning/ReportsforQA/BREWEBReport.pdf

6.3 IBA Recycling Technology Suppliers

Each of the technology providers identified processes IBA into IBAA in a manner that is broadly consistent with the process described in Section 6.2.1.

6.3.1 Ballast Phoenix Ltd[22]

Ballast Phoenix Ltd (BPL) was incorporated in 1996 and is considered the UK market leader in IBA processing. A major shareholder is Feniks Recycling, a Dutch IBA processor since the early 1980s. BPL works in partnership with a number of waste management companies and a number of facilities are co-located at EfW sites. BPL currently operates 7 facilities:

- Castle Bromwich, Birmingham
- Billingham, Teesside
- Edmonton, London
- Rainham, Essex
- Ridham, Kent
- Sheffield, South Yorkshire
- Port of Tilbury, Essex

6.3.2 Day Group Ltd[23]

Day Group Ltd is based in the south east of England and the group deals with over 3 million tonnes of construction materials each year. The company was incorporated in 1947 and operates from several sites in the area of London, Sussex and Kent. In October 2011 Day Aggregates signed a 10-year contract with Veolia Environmental Services to collect IBA from their Newhaven EfW facility and transport it via rail to Brentford for aggregate recycling.

6.3.3 Raymond Brown Minerals and Recycling Ltd[24]

Raymond Brown Minerals & Recycling Ltd (RBMR) was established in 1953 and is based in Hampshire. RBMR is experienced in extraction, crushing, screening, washing and recycling operations. RBMR operates an IBA processing facility at Blue Haze, Verwood, which processes IBA from the Veolia Environmental Services Integra South East (Portsmouth), North (Chineham) and South West (Marchwood, Southampton) Energy Recovery Facilities. RBMR recently invested in a Rookery Farm aggregate recycling facility and IBAA processing facility.

6.3.3.1 Leachate Testing of Secondary Aggregates

The Environment Agency, through the Quality Protocols Programme, a partnership with WRAP, defined characterisation testing requirements for materials intended to be applied as secondary aggregates. These requirements apply to IBA and APCr across the range of potential bound and unbound applications and equally to other secondary aggregates, such as steel slags and pulverised fuel ash (PFA), in addition to recycled aggregates.

The Agency requires a robust risk assessment to ensure that specific applications of fully processed materials that meet a publicly available specification do not lead to a risk of harm or pollution of the environment. Most importantly materials should be tested in the form that they are intended to be applied. This should take into account processing of the waste in addition to further blending with waste or virgin materials to manufacture products such as unbound sub-base or engineering fill (including mixtures with recycled or virgin aggregate); hydraulically bound material (HBM); or fully bound materials such as bitumen bound material for road construction or concrete.

22 http://www.ballastphoenix.co.uk/
23 www.daygroup.co.uk/incinerator-bottom-ash-aggregate.php
24 www.raymondbrownmineralsandrecycling.co.uk

The Quality Protocols Programme determined that waste acceptance criteria (WAC) leaching tests (batch tests) (BS EN 12457 series) were not appropriate to consider the leaching potential of certain products, primarily due to the requirement to crush the material prior to testing. Crushing gives results that are not representative of processed material, for example IBAA is characterised by a carbonated surface and crushing before testing changes the characteristics and leaching potential of the material. Such crushing is not a concern in relation to the testing of materials in specific circumstances, e.g. APCr following accelerated carbonation where the ash is subject to carbonation prior to cementation therefore crushing does not change its leaching characteristics. BS EN 12457 testing is therefore appropriate.

The Agency has identified a number of tests developed by CEN[25] to be applied within the framework BS EN 12920 *Characterization of waste: Methodology for the Determination of the Leaching Behaviour of Waste under Specified Conditions* and including both pH dependence and release data. As described above testing should be conducted on the fully processed material in the form and blend to be applied in the specific application. Sampling should follow the requirements of BS EN 14899:2005 *Characterization of waste. Sampling of waste materials. Framework for the preparation and application of a sampling plan* which is supported by CEN/TR 15310-1 to 5.

Further explanation of the application of test methods and interpretation of results can be found in the outcomes of Defra research project WR0108[26] (2005-2008), which summarises the leaching test procedures for stabilised wastes. The following summarises the tests required to determine leaching potential. The approach to testing should consider a strategy to prove reliability and reproducibility of results.

Up-flow percolation (column) test (CEN/TS 14405) to test leaching behaviour of unbound/fine material. Appropriate where there is potential for significant infiltration in the application scenario.

Monolithic tank test (PD CEN/TS 15863 and 15864) to test leaching behaviour of bound, including hydraulically bound, monolithic material. A decision not to test fully bound (e.g. bitumen bound and concrete) material might be appropriate given the limited leaching potential of application scenarios.

Compacted granular tank test (CEN/TC 351 based on NEN 7347) to test leaching behaviour of unbound compacted granular/coarse material based on test developed by the Netherlands Standardization Institute (NEN).

pH dependence test (CEN/TS 14997 and 14429) to characterise the pH dependent leaching behaviour of size reduced stabilised waste. Applies to all materials/ applications i.e. unbound or bound. Involves leaching crushed material at a range of pH values, each at a liquid to solid ratio (L/S) of 10.

Testing for conductivity, DOC and REDOX potential to be carried out after size reduction and mixing where appropriate to support results interpretation.

6.4 APC Treatment and Reuse

The following sections summarise APCr treatment processes, sub-divided into the following categories:

- washing;
- stabilisation and solidification;
- thermal treatment; and
- disposal without treatment

[25] European Committee for Standardisation

[26] WR0108 *UK Support for EU LEACHXS Expert Database on Waste Characterisation Annex D1 – Example interpretation and Modelling of Stabilised Wastes (ECN)* [Energy Centre Netherlands] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14663

Treatment processes are available to treat APCr to remove (leach) toxic elements and/or reduce their leachability prior to disposal or use. The technical performance of the treatment process and the potential environmental impact of the final product would determine how the processed APCr can be utilised. The stabilisation of APCr does not necessarily remove its toxicity[27].

The concentration of soluble salts, heavy metals, and organic compounds makes disposal of APCr challenging and a common strategy for APCr management is treatment followed by landfill in either hazardous or non-hazardous facilities. Its use may create a new pollution source somewhere else, which will have an environmental impact, particularly as long term leachability is still unknown in relation to processed APCr from specific treatment processes.

6.4.1 Washing

'Washing' refers to the extraction (leaching) of salts by the addition of water and/or acid as a leachant. Ricardo-AEA is not aware of any UK operations using water washing only. The process aims to remove a number of minerals from APCr and thereby reduce the leachability of various compounds present, improving the quality of the residue obtained for utilisation, further treatment or disposal. In acid washing processes, waste acid from other industrial sources is used to enable the waste streams to be managed at the same time and reduce the cost of washing.

Acid gas neutralisation reactions in dry and semi-dry lime injection APC systems result in the significant production of a predominantly calcium chloride ($CaCl_2$) and calcium sulphate ($CaSO_4$) salt waste residue stream. The $CaCl_2$ and excess lime present in APCr are soluble and are therefore released from the solid matrix quickly on contact with water. The removal of chloride is crucially important because it will affect APCr quality for utilisation.

The main environmental impact in any washing process is the use of fresh leachant and the resultant liquid waste which requires further treatment for removal of dissolved salts. In addition, any treatment process will require significant amounts of additives which can be utilised in other industrial applications. The chemical treatment method still is considered to have advantages over cement stabilisation processes because it removes a significant amount of salts from the APCr[28].

The following processes are most commonly used for APCr washing and are described in the following sections:

- ash washing with magnesium sulphate ($MgSO_4$);
- acid leaching with nitric acid (HNO_3); and
- bioleaching using *Asphergillus niger* (fungus)

6.4.1.1 Ash Washing with Magnesium Sulphate ($MgSO_4$)

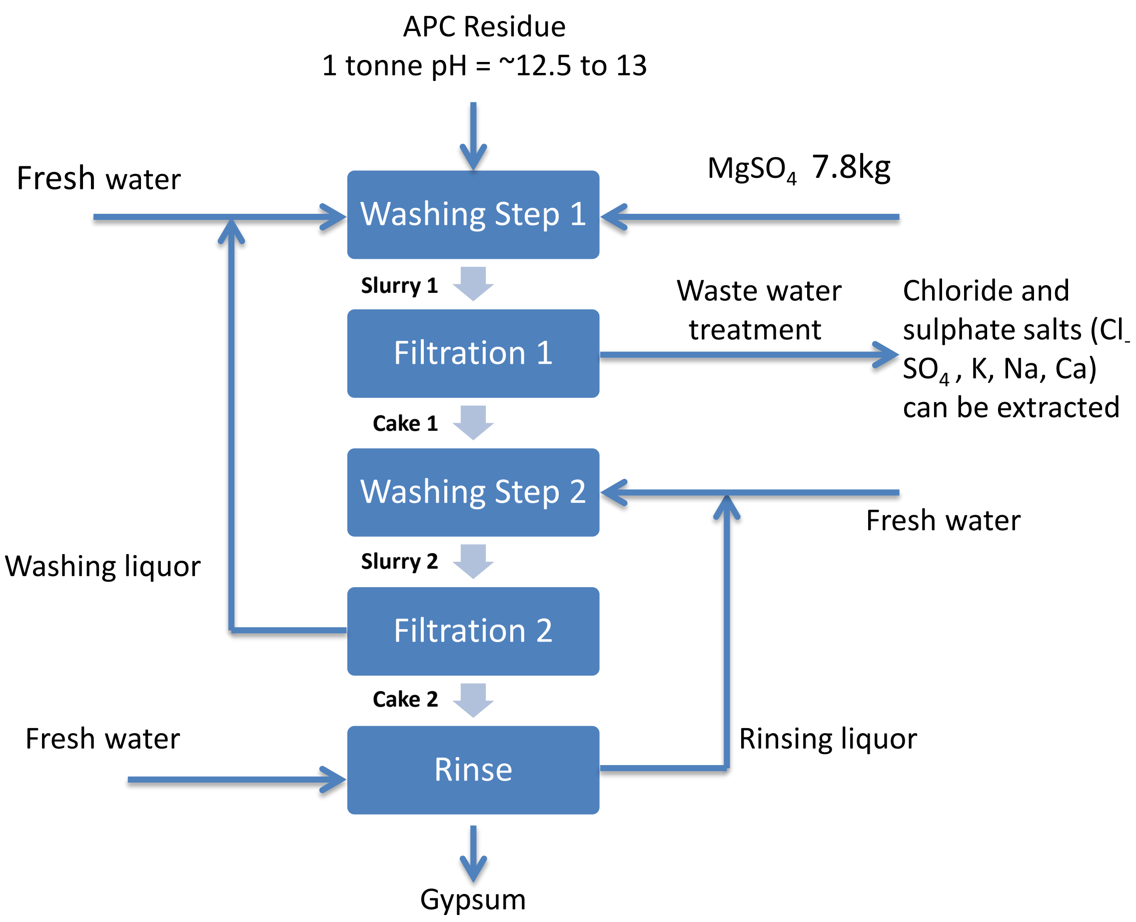
This process involves a multi-stage washing process to reduce the leaching of chloride and sulphate salts from the processed APCr. Where co-located, some of the waste water can be reused in the EfW facility to quench IBA. The washed residue is ready to be utilised as secondary material or can be landfilled[29]. The key stages of $MgSO_4$ washing are shown in Figure 6. Research conducted by Zhang et al (2008) shows that the leachability of the heavy metals and chlorides present in APC residue depends on its pH level. The pH of the solution, when $MgSO_4$ is added during the washing process, may be controlled by the formation of gypsum:

