# Contract Report

arrb research

## Report on Construction and Demolition Waste Recycled Materials Workshop

*by* *Bob Andrews, Kieran Sharp and Paul Robinson*

for Zero Waste SA

RC74540-1 June 2009

# Report on Construction and Demolition Waste Recycled Materials Workshop

for Zero Waste SA

| | Reviewed |
|---|---|
| **Project Leader** | Bob Andrews |
| **Quality Manager** | Kieran Sharp |

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## Summary

The processing of construction and demolition (C&D) waste into recycling products is a maturing industry in South Australia (SA). Confidence in their use is slowly developing under the constraints of customer perceptions of their inferiority to virgin materials, poor quality control, contamination, occupational health and safety issues, leachate concerns, etc.

ARRB Group Ltd (ARRB) is conducting a project, 'Development and Implementation of a Strategic Direction for the SA C&D Recycling Industry'. The project is being supported by Zero Waste SA, Resourceco and Adelaide Resource Recovery (ARR).

A major component of this project was an introductory Workshop conducted in Adelaide in March 2009. Delegates included the industry (represented by the Waste Management Association of Australia (WMAA) C&D Working Group), relevant State Government departments and principal associations including the Local Government Association (LGA), the Institute of Public Works Engineers (IPWEA), the Institution of Engineers Australia (IEAust), the Civil Contractors Federation (CCF), and the Australian Consulting Engineers Association (ACEA). The desired outcome of this consultancy process was a number of action plans and a potential marketing strategy.

This report presents details of the Workshop, including a summary of the presentations and the facilitated discussion. The main question addressed in the facilitated session was how to optimise the use of recycled materials in SA given that lack of source material, the current quiet market and the types of material available.

It was agreed that the aim should be that recycled (C&D and other) materials be recognised as 'another quarry material' capable of producing a range of products that in certain applications (e.g. Class 1, etc.) can compete as an alternative materials source.

Subsequent to the Workshop, the project team have developed an action plan to address the issues raised in addition to providing engineering and environmental qualification of recycled products in road infrastructure. This action plan includes an industry accreditation process and product branding.

It was also agreed that there is a need for a national Seminar to give a national perspective and voice to recycled product usage of C&D waste. The Seminar would have to have a specific theme / goal and address the topic of where technology currently sits.

# Contents

# 1 Introduction

The processing of construction and demolition (C&D) waste into recycling products is a maturing industry in South Australia (SA). Confidence in their use is slowly developing under the constraints of customer perceptions of their inferiority to virgin materials, poor quality control, contamination, occupational health and safety issues, leachate concerns, etc.

ARRB Group Ltd (ARRB) is conducting a project, 'Development and Implementation of a Strategic Direction for the SA C&D Recycling Industry'. The project is being supported by Zero Waste SA, Resourceco and Adelaide Resource Recovery (ARR).

In terms of the extent to which the project will lead to an increase in the size and diversity of markets for recycled materials, and support for the local reprocessing of recycled materials, it was considered that, with increased technical and environmental awareness of the technologies supporting recycled materials, the market would increase because of:

- a broader customer base and increased confidence in the materials and products
- increased application of recycled materials on high-profile projects
- increased awareness of the diversity of products available for use
- the setting of industry standards to meet customer product expectations
- the climate change benefits associated with the use of recycled materials.

The project is innovative in that leading-edge laboratory characterisation procedures, developed as a result of projects conducted in Australia and overseas addressing the characterisation and performance of pavement materials, will be adopted. The aim of the market survey and technology transfer activities is to address current concerns associated with the use of recycled materials as well as contract tendering.

## 1.1 Stages of the Project

The project is being conducted in three stages.

*Stage 1: Consultative process*

A consultative process with industry and its stakeholders to identify gaps in industry practices, product benefits/deficiencies, education and product research requirements.

A major component of this stage was an introductory Workshop conducted in Adelaide in March 2009. Delegates included the industry (represented by the Waste Management Association of Australia (WMAA) C&D Working Group), relevant State Government departments and principal associations including the Local Government Association (LGA),the Institute of Public Works Engineers (IPWEA), the Institution of Engineers Australia (IEAust), the Civil Contractors Federation (CCF), and the Australian Consulting Engineers Association (ACEA).

The desired outcome of this consultancy process is a number of action plans and a potential marketing strategy.

*Stage 2: Demonstration of product suitability and performance*

This stage involves the conduct of state-of-the-art laboratory characterisation of products, supported by analysis of a demonstration road pavement field trial comprising 100% recycled products. This involves the adoption of performance-based testing methodologies developed internationally for pavement materials, where the performance of the recycled materials is compared to that of traditional SA quarry products. The demonstration field trial includes the

evaluation of various aspects associated with the construction of pavements incorporating recycled materials, including water consumption, compactability, equipment requirements and completed level of structural integrity and aesthetic acceptance. The process adopted followed similar lines to that undertaken in the development of Bitumix under a Zero Waste SA grants awarded to Resourceco and undertaken by ARRB.

The successful conduct of this stage of the project would:

- demonstrate industry standards of product environmental compliance with state legislation, including leachate proportions and asbestos control
- increase awareness of the potential impacts of climate change, and the need to reduce greenhouse emissions. A study of relative embodied energies (and emissions) of the recycling industry would also be incorporated.

*Stage 3: Knowledge transfer*

A key element of the project is the effective knowledge transfer to stakeholders at the completion of the project to ensure that the outputs of the project are effectively disseminated.

This report presents details of the Workshop, including the workshop program and a summary of the facilitated discussion, The presentation to the Workshop are contained in a companion CD which will be distributed to all delegates and other key stakeholders.

# 2 Details of the Workshop

The Workshop on 'Construction & Demolition Waste Recycled Materials' was held in Adelaide in March 2009. The purpose of the Workshop was to inform delegates on advances made in: product specifications, manufacture, product quality control, engineering properties and environmental aspects. Another purpose of the Workshop was to identify those issues associated with the acceptance of recycled products in order than an action plan for resolution is developed.

Over 50 delegates representing government and private industry attended the Workshop. Delegates representing organisations which had considered and rejected the use of recycled materials were encouraged to attend, so that feedback on ways to address industry concerns could be assembled.

The Workshop program is shown in Appendix A, whilst the details of the Workshop attendees are shown in Appendix B.

A feature of the program was the facilitation session, which gave delegates an opportunity to share project experiences in the use of recycled materials (good and bad) and also to provide input on the following questions

1. Are quarry materials more preferable than recycled materials? Why, and under what circumstances?
2. What are the fears about using recycled materials – quality, variability, risk, price, workability, environment, asbestos, chemical contaminants?
3. Would certification of recycled materials assist in their more common acceptance?
4. Is there anything the recycling industry could improve to increase product confidence?

# 3 Summary of Presentations

The presentations to the Workshop are contained in a companion CD which will be distributed to all delegates and other key stakeholders.

## 3.1 Overview of Zero Waste SA

Zero Waste (ZW) was established on 1 July 2003. It forms part of the Environment & Conservation portfolio. Current priorities include:

- food waste from households
- recycling collection for business
- recycling infrastructure capacity
- resource efficiency with business
- local markets for recycled products

The amount of waste material used as landfill has reduced from over 1.3 Mt in 200/2001 to about 1.1 Mt by 2007/2008. The target is to reduce this to 0.95 Mt by 2014 (see Figure 1). Currently, approximately 30% of this waste is household waste, 30% business waste and 30% construction waste.