$Ca(OH)_2 + MgSO_4 \rightarrow CaSO_4$ (gypsum)+ $Mg(OH)_2$ (insoluble)

---

[27] Ferreira C, Ribeiro A, et al., 2003 *Possible applications of municipal solid waste fly ash*. Journal of Hazardous Material.
[28] ISWA position paper on handling APC residues(2008)
[29] Chimenos et al., 2005, *Optimizing the APC residue washing process to minimize the release of chloride and heavy metals*.

Figure 6: $MgSO_4$ washing of APCr



6.4.1.2 Acid Leaching with Nitric Acid (HNO_3)

This leaching process uses nitric acid to remove the easily leachable materials such as zinc (Zn), cadmium (Cd) and the chloride and sulphate salts and achieves approximately 70% mass reduction (Mulder et al., 1996). The main aim is to produce a secondary raw material which can be utilised in other manufacturing processes. The bulk of residue that remains is rich in calcium and silicon and can be used in, for example, road foundations (following cement stabilisation) and to substitute sand/cement stabilisation layers. See Figure 7.

6.4.1.3 Bioleaching using Asphergillus niger (fungus)

This process is considered to be a bio-hydrometallurgical approach to extract heavy metals from APCr. It makes use of the natural ability of microorganisms to break down solid compounds into soluble and extractable form by enzymatic oxidation or reduction. The process uses the acids secreted by *Aspergillus niger* fungus such as oxalic acid, citric acid and gluconic acids to extract the heavy metals.

Water-washing is used as a pre-treatment before the bioleaching process to reduce the bio-leaching period from 30 to 20 days and to extract the maximum amount of chloride and sulphate salts. Acid extraction may also be required. The process requires large quantities of water and with very low pH which makes the treatment less suited for APCr on an industrial scale (ISWA 2008). See Figure 8.

Figure 7: Nitric acid leaching of APCr

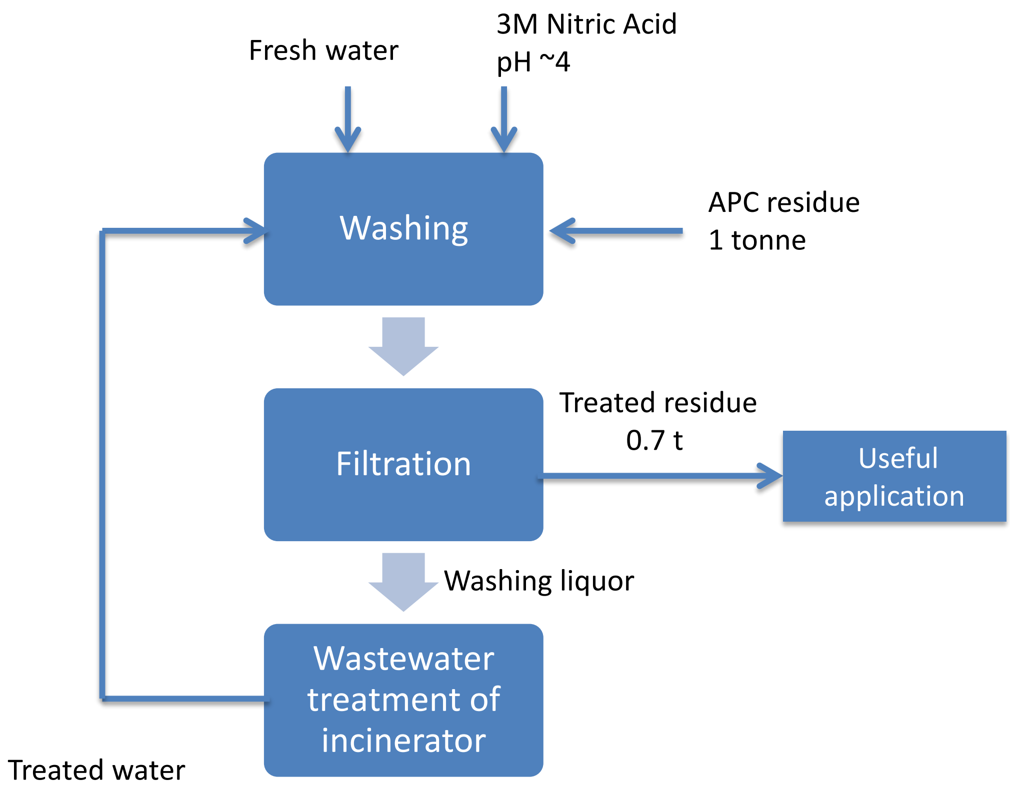
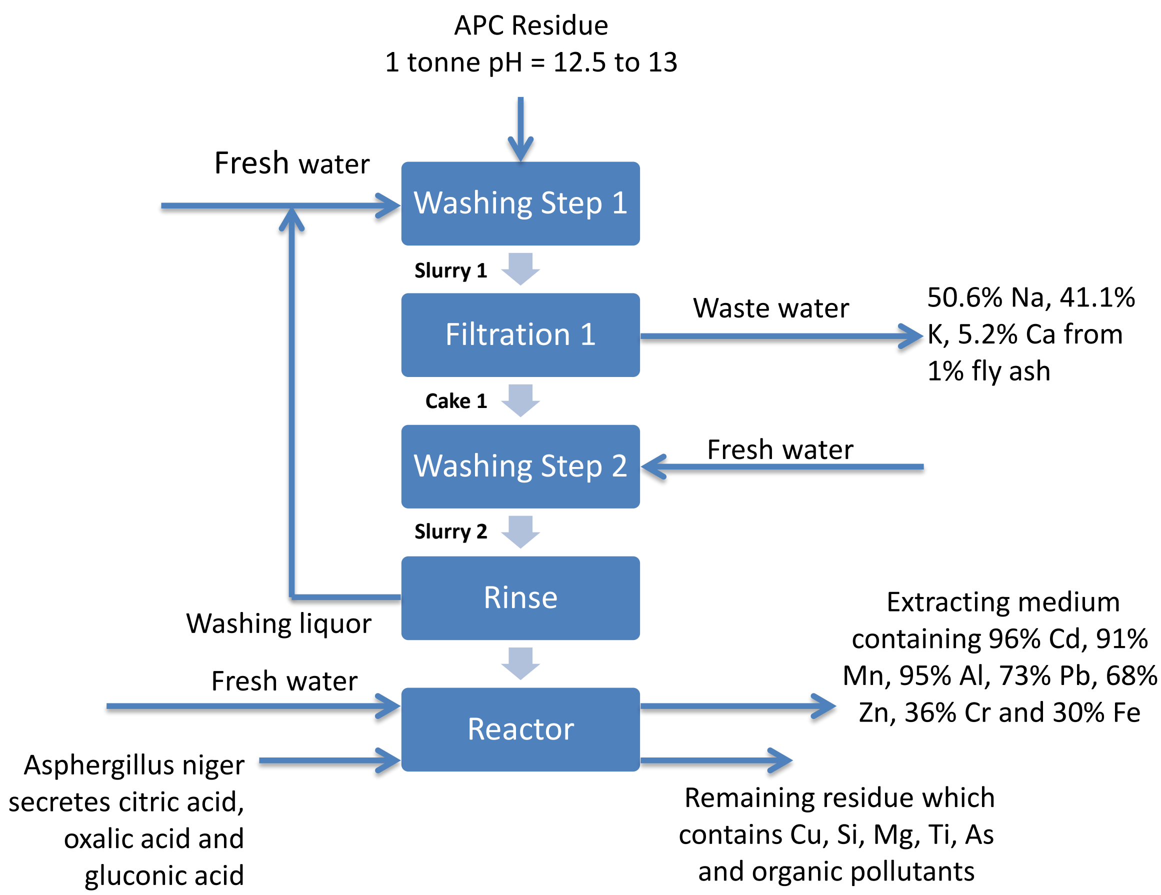


Figure 8: Bioleaching of APCr



6.4.2 Stabilisation and Solidification (S/S)

The main purpose of chemical stabilisation processes is to bind and restrain pollutants such as heavy metals in the residue matrix by altering the geochemical properties of the ash. The processes aim to reduce the environmental impact of APCr disposal or use through a combination of processes such as washing to lower the total concentration of the contaminants; stabilisation to reduce the leachablity of contaminants; and solidification to decrease the rate of leaching of contaminants[30]. The processes are therefore typically a combination of relatively simple sub-processes, such as water extraction, chemical reactions and de-watering.

Solidification helps to reduce the hazardous nature of the residues through encapsulation, reducing the surface area and permeability for contact. Solidification might be regarded as a stabilisation process, as activities of the metal ions will greatly be reduced. Usually binders like cement are used to encapsulate the waste material in order to immobilise contaminants and reduce leachablity, for example addition of Portland cement is used in many countries. Solidification processes may also involve elements of chemical stabilisation, for example in cement solidification techniques.