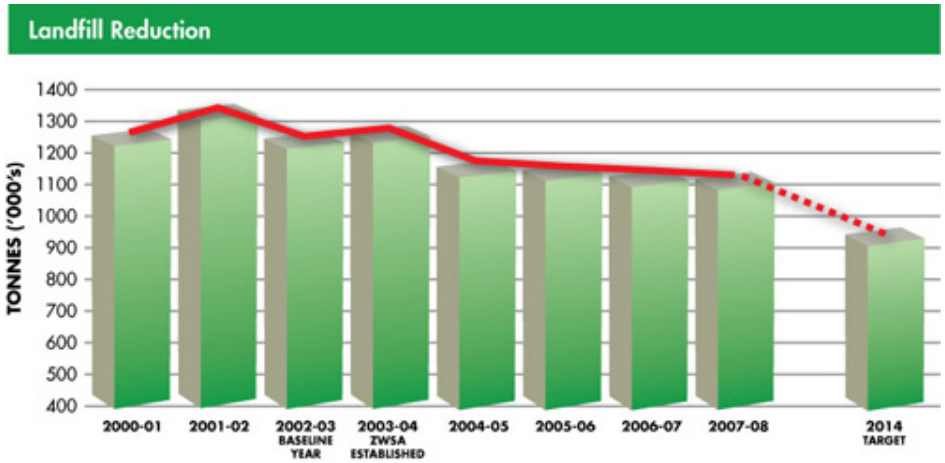


***Figure 1: Reduction in waste material sent to landfill***

In terms of the recycling of materials, South Australia is the second most successful State or Territory in Australia (see Figure 2).

In terms of marketing development, the main priorities are:

- high value, fit-for-purpose products
- new product development
- quality assurance
- support for government procurement of recycled products.

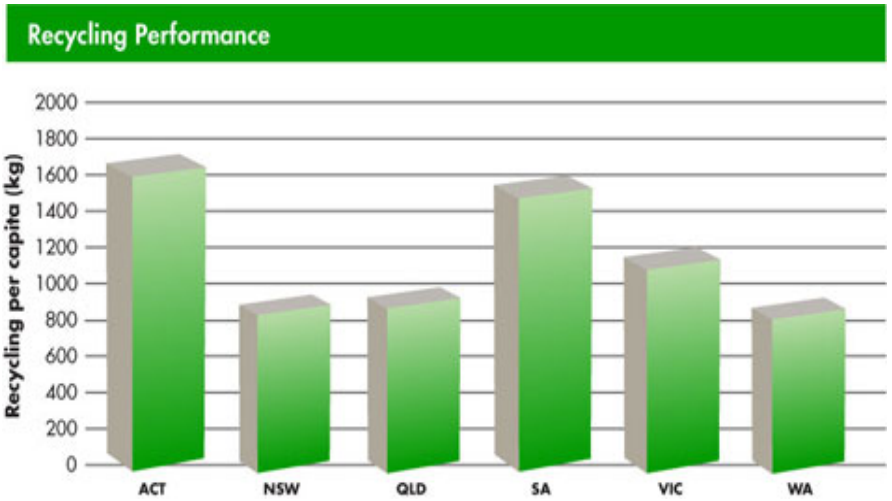


***Figure 2: Comparison of recycling performance in Australian States and Territories***

Current construction and demolition (C&D) waste recycling in SA is shown in Figure 3. It can be seen that concrete represents one-third of the C&D waste recycled, whilst asphalt represents only 2%.

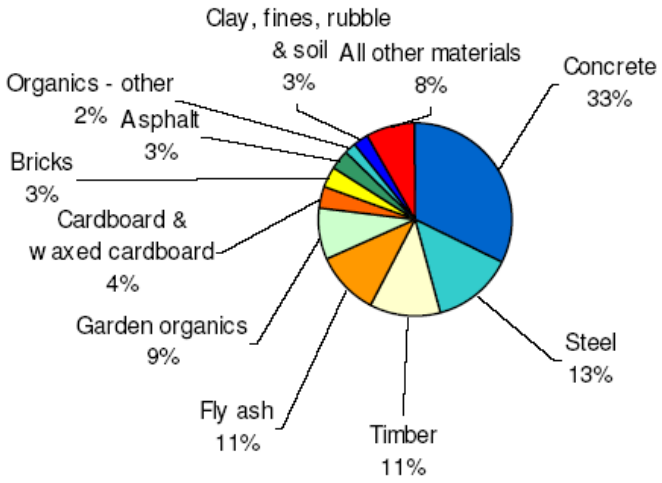


***Figure 3: Current construction and demolition (C&D) waste recycling in SA***

The benefits of recycling aggregates include reduced landfill, reduced greenhouse impact, resource savings and the process is price competitive. Current issues regarding the recycling of materials are related to the impact of the global financial crisis and the Commonwealth Government stimulus package and the impact of the Carbon Pollution Reduction Scheme.