A drawback is that this process is not suitable for treating soluble salts and long-term leaching will be an environmental problem. Also, the volume of waste will be increased (almost doubled) using this method[28] although this may not be considered a significant drawback when treating highly toxic waste material. Strategies may vary dependent on the final objective, e.g. for disposal in hazardous or non-hazardous landfill or further reuse.

Common processes for APCr stabilisation and solidification are described in the following sections:

- Ferrox process;
- cement production; and
- concrete production

6.4.2.1 Ferrox Process

The Technical University of Denmark developed a Ferrox process to remove salts and immobilise heavy metals by washing APCr in a ferrous sulphate solution with subsequent oxidation of iron to form insoluble iron oxides[31]. The Ferrox process (Lundtorp, Jensen et al., 2002) is summarised as:

- APCr is mixed with a ferrous sulphate solution in a liquid-to-solid ratio (L/S) of 3 l/kg. The iron concentration in the ferrous sulphate solution corresponds to 15g Fe per kg APCr and 60g Fe per kg semi-dry residue.
- The pH in the ferrous suspension increases quickly to above 10 which results in precipitation of the ferrous hydroxides on the solids.
- The suspension is aerated with atmospheric air for 24 hours and Fe(II)-hydroxides are oxidised to Fe(III)-hydroxides causing a change of colour of the suspension from greyish/black to red.
- The solids are separated from the solution by vacuum filtration and washed twice with mains water to remove the salt-containing pore water from the wet Ferrox-product.
- The Ferrox-product is dried for a week at 60°C. After drying the Ferrox-product is kept in closed containers at -18°C until leaching tests are performed.

The main advantage is improved leaching properties of the final product. Ferrox stabilised residues typically have far better leaching properties than cement solidified residues. The

[30] Charles H, et al., *Use of Incineration MSW Ash: A Review*, Sustainability 2010.
[31] Jensen D.L, T.H Christensen et al., 2002, *Treatment of waste incinerator APCr with $FeSO_4$: Laboratory investigation of design parameters*, Waste Management & Research.

stabilisation unit can be an integrated part of the EfW facility or a centralised treatment plant handling residues from several facilities (ISWA 2008). Babcock & Wilcox Vølund has established a pilot plant in Denmark.

6.4.2.2 Cement Production

Cement is a binder, a substance which sets and hardens after being mixed with water, and can bind other materials together. Cement is manufactured by blending different raw materials and firing them to achieve precise chemical proportions of lime, silica, alumina and iron in the product 'cement clinker'. Cement is essentially a mixture of calcium silicates and smaller amounts of calcium aluminates that react with water and cause it to set. Calcium is provided by limestone; silica and alumina is provided by clay or mudstones.

The final product is produced by grinding approximately 95% cement clinker with 5% gypsum which is required to help retard the setting time. Portland cement is the most widely produced cement in the UK and worldwide and is manufactured from limestone (calcium carbonate $CaCO_3$) mixed with clays and other aluminium and silica containing materials.

Around 80-90% of the raw material is limestone. APCr contains (refer to Figure 3) calcium oxide (CaO), silica (SiO_2), iron oxide (Fe_2O_3) and alumina (Al_2O_3), similar to the composition of raw materials for cement production, and can be used to replace limestone dependent on the quality of the final product and market acceptability. A potential application for APCr is low energy cements, also called calcium sulfoaluminate cements, which can be synthesised at low temperatures and present high strength and rapid hardening. APCr provides a source of both alumina, for the formation of calcium sulfoaluminates, and silica, for the formation of calcium silicates (Beretka et al., 1993).

Another potential application of treated APCr is 'Ecocement', which contains 50% (dry base) ash supplemented with other wastes (sludge etc.)[32]. Chlorine in the ash is combined with added alkalis or heavy metals and extracted as metal chlorides which are recycled as metal sources. Ecocement can be used in the fields of ready mixed concrete, concrete blocks or soil stabiliser and is highly used in Japan where landfill capacity is very limited.

6.4.2.3 Concrete Production

Concrete is a construction material that consists of cement (usually Portland cement), aggregate, water and admixtures. It solidifies and hardens after mixing and placement due to a chemical process known as hydration and the reactions that occur are the basis of the stabilisation and solidification process. The S/S process is applied world-wide for the treatment of hazardous waste. Since the size of APCr particles is small (<150µm) they become encapsulated inside the concrete matrix[33].

The main disadvantages are that the physical integrity of the product may deteriorate over time and that APCr mass and volume increases with treatment (ISWA 2008). In addition, aluminium in APCr can react with alkalis in the cement resulting in expansion and cracking in the concrete. Various authors recommend that pre-washing of APCr will remove the soluble salts and thus increase the setting time and that the alkali-aluminium reaction must be evaluated before its application in concrete.

6.4.3 Thermal Treatment

Thermal treatment of APCr is used extensively in some countries to reduce its volume and improve its leaching properties. Thermal treatment can be categorised as vitrification, melting or sintering. The differences between these processes are related to the characteristics and properties of the final product. Thermal treatment is an energy intensive process.

The techniques employed for vitrification and melting (fusion) of residues are similar and they are considered together in the following sections. The main difference is the addition of glass

[32] Tomita, Hirao et al., 2006.
[33] Ferreira et al., 2003, *Possible application of MSW fly ash*, Journal of Hazardous Material.

forming additives in vitrification. Several techniques for heating are used, e.g. electrical melting systems (electric arc, plasma arc, resistance heating), fuel fired burner systems and blast melting. These differ only in the way the energy is transferred to the residues. In all systems, the residues are fed into a reaction chamber usually by a charger system. The melting process can be operated in such a way that a continuous cooler layer at the top of the smelter is maintained in order to confine the melting process, or the entire residue amount in the reaction chamber can be in a molten state.

6.4.3.1 Vitrification

Vitrification involves melting a mixture of APCr and glass precursors (silica) to around 1,300 to 2,000°C[34] to form an amorphous glassy material and bind (encapsulate) the residue. Temperatures of approximately 1,400°C will effectively destroy dioxins, furans and other toxic organic compounds[35]. Moreover, this type of treatment allows the reuse of melted slag as a resource[36]. As these methods involve high temperatures, the cost is usually high and release of contaminants during melting is possible, therefore further APC is required.

Vitrification of APC residue is an established technology in Japan where there are very few landfill sites. Until recently, it has not been economically viable on any significant scale when applied to non-radioactive wastes. There are technology suppliers in the UK who are using this process for treating APCr.

6.4.3.2 Sintering

Sintering involves heating to the point at which individual particles are bound together. Temperatures are around 900 to 1,300°C and a denser and less porous material is produced. Sintering of APCr typically involves re-introduction of the residues to the incinerator furnace. Sintering is less common than vitrification and melting, however a number of European companies are marketing treatment technologies that include routing APCr back to the furnace for sintering with IBA (ISWA, 2008). It is reported that water-washing followed by sintering can effectively result in detoxifying APCr[37].

6.4.4 Disposal without Treatment

The disposal of untreated APCr in salt mines is beneficial because no free water exists in salt mines and they are not in contact with groundwater reservoirs. Deposit in salt mines may be considered a recycling option, for example referred to as 'filler material for salt mines' (ISWA, 2003) where the purpose is to reinforce mine workings and significant quantities of APCr are 'recovered' in such a way in Germany.

In the UK, the Minosus underground storage facility operated by Veolia Environmental Services near Winsford, Cheshire is an established hazardous waste facility. The substantial facility, 170 metres (550ft) deep, provides safe underground storage within a worked out area of a rock salt mine for the permanent disposal of a range of solid and granular hazardous wastes. Stabilisation is not required for salt mine disposal but it is essential for any coal mine disposal where there is significant free water.

The international market is open to the transport of APCr to deep underground storage sites such as salt mines however it would not be competitive over long distances because storage costs are not significantly lower than for surface landfills.

[34] Reimann et al., 1990.
[35] Lima et al., 2003, *An effective thermal technology for the detoxification of MSW fly ash*, International J. Environ. Technology Management.
[36] Hiraoka et al., 2000, *Municipal solid waste incinerator residue recycling by thermal processes,* Waste Management.
[37] Wey M Y et al., 2006, *Thermal treatment of the fly ash from municipal solid waste incinerator with rotary kiln*.

6.5 APCr Treatment and Recycling Technology Suppliers

The following sections present detailed reviews of a number of APCr treatment technology providers, with focus on accelerated carbonation and plasma vitrification as the processes referred to in the public submissions and about which least information was known at the time the TTS technical documents were prepared. All technology types are reviewed however alternative providers are available for a number of processes, notably washing.

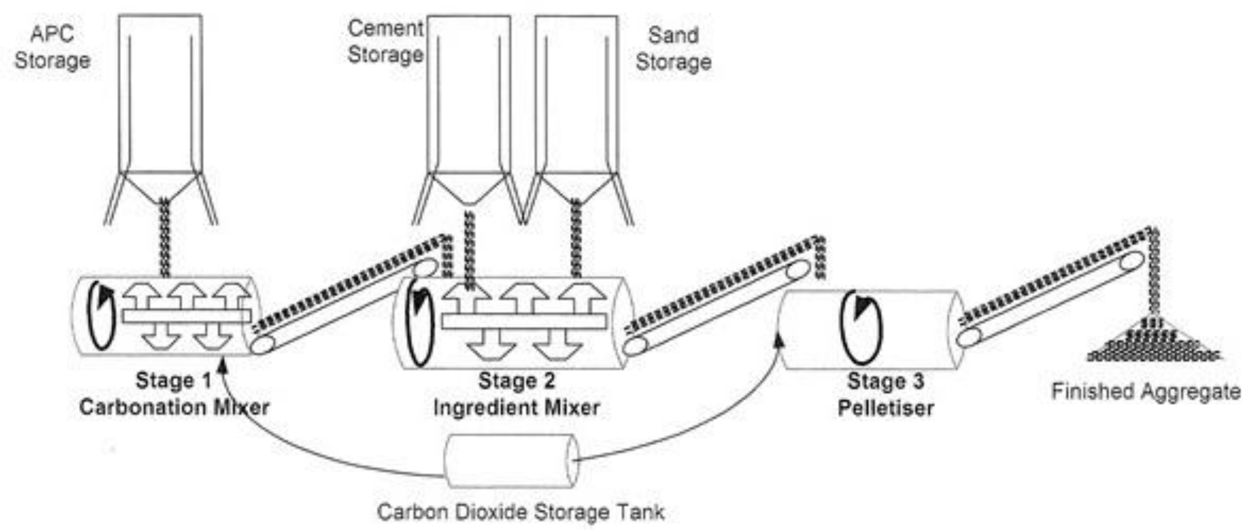
6.5.1 Carbon8 Aggregates Ltd[38]

- Technology: Accelerated carbonation technology (ACT)
- Facility location(s): Brandon, Suffolk
- Maximum capacity: 18,000 tpa

The following information was developed following a site visit on 9 August 2012. Carbon8 Aggregates was formed in May 2010 and is 40% owned by Grundon Waste Management Limited. Carbon8 Aggregates has an exclusive licence for the treatment of APCr using ACT from Carbon8 Systems Limited which is a spin-out from the University of Greenwich. The two companies have some common shareholders but are independent. The ACT process was successfully trialled in November 2010 and is currently operational, although undergoing optimisation, at the Brandon site. Carbon8 Aggregates reports that additional UK facilities are proposed.

The innovative ACT process is designed for the rapid and cost-effective treatment of soil and waste, including APCr. ACT involves a controlled accelerated version of the naturally occurring carbonation reaction where CO_2 reacts with lime and other calcium compounds in APCr to form limestone ($CaCO_3$). This results in an improvement in the chemical and physical properties of the treated materials including reduced pH and leachability of metals such as lead and zinc. The carbonated material is then blended with binders and fillers, with cement added at 5-15% of the mix. Figure 9 presents a simplified process, described below:

Figure 9: Simplified view of 3 stage Carbon 8 Aggregates process



- **Stage 1:** APCr undergoes patented accelerated carbonation using waste CO_2 emissions from a manufacturing process, capturing significant volumes of CO_2.
- **Stage 2:** carbonated material is mixed with binder (cement) and filler (sand).
- **Stage 3:** mixed material is pelletised in CO_2 in a patented process.

38 http://c8s.co.uk/

- **Aggregate production:** pelletised material is discharged and undergoes setting; oversize is screened and crushed and re-enters the process; finished aggregate is a mixture of carbonated APCr, carbonated cement binder and sand and is a product at this stage so that it can be transported without waste management controls.
- **Aggregate use:** finished aggregate is used as a replacement raw material in concrete block manufacture as a replacement for virgin aggregate in lightweight blocks that comply with EN 771-3. Chlorides in APCr act as an accelerant and are beneficial to the block making process.

The Brandon facility has the capacity to produce 36,000 tonnes of lightweight aggregate per year from 18,000 tonnes APCr. The equipment is relatively standard in the cement products industry with specific novel alterations for APCr treatment. There are no emissions or leachate from the process. The aggregate is used in the adjoining block making factory operated by Lignacite Ltd, the UK's largest independent block maker and the blocks can be marketed as carbon neutral or carbon negative.

The Environment Agency has determined that the concrete blocks satisfy the requirements of its end of waste test. Appendix 2 presents the Environment Agency's decision letter, which confirms:

> *"Despite elevated levels of substances in the unbound, untreated [APCr], concrete blocks manufactured from the treated, bound and pelletised material appear to show no worse detriment to the environment or human health than blocks made from virgin aggregate."*

Ricardo-AEA understands that the decision is valid for APCr from any waste incineration process and the ACT process can be adjusted to accept APCr from any such source. Data were derived from EN 12457 WAC leaching tests. The decision is limited to concrete block manufacturing however Carbon8 confirms that it should be possible to apply the finished aggregate in other cement or hydraulically bound products although site specific risk assessments or a further end of waste test would be required in order to exploit these markets in the UK.

ACT can be used in both on-site and off-site operations and can be integrated into existing EfW facilities. The process cannot accept APCr that has been in storage due to impacts on handling and would require deliveries in sealed tankers. The Carbon8 model is for the company to be owner/operator at a leased site. CAPEX is estimated at £1M and OPEX £100-120/tonne and the strong indication is that a facility on Jersey, rather than a UK merchant plant, would be the appropriate solution. Carbon8 indicates that the replacement of part leca (lightweight expanded clay aggregate) and part heavy aggregate in block making is feasible. Figure 10 shows the pelletised material leaving the process conveyor.

Figure 10: Pellets leaving process conveyor

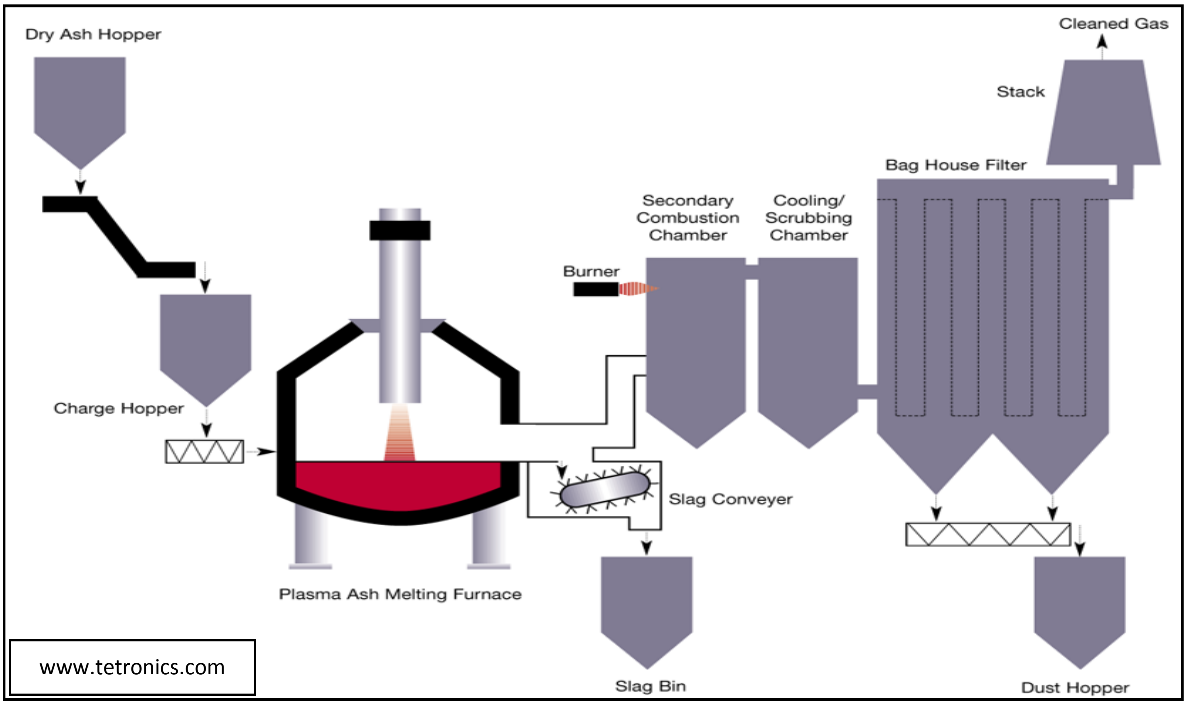
6.5.2 Tetronics Limited[39]

- Technology: Plasma vitrification
- Facility location(s): Swindon, Wiltshire (merchant test facility)
- Maximum capacity: Approximately 2-3,000 tpa

The following information was developed following a site visit on 8 August 2012. Tetronics was established in 1964 and is one of the oldest plasma companies worldwide. Tetronics has built around 80 plants worldwide and around 50 are currently in operation. The company operates in the nuclear and precious metal recovery sectors but hazardous waste is the largest sector and within that APCr treatment is the primary area. APCr treatment is focussed in Japan where there are around 20 facilities.

The Swindon facility is the only UK facility currently taking APCr and only on a test basis, e.g. for feasibility work to present to funders. Tetronics operates a 30-40Ktpa capacity facility in Sheffield with delivery partner Harsco Metals which treats electric arc furnace dust (vitrified output to Harsco Metals Steelphalt as aggregate) and was recently selected by Peterborough Renewable Energy Ltd (PREL) to treat APCr from a proposed biomass power plant for use in e.g. bricks and tiles for the building industry. Tetronics also reports negotiations in relation to UK APCr treatment facilities including merchant scale. Figure 11 shows a simplified process.

Figure 11: Tetronics process



The process operates on a semi-batch basis. The core of the process is the plasma converter, which is heated by a single graphite electrode. The hearth contains conductive elements to carry the return electrical current. The cylindrical unit is of all welded construction and lined with high grade refractory. The plasma power is modulated to maintain the melt temperature at around 1,500°C. The APCr is melted rapidly and the molten slag phase continuously overflows the converter where it is water granulated or cast. The following describes the process in greater detail:

- **Stage 1:** APCr is blended with a fluxing agent (typically <10% w/w) from a waste source or virgin mineral (e.g. silica sand) to produce a low melting point, aid melting and enhance product properties.

[39] www.tetronics.com

- **Stage 2:** The plasma furnace is preheated to 1,400 to 1,600°C and primed with material before blended APCr is continuously fed in through the furnace roof close to the plasma arc (temperature around 8,000°C at the arc), being assimilated into the melt at its upper surface (‘hot top’).
- **Stage 3:** Heat and light from the plasma destroys and/or transforms hazardous components; destruction and removal efficiencies are 99.9999% with residence time in tens of minutes. Plasmarok® (primarily aluminosilicate) is produced at the same mass flow rate as the feed but at 3x the density gives a significant volume reduction (approximately 4:1).
- **Stage 4:** Nearly all the material that enters the plasma furnace is transformed into products. Exhaust gas is treated in a thermal oxidizer unit to fully oxidize any residual combustible gas species well below IED limits; the gas is cooled and particulates removed in a bag filter prior to venting to atmosphere leading to secondary APCr waste (<1%). It would be possible to use an EfW APC system if co-located. Hydrochloric acid (18%w/w) is recovered from the off-gas stream by dissolving hydrogen chloride in water, displacing acid gas emissions and minimising wastes.