## 3.2 Overview of Raw Materials Market in Metropolitan Adelaide

The current Adelaide metropolitan raw materials market is in excess of 5 million tonnes, of which recycled materials represent approximately 1 million tonnes. It is a very mature market with no new entrants in recent years. There have also been no new major technical advances.

Each tonne crushed produces approximately equal volumes of aggregates and sand. This is not by design but usually an inherent property of the crushing process. This can be influenced slightly by raw feed quality.

The products produced are used in pavements (including drainage layers), as bulk fill or in agricultural applications. In terms of value some sands, low grade subbases and other by-products are classed as 'low value', Class 1 & Class 2 pavement materials and some drainage aggregates as 'medium value and concrete, asphalt and sealing aggregates as 'high value'. There is current over-supply of some sands & bulk fills and the market for pavement materials is volatile. There is also a shortage of aggregates, with demand being met by satellite quarries

The recycling of materials commenced in the early- to mid-1990s. At that time, most demolition waste was going to (legal & illegal) landfill. Initially crushing and reusing on project sites was the most common method adopted, resulting in a low value, low quality, product and little market acceptance. The driver was a slightly cheaper alternative to dumping.

Currently there are only three operators of metropolitan quarries (Boral, Cemex and Hanson). As the distance that quarry products needing to be hauled into the metropolitan area increases, recycled product are becoming more attractive as a raw material source. Examples include the Port River Expressway and, more recently, the Northern Expressway (NEXY) project which will require 1 million tonnes of fill. A significant proportion of this need could be met if recycled products were used rather than quarried material.

Since then the market has grown as a result of the securing of-long term locations close to markets, closer cooperation with Government Departments (e.g. DTEI and the EPA) and local Councils, and the commencement of R & D work conducted using Government grants (e.g. Zero Waste) and using organisations such as ARRB group, and product development conducted by the industry.

As a result, recycled materials are now included in DTEI PM specifications, SA Water has approved their use and several sites dedicated to the receipt and processing of C&D waste streams have been established. There has also been a significant investment in plant, equipment and infrastructure. This has resulted in wider market acceptance; recycled products are now a viable alternative to quarried products.

However, there are still several issues to be addressed:

- For example, there is still the perception that recycled products are a cheaper alternative and that the quality of recycled products is lower than that of quarried products. As a result, some Government Departments still exclude their use.
- The location of some of the sites is also an issue because of the impact on neighbourhoods (visibility, dust, noise, etc.) and EPA constraints.
- Another constraint is related to volume; only available material can be crushed and the volume available is dependent on new development activity levels. Quarries have an advantage in that they can ramp up production using reserves.
- Another issue is the dependency on raw feed (concrete, bricks, asphalt, masonry products). Continual sorting and classifying is required to achieve the best result.
- The market is also very volatile in terms of the availability of materials such as scrap steel and cardboard / plastic.
- Potential contamination demands diligent inspection of every load received. Recycling is labour intensive despite. Another issue is asbestos.

However, the benefits of recycling are widespread, including:

- the use of recycled materials assists in the sustenance of the life of quarries, which have finite reserves; no new quarries will open in the metropolitan area
- a reduction in the industry's carbon footprint
- the minimisation of waste going to land fill
- the minimisation of the impact on existing infrastructure, e.g. shorter haul distances (both at disposal and delivery)
- reduced greenhouse gas (vehicle and land fill) emissions

## 3.3 DTEI Product Specifications

This presentation involved a demonstration of the DTEI Master Specification for Roadworks which can be accessed via http://www.transport.sa.gov.au/index.asp. Elements demonstrated included contracts and tenders, specifications, with emphasis placed on Part 215 of Division 2 (Pavement Materials). Products covered by Part 215 include:

- spalls
- road Ballast
- Class 3 recycled pavement material
- Class 3 quarried pavement material
- Class 2 recycled pavement material
- Class 2 quarried pavement material
- Class 1 recycled pavement material
- Class 1 quarried pavement material
- stabilised pavement material
- sealing aggregate
- sand
- asphalt aggregate
- mineral filler for asphalt, other than hydrated lime.