Figure 12: Tetronics Swindon merchant test facility

Figure 13: Vitrified product (Plasmarok®)

The small scale Swindon merchant test facility is shown in Figure 12. The facility is compact and requires a standard warehouse and floor loading. Typical vitrified product (Plasmarok®) shown in Figure 13. The Environment Agency has determined that Plasmarok® satisfies the requirements of its end of waste test. Data were derived from EN 12457 WAC leaching tests. Appendix 3 presents the Environment Agency’s decision letter, which confirms:

"On the basis of information given the Environment Agency is happy to class the material as… fully recovered at the point when it leaves the plasma arc process and can be used as an aggregate. At this point it will no longer be classed as a waste."

The process can be co-located with an EfW facility and generally operates at 12-50,000tpa (single line). Tetronics reports the average capacity is 12Ktpa but that any smaller capacity is technically feasible (the Swindon facility is an example) although there is likely to be excess capacity with an impact on treatment cost per tonne as a result. There do not appear to be any UK merchant plant options within 3 years and Tetronics indicated that an asset located on Jersey is the only potential solution. CAPEX is estimated (5Ktpa facility) at £3-4M and OPEX £120/tonne (regardless of capacity). Time from order to commissioning would be around 1 year. Energy use is significant (estimated 2MW for 5Ktpa facility).

Notably Ricardo-AEA identified a shift in the position of Tetronics between a telephone discussion in early July and the site visit in early August. Early discussions identified that 12Ktpa was the minimum process size and a merchant facility was the only potential solution for Jersey; this position was reversed in August. The process could accept APCr after periods of storage.

Although outside the scope of this review, the technology can potentially manage asbestos waste as it is proven on its treatment (with front-end sealed shredding) and other hazardous and clinical waste. Treating asbestos may require a higher arc temperature and would require a second reactor due to the different lining needed.

6.5.3 Grundon Waste Management Ltd[40]

- Technology: Ash washing and landfill disposal
- Facility location(s): Wingmoor Farm Treatment Facility, Cheltenham
- Maximum capacity: 75,000 tpa

The treatment facility accepts APCr, IBA and liquid waste for processing. APCr is treated (conditioned) before being landfilled in the following way:

- APCr transferred from powder tanker into 75 tonne silos;
- air is filtered to remove 99.97% of dust;
- clean water and liquid wastes (e.g. non-hazardous landfill leachate and oily water wastes) are stored in tanks for mixing;
- APCr is discharged into hoppers and mixed with water in mixing vessels;
- final product (40% water, similar texture to wet sand) is discharged to site vehicles

The aim of the process is to produce a stable material and prevent dust on landfill deposition. It appears Grundon operates the facility under a WAC derogation (refer to Section 3.2.3.2) which is expected to be withdrawn in the relatively short term. For this reason, the type of operation carried out at this facility is potentially short-lived in the UK and is thought to be one potential reason for Grundon's investment in the Carbon8 process.

6.5.4 Cenin Limited[41]

- Technology: Cement replacement manufacturing technology (patented)
- Facility location(s): Stormydown, Bridgend, Wales
- Maximum capacity: Unknown

Cenin manufactures two specific cement replacement products (semi-dry product SDP and wet-cast product WCP) from industrial by-products including ground granulated blast furnace slag (GGBS), pulverised fuel ash (PFA) and other mineral wastes. Ricardo-AEA understands

[40] www.grundon.com/whatwedo/colServicesHazardousAPC.htm
[41] www.cenin.co.uk/

that APCr is also being accepted into the process. Cenin reports that production started in July 2008 and that the products are tested according to the EN 196 series of standards. Cenin reports the products are accepted by 'a number of major players in the construction industry'.

Cenin reports SDP and WCP both have a similar composition to calcareous fly ash described in EN197-1, consisting reactive calcium oxide (CaO), reactive silicon dioxide (SiO_2) and aluminium oxide (Al_2O_3) with the remainder being iron oxide (Fe_2O_3) and other compounds. SDP and WCP contain the same oxides as Ordinary Portland Cement (OPC) in specific proportions for their market. SDP is intended for the masonry block and block paving industry and other dry/semi-dry production processes; WCP is intended for the ready mix and precast concrete industry and other wet cast specialist applications and production processes.

The crystal structures of OPC are well understood and Cenin has developed a process to reproduce these structures utilising the properties of the input wastes and without using a kiln. Cenin has developed the ability to build and manage these structures to the point where its cement replacements will perform equally to that of OPC in an identical environment.

No detail is available in relation to Cenin's production process, described as advanced technology to process materials using a modification technique, except that it involves thermal treatment, particle size distribution changes and chemical blending. Cenin confirms it has carried out analysis on OPC and GGBS to it to engineer products to match the changes that occur during hydration and create products for specific applications and with specific setting times, strength development etc. As chemical blending (rather than waste blending), advanced processing and modification are referred to, Ricardo-AEA infers separation of oxides from the wastes may be involved. Available information indicates there are no process emissions.

Ricardo-AEA is aware that Castle Environmental has entered into a long term agreement with Cenin. Trials incorporating APCr within the SDP and WCP were completed in 2010 and further formulations aimed at the precast concrete products market are in development. Castle is working with Cenin to develop new markets and expects this route to provide a significant long term sustainable opportunity for APCr disposal with the opportunity of being able to offer long term (10 years) contracted arrangements. In addition significant development resource is being assigned to further expand the range of materials that can be processed via this route and develop enhanced separation and thermal treatment techniques to further develop the applicability and performance of the products.

Ricardo-AEA understands that Cenin does not benefit from an Environment Agency end of waste decision that would give confidence that the finished product, whether a raw material or finished construction material, was able to be used in the same way as the equivalent virgin material with no greater risk to human health or the environment. In addition Ricardo-AEA could not identify any information in relation to specific customers of materials derived from APCr.

6.5.5 Castle Environmental[42]

- Technology: Acid washing for recycling and disposal
- Facility location(s): Stoke-on-Trent, Staffordshire and Ilkeston, Derbyshire
- Maximum capacity: 6,000tpa and 100,000tpa

Castle Environmental is a supplier of specialist collection, treatment, disposal and recycling services for hazardous and non-hazardous wastes. It was established 30 years ago and has APCr treatment facilities in Ilkeston, Derbyshire and Stoke-on-Trent. The company is permitted to treat APCr at its Stoke (6Ktpa) and Ilkeston facilities (100Ktpa) and notably both are well located for backhaul of APCr from Jersey following lime deliveries from Buxton, Derbyshire. The APCr treatment capacity at the Stoke facility will double by the end of 2012

[42] www.castle-environmental.co.uk/index.html

and a 10Ktpa facility in Cardiff is in progress. Castle Environmental receives APCr from a wide range of customers on a daily basis and currently imports APCr from the Isle of Man.

Both sites have powder silos designated exclusively to APCr. The Stoke facility can only take waste in sealed powder tankers which is conveyed to the silos using compressed air in a completely sealed system. The Ilkeston facility can take APCr in fibre bags/industrial bulk containers (IBCs) or sealed powder tankers and can crush APCr prior to treatment if it has become hardened in storage. The operation of these two facilities is slightly different with the final product from the Ilkeston facility going to non-hazardous landfill, whereas the Stoke facility sends the final product for recycling as secondary aggregate.

Waste treatment at Ilkeston is based on neutralising the APCr with waste acid before landfill. APCr is analysed and modelled with acidic materials to ensure that that the resultant residues meet WAC at the receiving landfill site. Once modelling is completed the material is processed through one of two parallel treatment systems.

The following process description focuses on the Stoke facility following a site visit on 20 August 2012. APCr contains residual lime, other minerals, calcium chloride and various other contaminants including heavy metals. The lime and a number of the other minerals are useful in a variety of processes but the presence of soluble chlorides prevents their use. The process developed by Castle Environmental removes the chloride contamination to facilitate recycling into construction products.

APCr treatment uses a 2-stage washing process to remove the leachable components so that the treated APCr meets the specification required for synthetic gypsum, which is used as a setting retardant in OPC in place of primary sources. The material can also be used as a fine aggregate in the production of asphalt for a number of applications or as an expansion control additive in the production of precast concrete products.

The washing process uses waste acids (e.g. sulphuric, nitric or hydrochloric acids) to reduce alkalinity and remove heavy metals. Water is used to remove soluble chlorides and the slurry is passed through a pressurised filter press. The filtrate, which is high in dissolved chlorides, is discharged to the sewage treatment works and the dry reside is sent for recycling. The solubility of certain metal species, particularly lead, is significantly reduced to produce a stable non-leaching residue.

JBMI Group Ltd accepts the dry residue as a raw material for cement manufacture. Castle Environmental has confirmed that JBMI Group has made an end of waste test submission to the Environment Agency for the material produced from treated APCr. JBMI Group appears to manufacture and market alternative raw materials blended from a variety of wastes to meet the requirements of product specifications.

6.5.6 Future Industrial Services Limited[43]

Future Industrial Services Limited (FIS) is part of the ClearCircle Environmental group of companies and offers a range of waste management and specialised industrial waste management services to government agencies, local authorities, public utilities and national and multi-national companies.

FIS operates a waste management centre in Knowsley, Liverpool, which information from FIS and ClearCircle indicates incorporates an ash recycling facility capable of recycling 150 tonnes of APC residues per day creating synthetic gypsum for use as a gypsum substitute in the cement industry. The FIS website reports that the facility began accepting waste in June 2008. The process appears to be a washing process where water and acids may be used followed a dewatering unit. FIS has not confirmed this and there is very limited information available on their website. The supplier has not been contacted during this study as this type of process has been reviewed in detail in relation to Castle Environmental (refer to Section 6.5.5).

[43] www.futureindustrial.com/news.php?id=12

7 Conclusions and Recommendations

7.1 Incinerator Bottom Ash (IBA)

7.1.1 For at least 10 years a significant proportion of IBA has been processed in European countries to recover metals and manufacture secondary aggregates. In the UK, the IBA reprocessing industry was in its infancy 10 years ago, but it is now common practice to reprocess IBA into IBA aggregate (IBAA), meeting the requirements of a publicly available specification, and IBA recycling now forms part of solutions for local authority and merchant EfW facilities in most, if not all, cases.

7.1.2 The leading IBA processors in the UK are Ballast Phoenix Ltd, considered the market leader, Day Group Ltd and Raymond Brown Minerals & Recycling Ltd (RBMR). All use a similar dry treatment process involving crushing, metals recovery, weathering to change the leaching characteristics of the material, and screening. TTS is clearly aware of this process. RBMR is based in Hampshire and treats IBA from the Veolia Hampshire (Project Integra) facilities.

7.1.3 At the Environment hearing, the Minister for Planning and Environment suggested that the commonly used dry IBA treatment process may not represent best available technology and suggested accelerated carbonation technology (ACT) and plasma arc vitrification be considered for IBA treatment. Ricardo-AEA does not accept either process is currently used or commercially viable for IBA processing and suggests the cost would be prohibitive. A consistent view was provided during the TTS hearing. Furthermore, Ricardo-AEA considers ACT would not be capable of treating IBA due technical and handling issues relating to its physical characteristics.

7.1.4 In the UK, the Environment Agency, WRAP and Highways Agency support the use of IBAA that meets an appropriate specification in defined applications with appropriate risk assessment. Due to its good cement like properties, IBAA is an excellent substitute for natural aggregates and has been used in a number of significant construction projects.

7.1.5 The Environment Agency and its partners, including industry, has for some time sought to agree an end of waste Quality Protocol for IBA to enable it to compete with virgin aggregates. Such a ‘generic’ position is considered unlikely to be achieved in the short to medium term, but this does not imply that using IBAA within the controls described above represents an unacceptable risk. The Environment Agency accepts the use of IBAA conforming to the relevant publicly available specification in a range of bound and unbound applications whilst the Protocol is in development.

7.1.6 IBA is a fairly stable material containing very few toxic elements and is primarily composed of a mix of ceramics, slags, and glassy material along with some metals. Following treatment, the leaching potential of IBAA in the form that it will be used, e.g. bound or unbound, blended etc. should be tested using CEN methods. Reuse of IBAA can deliver significant benefits including landfill diversion and avoiding quarrying and related energy use and emissions.

7.1.7 TTS’ strategy centres on IBA disposal in non-hazardous landfill cells at La Collette and appropriately states that studies are required to assess the potential for IBA recycling. Documents indicate that TTS will investigate IBA recycling and TTS has stated its intention to develop a dry treatment operation at La Collette. Commitment to explore IBA recycling was made as early as the 2005 waste strategy and 58% of submissions to Scrutiny agreed with the strategy of IBA recycling. TTS restated its commitment to achieve IBA recycling in the TTS hearing.

7.1.8 IBA disposal in non-hazardous landfill is still common in the UK where reprocessing capacity does not exist. The design of the non-hazardous cell at La Collette does not appear to comply fully with the UK Landfill Regulations, a view supported by statements in the TTS hearing in relation to the geology of the site. The design does however appear to be robust and represents the best practical on-island disposal option. Furthermore, the regulator accepts that the regulatory powers are sufficient to deal with the facility and ensure no harm or pollution occurs. If IBA is reprocessed on island in the future there will remain a need for limited landfill capacity to manage rejects from the process. The continuation of this current practice is therefore considered appropriate in the short term. Fichtner 2011 recommended this whilst the feasibility of IBA recycling is trialled.

7.1.9 Problematic waste streams, specifically WEEE and vehicle shredder residues, have already been, or will soon be, largely excluded from EfW inputs. This is appropriate to protect IBA quality, but extending this commitment to exclude other materials with the potential to affect IBA quality and the ability to reuse IBAA may be appropriate.

7.1.10 In relation to batteries, the Minister for Planning and Environment stated no recycling scheme is in place and separation should be encouraged, whereas comments in the TTS hearing indicated battery recycling is carried out. Batteries have a significant potential to affect IBA quality and separation schemes are recommended if these are not already in place. The Minister for Planning and Environment suggested improved household recycling would protect IBA quality, specifically metals separation, but Ricardo-AEA does not consider that this would be beneficial and this view was supported in the TTS hearing.

7.1.11 As an island community, Jersey may be restricted in its ability to exclude other waste streams and input waste will continue to include a high proportion of commercial and bulky waste. Responding to a suggestion to exclude additional waste streams in the TTS hearing, the Chief Officer stated that the treatment of tyres, treated waste wood and, for the next 12-18 months, shredded bulky waste extracted from La Collette, will not affect IBA quality, regardless of the high chlorine content of the shredded bulky waste, which requires significant additional lime input to the APC system. TTS outlined a strategy whereby EfW inputs will be reviewed if tests indicate the required IBA quality cannot be reached. This is considered appropriate.

Recommendation 1: review measures to exclude batteries to protect IBA quality and consider measures to limit or exclude additional waste streams with the potential to affect IBA quality, such as tyres and treated wood waste, if testing indicates their exclusion would protect IBA quality.

7.1.12 Capita Symonds advised TTS that testing should not start until ‘normal conditions’ are established. TTS has however now commissioned IBA testing to determine chemical composition and ‘worst case’ leaching. Capita Symonds also advised testing IBAA (not IBA), which Ricardo-AEA agrees is appropriate. Whilst shredded bulky waste extracted from La Collette is being treated, ‘normal conditions’ might not be considered to be established. Waiting 12-18 months for the treatment of this material to finish may however represent an unacceptable delay, and may be unnecessarily cautious in view of opinion from the TTS hearing that this material is not expected to affect IBA quality.

7.1.13 TTS has confirmed its view that vehicle shredder residues might significantly affect IBA quality therefore this waste stream will be excluded from late 2012. The Minister for TTS confirmed this measure enables testing on better quality IBA to start from January 2013. Ricardo-AEA considers this a pragmatic position that allows trials and testing to start in a timely way, having excluded a high risk material and whilst TTS continues to review the need to exclude further waste streams if testing results indicate this is appropriate.

7.1.14 The results might be considered 'relatively worst case' whilst shredded bulky waste is still being treated and in view of uncertainty in relation to whether batteries are being separated. Results may however demonstrate, through the risk assessment process, that IBAA use is acceptable, providing an opportunity to facilitate IBA recycling without unnecessary delay. The risk is that if these results, though risk assessment, indicate unacceptable risks, IBAA characterisation testing may need to be repeated and the risk assessment revised upon achieving 'normal operations'.

7.1.15 TTS' roadmap indicates that IBA composition (referred to as 'characterisation') testing will inform the timing of maturation trials. It is not clear how the data will be interpreted to inform this decision, that is, how results will enable TTS to determine whether processing IBA of the determined composition would result in IBAA that could be used without unacceptable risks to the environment. This is particularly unclear given that the current testing is taking place before the exclusion of vehicle shredder residues. The value in this testing is therefore not entirely clear.

7.1.16 TTS has stated that IBA stabilisation trials, market development and site specific risk assessment will all take place, which Ricardo-AEA agrees are all precursors to IBA recycling. Both Ministers have stated that a risk-based approach to IBA use using site specific risk assessment is appropriate. Such risk assessment must follow IBA processing trials and IBAA testing to establish risk assessment source term data. Market analysis will indicate products that are acceptable in Jersey, for example bound or unbound, blended with recycled or primary aggregates etc., thereby determining the products to be manufactured and tested. Market analysis need not however delay testing to define 'worst case' source term data for unbound, unblended IBAA and this data can be presented to industry to facilitate iterative discussions and testing in relation to potentially acceptable products. The TTS hearing established that product needs to be presented to industry to facilitate this process, which is considered appropriate.

7.1.17 Comments made in the TTS hearing indicate that pilot scale maturation trials have started. Trials at this stage precede the exclusion of vehicle shredder residues and completion of IBA characterisation testing. The timing also appears contrary to the proposal for testing to start in January 2013 on better quality IBA. It is not clear why the trials have started, for example if they are intended to set-up and test equipment or derive initial 'worst case' data for comparison. Testing at this stage may potentially enable the extraction and processing of existing deposits of IBA from the La Collette EfW, as this was produced from similar waste. It should also be noted that whilst work is underway to explore IBA recycling disposal at La Collette will continue.

7.1.18 Importantly, the trial processing should replicate a potential full-scale process as far as possible to ensure similar conditions. Crucially the weathering process should be representative in terms of duration and the dimensions and management of the piles to ensure the potential for carbonation and hydration is consistent with that in a full scale process. Other aspects such as metals recovery efficiency and final product specification(s) are also important. Ricardo-AEA has not seen details of the trials but would have concerns over the validity of results on this basis.

Recommendation 2a: ensure that trials on the IBA dry treatment process to derive IBAA replicate potential full-scale operations as far as possible; in parallel undertake market testing to determine acceptable products to inform the trials in relation to the products to be manufactured and tested; in parallel commission advisors to scope the risk assessment to ensure appropriate source term data are obtained during the trials.

Recommendation 2b: manufacture trial products from IBAA meeting the requirements of the relevant specification(s); design a sampling and testing programme following best practice and test the products; undertake site specific risk assessment to determine if IBAA products can be used; if results are positive establish a compliance testing regime for the specific acceptable products.

7.1.19 TTS has stated its openness to all IBA management options, including export. Ricardo-AEA suggests IBA export is unlikely to be accepted by any jurisdiction based on Jersey being able to manage IBA in an environmentally sound manner using the current disposal option or in future obtaining the technical capability to recycle IBA. This is consistent with Fichtner's findings. Only if the use of IBAA in any form in Jersey is determined to be unacceptable; La Collette ceases to be available; and no other on-island disposal options exist might this ever change. Ricardo-AEA also considers IBA export to Guernsey is not acceptable.

7.1.20 Ricardo-AEA suggests export of IBAA, or products containing IBAA, may be acceptable to any jurisdiction. This is because, if meeting the end of waste test in the Waste Framework Directive, or Member States' interpretation, IBAA is classified as a product. The cost of shipping (around £100/tonne) however means this is unlikely to be commercially viable. IBAA export to Guernsey may however be possible. The TTS hearing elicited consistent opinion, specifically that export of IBAA that exceeds the capacity of the local market would be considered.

7.1.21 Capita Symonds considered sites for ash disposal only, not recycling. La Collette was the preferred site for IBA disposal and this is unlikely to change for IBA recycling given the proximity of the EfW facility; the non-hazardous landfill required for rejects; and the recycled aggregate processing facility, which would allow blended aggregate products to be manufactured on site.