Clause 7 of Part 215 addresses recycled materials:

- Clause 7.1 – Construction and demolition materials
- Clause 7.2 – Alternative sources of recycled materials
- Appendix 1 – product specification sheets for recycled materials – foreign materials and binder content.

## 3.4 City of Canning Demonstration Project

Welshpool Road in Perth, WA, is a four-lane undivided road carrying significant heavy traffic including road trains and extra wide loads. It was recently widened to 4.5 m each side, with four lanes divided. The design traffic is 2 x $10^7$ ESA (30 years).

The following pavement profiles were installed:

- 250 mm commingled recycled subbase with 150 mm new road base
- 400 mm commingled recycled base
- 250 mm of 50 mm maximum size commingled
- recycled subbase with 150 mm of 20 mm recycled concrete base
- 400 mm recycled concrete base.

The presentation then went on to explain the concepts of particle size distribution, the field and laboratory performance of granular materials under load and the results of repeat load triaxial testing (RLTT), shear box testing and Falling Weight Deflectometer (FWD) testing of the various materials. Observations made of the workability of the materials during construction were also included in the presentation. It was found that variations between tests can lead to differing conclusions.

The next part of the presentation addressed the back-calculation of the modulus of the various materials based on the deflection data, and the breakdown of the materials (i.e. change in particle size distribution) during field compaction.

Risks associated with the use of recycled materials included:

- the presence of cement clinker around aggregate can possibly weaken the pavement
- changes in grading during construction due to breakdown
- the possibility of contamination

Cost comparisons, including transport costs, in situ costs and disposal costs, were also presented. For example, a comparison of disposal costs is shown in Table 1.

**Table 1: Comparison of Disposal Costs**

| Material | To Landfill | | To C&D Recycling | |
|---|---|---|---|---|
| | Base Price ($/t) | Transport Cost ($/t) | Base Price ($/t) | Transport Cost ($/t) |
| Concrete | 25.00 | 5.50 | 8.46 | 1.18* |
| Mixed Sand & Concrete | 25.00 | 5.50 | 8.46 | 1.18* |
| Sand | 5.00 | 5.50 | 4.23 | 1.18* |
| Mixed Grass & Concrete | 60.50 | 5.50 | 12.69 | 1.18* |

* Effective cost allows for back loading.

The main findings of the study to date were:

- there is a need to have an understanding of the long term field performance of materials rather than simply an understanding of their compliance to specifications; not enough work is being conducted on the field performance of in-service pavements
- the traditional method specification approach may not be completely applicable to recycled materials due to differences in behaviour; it would be preferable to consider performance based specifications for behaviour after placement (e.g. deflection, curvature, etc.)

- there are considerable environmental and economic benefits associated with the use of recycled materials
- recycled materials can be used with confidence as a base in lightly-trafficked roads and as a subbase in heavily-traffic roads and it is likely that recycled materials are suitable for use as a base in heavily-trafficked roads
- problems that occur may not be so related to the materials but rather with a contractor's ability to place materials correctly as they handle differently to 'new' materials. For example, more water is required in a recycled material mix (say 10-12%) compared with 'fresh' crushed rock (say 6%).

## 3.5 Processes, Issues and Controls: a South Australian Environmental Regulatory Perspective

The presentation commenced with a definition of 'waste' as defined in Part 1 of the EP Act. This was followed by a summary of the objectives of the *Environment Protection Act 1993* – Section 10.

A number of issues associated with the use of waste materials were identified, including:

- At what point does a waste become a suitable recycled product?
- What is the waste management process and the process to demonstrate suitability and product quality?
- Risks to the environment and human health.
- Reducing the potential future use of land by reduced environmental quality.
- The potential generation of new site contamination.
- The need to remove contamination from the environment to reduce overall risk rather than simply moving the risk to another location.