7.2 Air Pollution Control Residues (APCr)

7.2.1 APCr is a hazardous waste that can only be disposed in specialised landfill sites or storage facilities. APCr is strongly alkaline, resulting in its hazardous designation, and contains toxic elements such as lead, nickel, and mercury as well as elements that are both carcinogenic and toxic such as cadmium, hexavalent chromium and arsenic. APCr is very soluble in water and represents a contamination risk if disposed in such a way that it may come into contact with groundwater.

7.2.2 APCr management options are more numerous than for IBA, where one treatment process is known to be used, but a number of the technologies are near-to-market or new-to-market, which impacts on their risk profile. The recent emergence of APCr recovery options is shown by the Environment Agency reporting in 2002 that 100% APCr was disposed in landfill, either directly (88%) or following treatment to neutralise and solidify other waste streams. Since 2002, the implementation of the Landfill Directive has restricted landfill disposal of APCr in England and Wales to a limited number of hazardous waste facilities which, combined with escalating landfill costs, has encouraged process development.

7.2.3 In the UK, APCr is also likely in the near future to require treatment before hazardous landfill disposal (except permanent underground storage). This follows the expected removal of a derogation in relation to meeting Landfill Directive maximum leaching limit values, referred to as the Waste Acceptance Criteria (WAC). APCr can also be treated for disposal in non-hazardous landfill.

7.2.4 TTS' October 2011 ash management strategy confirms APCr will be disposed at La Collette in dedicated hazardous waste cells (currently cell 33) but does not make any commitment in terms of alternative future options. TTS' June 2012 position however confirms its view that landfill disposal does not leave a good legacy and the current 'disposal' of APCr in cell 33 in removable bulk bags indicates TTS' intention to identify and use alternative disposal or treatment options in the short term.

7.2.5 Comments at the TTS hearing indicated cell 33 has approximately 6 months licensed capacity remaining and TTS also stated that it does not want to commission another APCr cell. The Environment hearing elicited opinion that remaining capacity is closer to 12-18 months but TTS stated any additional capacity would involve a third layer of bags, which is not licensed and which would require temporary cover over the first 2 layers. Considering the limited time before cell 33 reaches its licensed capacity, any alternative option to deal with the contents of cell 33 must involve export. Ricardo-AEA agrees with TTS' assessment that the only options to divert 'legacy' APCr from cell 33 involve export to disposal.

7.2.6 Comments at the TTS hearing indicated TTS applied to the regulator to make a duly reasoned request (DRR) to the Environment Agency for export to England and Wales at or around Christmas 2011. A DRR is required for export to disposal, not recovery, and is the first stage in the process of obtaining export permission. No DRR appears to have been made by Environment, although comments at both hearings suggested discussion with the Environment Agency had indicated a DRR for APCr export in the short term may be successful. It appears the DRR may have been on hold pending discussion with the Environment Agency to gain an indication of the likelihood of a DRR being accepted; as this discussion has now taken place, and indications were positive, there does not appear to be any reason to withhold the DRR.

7.2.7 Comments at the Environment hearing suggested the Minister preferred options to export to France, which were not defined, but the Minister stated that Defra may seek to control export beyond the UK. Urgent resolution of this position would confirm if export other than to the UK is possible.

Recommendation 3a: submit a DRR to the Environment Agency to export APCr for disposal in England and Wales with a view of obtaining a decision before the end of 2012. The DRR should cover a period/quantity sufficient to export all 'legacy' cell 33 APCr and new APCr arising in the short term until an alternative recovery option can be fully considered.

Recommendation 3b: in parallel with 3a, if commercially viable APCr management options are available in France that are environmentally and economically preferable to known options in the UK, present evidence to Defra and determine whether export to France is possible; obtain a DRR decision from the French competent authority in the relevant département where the facility is located before the end of 2012.

7.2.8 TTS confirmed at the hearing it is considering export to the Minosus underground storage facility as its preferred short term solution for bagged APCr in cell 33 and new APCr arising within 3 years. TTS also indicated the option to export to the UK for acid stabilisation before non-hazardous landfill disposal will also be considered. Ricardo-AEA considers that either option is proven, robust and available, if a DRR succeeds.

7.2.9 In accordance with the legislation, when considering a DRR the Environment Agency will consider whether on-island facilities are available for the environmentally sound management of APCr. The cell 33 design appears well thought out, being double lined with electrical leak detection and constructed with full construction quality assurance (CQA). Furthermore, the regulator is confident this option does not present a risk to the environment, can be regulated and is the best practical option for Jersey. On this basis Ricardo-AEA suggests there is a risk that the Environment Agency will reject such a DRR. Ricardo-AEA however accepts TTS' assessment that the geology at La Collette is not fully appropriate for landfill in relation to the requirements of the Landfill Directive, which may be significant to a DRR decision.

7.2.10 Ricardo-AEA considers that the risk of environmental harm from the operation at La Collette in terms of its proximity to the Ramsar site and visual impacts may potentially be taken into account by the Environment Agency when applying the meaning of the Waste Shipments Regulation to determine any DRR. Visual impact is however clearly a subjective issue and Ricardo-AEA accepts the opinion of the Minister for TTS raised in the hearing that the visual impact may not be taken into account. Fifty per cent of submissions to scrutiny cited concern about burial in a 'headland' at La Collette and the potential environmental impacts, including visual; 50% were also aware of the hazardous nature of ash and there was support to consider all available treatment technologies, whilst being aware of cost as an issue.

7.2.11 TTS' outlook confirms that its work to develop a new ash strategy will focus on the viability of alternative APCr disposal and recycling options. TTS has reviewed various available APCr treatment technologies and the October 2011 Fichtner report covers a comprehensive range of options notwithstanding the limited technical and commercial information available at that time for specific options, notably the Carbon8 Aggregates accelerated carbonation technology (ACT). TTS has since reviewed the ACT process together with other options including vitrification (Tetronics).

7.2.12 Ricardo-AEA does not consider earlier reports prepared for TTS were comprehensive in terms of APCr treatment options considered and justifications for continuing landfill disposal at La Collette, e.g. Capita Symonds, September 2010 and April 2011. TTS' 'roadmap' also appears restricted in terms of the potential medium and long term APCr management options, with focus on stabilisation for on-island disposal, whilst reviewing vitrification. Notably, TTS' position is no longer in preference of stabilisation with landfill due to the legacy issue. The position is however continually evolving and whilst stakeholders may previously have understandably concluded TTS was not considering all options, this is no longer the case.

7.2.13 The TTS hearing confirmed TTS' view that after an initial DRR the preferred long term APCr management option is recovery, either with on-island processing or export, based on commercial and environmental considerations. TTS indicated a preference for ACT for on-island treatment and stated on-island vitrification is not considered viable. Comments highlighted that on-island recovery is not viable without a market and critically IBAA will supply the same market as treated APCr and may potentially be more acceptable. This confirms the need to understand the available market in determining the long term option.

7.2.14 The TTS hearing also confirmed that TTS' future ash management strategy would not change if waste were to be imported from Guernsey in the future.

7.2.15 Table 6 provides an analysis of potential options for on- and off-island management of APCr across a range of timescales. The following key is applied:

(green)	Available with good degree of certainty considering technology and product market where applicable; assumed political and economic acceptability.
(orange)	Potentially available considering robustness of technology, product market where applicable, political and economic acceptability; keep under review.
(red)	Not available considering robustness of technology, product market where applicable, political and economic acceptability.

7.2.16 Table 6 indicates that a limited number of options are available with certainty but additional options are potentially available. Table 6 was presented at both hearings and only 1 point of difference was raised. Specifically, Ricardo-AEA assessed export to ACT as not available but TTS considered this option is potentially available, although the reason was not explained. Ricardo-AEA has not reclassified this option as Carbon8 strongly indicated that a facility on Jersey, rather than a UK merchant plant, would be the appropriate solution. Carbon8 is proposing further UK facilities but Ricardo-AEA is not aware how advanced these proposals are, or their locations and ability to accept merchant waste. The following summarises options over each timescale:

- **Cell 33 Legacy (6-12 months).** 'Do nothing' is the only certain option but all export with disposal options are potentially available if the Environment Agency (or other competent authority) accepts a DRR. Water stabilisation and disposal at La Collette is also technically achievable but shown to be unavailable due to it not being considered politically acceptable in Jersey.

- **Short term (<2 years).** As above (cell 33 legacy) however with the additional option of acid treatment for synthetic gypsum/fine aggregate production being available with a good degree of certainty, as this is considered a recovery option and not subject to a DRR. This includes the Castle Environmental (Stoke-on-Trent) and FIS processes.
- **Medium term (<5 years).** 'Do nothing' is technically available but considered unlikely to be politically acceptable in this timeframe. The main change from the short term options is that on-island treatment for recovery as aggregate potentially becomes an option, specifically the Tetronics vitrification and Carbon8 ACT processes. Both are potential solutions, but with neither being considered available with certainty, both are conservatively coloured amber.

  Tetronics is considered proven, including benefitting from an end of waste position, but is assumed prohibitively expensive. In addition, the small quantities of APCr and acid product arising from vitrification must be managed. Carbon8 is considered likely to offer a potential solution and also benefits from an end of waste position. ACT is however undergoing optimisation, although this would be expected to be resolved in the short-term. More significantly, product use is currently limited to incorporation in block making, which although understood to be carried out in Jersey by Ronez, this is a private enterprise and therefore presents a market risk.
- **Long term (>5 years).** Little change from medium term with the only exception being that 'do nothing' is by this time ruled out.