The challenge is to ensure that the recycled products industry can overcome these issues. Fundamental processes and procedures include:

- the promotion of source segregation
- QA/QC for:
    - receipt – inspection, acceptance or rejection of loads
    - product quality
    - isolation and the management and disposal of contamination, rather than dilution.

The presentation then addressed the Waste Reform Project, including guiding principles and protocols for waste derived products.

## 3.6 Recycled Aggregates – Some Greenhouse Issues

The presentation commenced with an outline of a recent case study in Adelaide. The aim of the study was to develop a method and collect data on the energy use, greenhouse gas emissions and other environmental/social impacts of Resourceco's recycling operations, and the beneficial reuse options for recycled materials.

A description of the C&D waste stream at a crushing plant is shown in Figure 4. From every tonne of waste delivered, there are recyclables extracted and, through reprocessing, there are a range of recycled products produced.

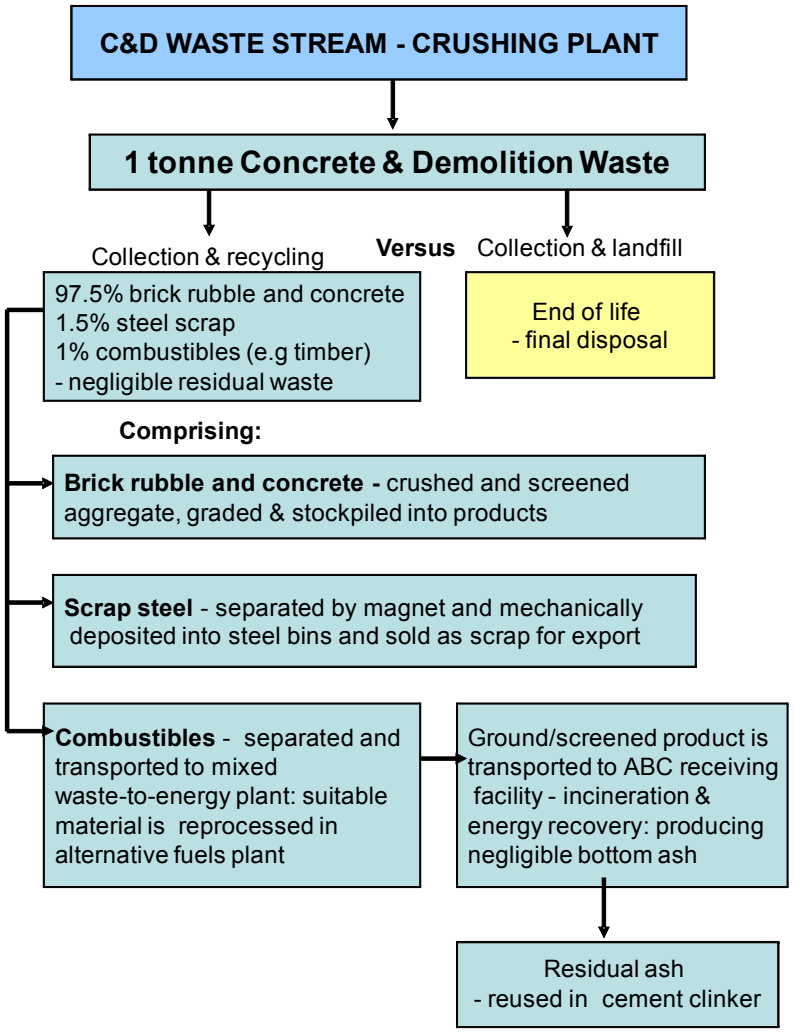


***Figure 4: Description of the C&D waste stream at a crushing plant***

The process for the production of recycled materials is shown in Figure 5. Activities addressed include waste collection and delivery, manufacturing and processing, and transport and distribution to en-use point. The overall impact is assessed in terms of the recycled C&D and mixed waste versus landfill.