Table 6: Conclusions – APCr management options

Route		Management option	Cell 33 Legacy (6-12 months)	Short term (<2 years)	Medium term (<5 years)	Long term (>5 years)	Comments
Jersey	Disposal	Untreated ('do nothing') to La Collette	Green	Green	Orange	Red	Robust; remains hazardous; potentially increasingly politically unacceptable over time
		Treated (water stabilisation) to La Collette	Red	Red	Red	Red	Remains hazardous; legacy remains (politically unacceptable); sludge unacceptable in working plan
		Treated (acid/chemical stabilisation) to La Collette	Red	Red	Red	Red	Effluent stream; legacy remains (politically unacceptable); waste acid unavailable; sludge unacceptable in working plan
	Recovery	Acid treatment for synthetic gypsum/fine aggregate	Red	Red	Red	Red	Waste acid unavailable; product quality/ local market risk
		Plasma arc vitrification for aggregate (Tetronics)*	Red	Red	Orange	Orange	Technically proven; end of waste position; assumed prohibitively expensive
		Accelerated carbonation technology for aggregate (Carbon8 Aggregates)*	Red	Red	Orange	Orange	Being optimised; end of waste position; product/market dependent on block making
		Sintering for aggregate	Red	Red	Red	Red	No known commercial operations
Export	Disposal	Untreated (salt mine)**	Orange	Orange	Orange	Orange	Robust; subject to DRR
		Treated (water stabilisation)	Orange	Orange	Red	Red	Subject to DRR; potential loss of derogation in the medium term
		Treated (acid/chemical stabilisation)	Orange	Orange	Orange	Orange	Robust; subject to DRR
	Recovery	Acid treatment for synthetic gypsum/fine aggregate	Red	Green	Green	Green	Unable to accept flexible bulk containers
		Physical treatment for cement replacement products	Red	Red	Red	Red	Uncertainty over process/products/markets
		Plasma arc vitrification for aggregate	Red	Red	Red	Red	No foreseeable merchant capacity
		Accelerated carbonation technology for aggregate	Red	Red	Red	Red	No foreseeable/economically advantageous merchant capacity
		Sintering for aggregate	Red	Red	Red	Red	No known commercial operations

* Medium term option not available independent of long term solution
** Salt mines in Germany may be classified as a recovery option therefore not requiring a DRR

Appendix 1: Detailed APCr Composition

Typical elements present in APCr (source: ISWA 2008)

Element	Fly Ash (mg/kg)	Dry or Semi-dry (mg/kg)	Wet (mg/kg)
Al	49,000-90,000	**12,000-83,000**	21,000-39,000
As	37-320	**18-530**	41-210
Ba	330-3100	**51-14,000**	55-1600
Ca	74,000-130,000	**110,000-350,000**	87,000-200,000
Cd	50-450	**140-300**	150-1400
Cl	29,000-210,000	**62,000-380,000**	17,000-51,000
Cr	140-1100	**73-570**	80-560
Cu	600-3200	**16-1700**	440-2400
Fe	12,000-44,000	**2600-71,000**	20,000-97,000
Hg	0.7-30	**0.1-51**	2.2-2300
K	22,000-62,000	**5900-40,000**	810-8600
Mg	11,000-19,000	**5100-14,000**	19,000-170,000
Mn	800-1900	**200-900**	5000-12,000
Mo	15-150	**9-29**	2-44
Na	15,000-57,000	**7600-29,000**	720-3400
Ni	60-260	**19-710**	20-310
Pb	5300-26,000	**2500-10,000**	3300-22,000
S	11,000-45,000	**1400-25,000**	2700-6000
Sb	260-1100	**300-1,100**	80-200
Si	95,000-210,000	**36,000-120,000**	78000
V	29-150	**8-62**	25-86
Zn	9000-70,000	**7000-20,000**	8100-53,000

Composition of APCr from various incinerators (source: ISWA 2008)

Elements	UK Incinerator - Aquaragia Digest 1997 - 2003	Golden et al. 1992	WRc 2000	Tyseley
Cl (g/kg)			111-207	197-236
Al (g/kg)	8-24	31-177	17	17.3-29.7
Ca (g/kg)	30-35% (w/w)	33-86		
Fe (g/kg)	3.0-5.2	3.1-320	0.6-7.8	3.9-7.8
Mn(mg/kg)	350-500		94-486	268-404
As (mg/kg)	10-210	3-750	200	2-166
Ba (mg/kg)	70-400		250	147-952
Cd (mg/kg)	100-150	2-7800	20-215	190-516
Co (mg/kg)	9-14		10	9-620
Cr (mg/kg)	12-200	20-3000	11-113	51-324
Cu (m/ kg)	350-600	200-5000	37-769	623-1067
Hg (mg/kg)	<1-16	1-100	11-30	2-25
Zn (mg/kg)	4000-8500	2000-280000	829-13950	12600-17600
Sb (mg/kg)	200-500		450	
V (mg/kg)	<30		30	16-175

Appendix 2: Carbon8 Aggregates End of Waste Decision

creating a better place

Environment Agency

Dr Paula Carey
Carbon8 Aggregates Ltd
Medway Enterprise Hub
University of Greenwich
Chatham Maritime
Kent , ME4 4TB

Our ref:
Your ref:

Date: 18th August 2011

Dear Dr Carey

Thank you for your submission of 1st April 2011 and subsequent supporting information regarding treating and stabilising Air Pollution Control residues to form a bound and pelletised material to be used to replace other aggregates, specifically in the production of concrete blocks for the building industry.

The End of Waste Panel is the way in which we organise ourselves to ensure that the end of waste submissions we receive, are dealt with by the right people within the organisation. Each submission is looked at on its own merits. The Environment Agency is not the final judge of whether or not something is waste: that is for the courts. We are simply giving a view.

We base our view on submissions to the panel on current waste law principles. The European Directive, the Waste Framework Directive (2008/98/EC) ("WFD") is the foundation of waste law, and together with its related guidance and applicable case law from both Europe and England and Wales, underpins the way in which we approach each submission. For these case by case assessments, we follow Article 6 of the WFD and specifically, the legal test laid down in the English and Welsh case: R(on the application of OSS Group Ltd) v Environment Agency and others [2007] EWCA Civ 611, the requirements of which are summarised below and reflected in our end of waste submission templates:

- **the waste has been converted into a distinct and marketable product;**
  You have shown evidence that there is demand from the block making industry for the aggregate and the co-operation of these companies by undertaking block making tests indicates a level of commitment to the product.
- **the processed substance can be used in exactly the same way as a non-waste virgin material;**
  Your testing and results for the material and the blocks show that, specifically and solely for the purpose of making concrete blocks, this material can be used without further processing as a direct replacement for virgin sourced materials such as gravel.
- **the processed substance can be stored and used with no worse environmental effects than a comparative virgin material.**
  Despite elevated levels of substances in the unbound, untreated Air Pollution Control residues (APCr), concrete blocks manufactured from the treated, bound and pelletised material appear to show no worse detriment to the environment or human health than blocks manufactured from virgin aggregate. This is dependent on the normal risk assessments being conducted during use as if the block was sourced from virgin materials.

Based on all of the information provided, our view is that your material meets the 'End of Waste' test for the reasons set out in the paragraphs above. Please be aware that our decision is only relevant to your specific submission and that any batch that fails to meet the prescribed technical specification you have supplied, will be regarded as waste, unless you can show otherwise. You will need to ensure you have the necessary quality assured processes and testing regimes in place to ensure this specification is always achieved. It is essential that all of the quality assurance procedures laid out in your submission and accompanying documentation are carried out and that routine sampling of the inputs and outputs of the process are maintained to ensure that there is no specification creep away from the levels indicated.

Should any standard or specification that you have relied upon either directly or indirectly in your submission change in the future, you may need to review and amend your own standards and specifications to ensure your aggregate retains its non waste status.

We want to make it easier for our customers to use waste derived products without the need for regulatory control where the waste material used has achieved end of waste status. Our aim is to remove any unnecessary regulatory burden on business whilst at the same time, ensuring the environment is appropriately protected.

Yours sincerely

PP

Pandora Rene
Tel: 07879 430366

Appendix 3: Tetronics End of Waste Decision

creating a better place

Environment Agency

Mr C. Chapman
Technical Director
Tetronics Limited,
Unit B3,
Marston Gate,
Stirling Road,
South Marston
Gate Industrial Estate,
Swindon,
Wiltshire, UK,
SN3 4DE

Date: 15 June 2007

Dear Mr Chapman

Thank you for the information you have sent us regarding plasma arc technology, which puts municipal and commercial waste through a thermal treatment process to produce an inert vitreous material. This treatment does require a PPC permit and the paperwork I have received does not indicate if you have already obtained one or are in the process of doing so, please do call us if us need more information on this. The information you have provided shows you intend this material to be used in an unbound form as a secondary aggregate in civil engineering construction projects.

Ceasing to be waste
You have asked us to give an opinion in regards to whether the material could cease to be a waste before it is used as an aggregate?

As stated in earlier email correspondence with my colleague John Kirkham (22.08.06) a waste material will only cease to be waste when it has undergone a 'complete recovery operation'. To come to this conclusion the following factors must be shown:

1) **Certainty of use:** It must be demonstrated that there is a need and a market for the recovered waste and that it will not be merely stockpiled awaiting the development of a market.
2) **Suitability for use:** the recovered waste should meet a recognised standard which attains the same level of specification as that of a raw material and which demonstrates the waste serves a useful purpose in replacing other materials.
3) **No risk to the environment or human health:** the recovered waste must not have the potential to undermine the aims of the Waste Framework Directive by causing pollution or harm to human health when it is either stored or used.

You have provided us with a letter from Aggregate Industries showing interest in using this material as pipe bedding material. There has also been further work done by Wardell Armstrong who has identified other end uses such as landfill drainage material. If the material is stockpiled then it may be waste so you need to ensure that there are markets in place before production starts.

Wardell Armstrong has also done further work on how suitable the material is to be used as an unbound aggregate in civil engineering operations. It is clear from the report that they are happy it meets the relevant European Standard, EN 13242:2002, for the use of secondary and recycled aggregates.

In regards to the last point required to be demonstrated you have had independent leachate testing done to ensure that the material complies with the Waste Acceptance Criteria for inert landfill. This report indicates that the vitrified material could be accepted for landfilling at an inert waste landfill and therefore not a risk to the environment or human health. If at anytime pollution or harm has or is likely to occur we may consider that it will undermine the principles of the Waste Framework Directive and that the material has not been sufficiently fully recovered. Our Enforcement and Prosecution policy can be found on our website at http://www.environment-agency.gov.uk/commondata/acrobat/enfpolicy.pdf

On the basis of the information given the Environment Agency is happy to class the material as having being fully recovered at the point where it leaves the plasma arc process and can be used as an aggregate. At this point it will no longer be classed as a waste and we will not regulate. There will not be any need for you to register under the Waste Management Licensing Regulations 1994 after this point.

If you need to speak to me further on this then please do call me on 01733 464686.

Yours sincerely
Laura Holloway
Waste Policy Adviser

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