Preliminary results of the total $CO_{2\text{-}e}$ per unit of production (preliminary) at Resourceco were 3 kg of $CO_{2\text{-}e}$ / tonne (21 MJ/t) compared with 7.5 kg of $CO_{2\text{-}e}$ / tonne (31 MJ/t) at a Victorian quarry. The process energy use and emissions associated with recycled aggregates could represent up to 60% fewer emissions compared with an equivalent quarry product.

A US study conducted by the EPA in 2003 found that there were 30% less emissions for recycled aggregates, whilst a study in the UK in 2008 reported by the Quarry Products Association found emission levels of 6 kg $CO_{2\text{-}e}$ / tonne overall & 4 kg/tonne for crushed rock.

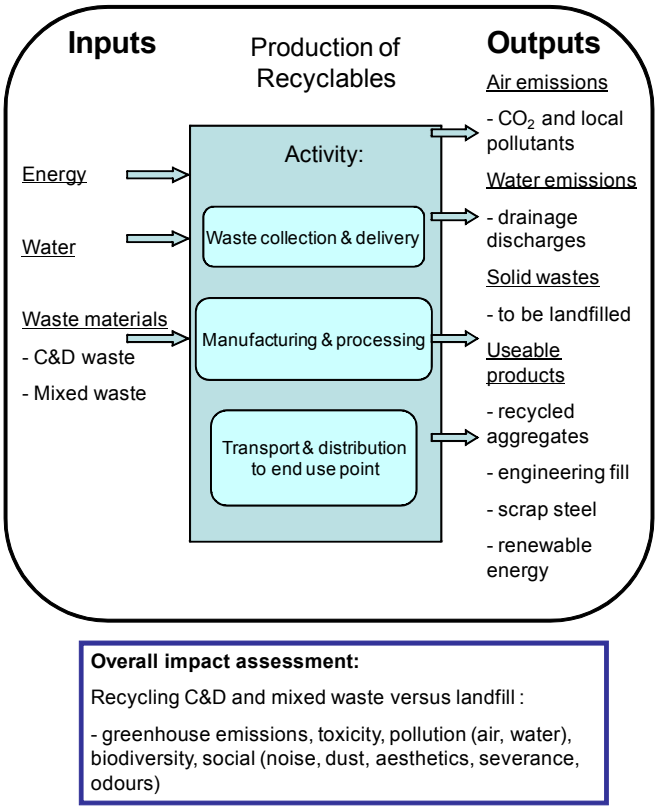


***Figure 5: Process for the production of recycled materials***

The studies are difficult to compare without viable information regarding the basis of the published figures. In addition, emission factors will vary according to the methodology (scope-direct/indirect) and local electricity generation (gas, coal fired, nuclear, etc.).

It was suggested that there is a need for further local studies investigating local applications, including:

- quarrying and aggregates recycling – energy assessments to generate some indicative benchmark figures
- roadworks and general construction and maintenance case studies.

## 3.7 Construction Waste and Recycling: a National Perspective

About 30 Mt of waste material is generated each year, of which 42% is C&D waste, 29% commercial and industrial waste and 27% municipal waste.

The presentation addressed the types of operations currently being practiced in Australia, the operation of a pugmill, mixed waste product development, and examples of products and their applications.

The next part of the presentation dealt with current standards in use in Australasia for a range of materials (see Table 2) and National standards (Table 3). The presentation then addressed, the design of stabilised materials, their uses in pavements, flood levees and industrial yards.

**Table 2: Comparison of Standards Operating within Australasia**

| | Resource NSW | MR WA | NZTA | DTEI SA |
|---|---|---|---|---|
| supplementary materials: brick, crushed stone, tiles, masonry, glass | 3% – 30% max. | 5% max. | 3% max. | 20% max. |
| friable materials: plaster, clay lumps | 0.2% max | 2% max | 1% max | 1% |
| foreign materials: rubber, plastic, paper, cloth, paint, wood, vegetable matter | 0.1% max | 0.5% max | 0.5% | 0.5% |
| bituminous materials: asphalt (slabs and planings), seals | 0.1% max. | 0% | 0% | bitumen content 1% max |
| asbestos | 0 | 0 | | 0 |

**Table 3: National Standards (National Environment Protection Council)**

| Substance | Health Investigation Level A (mg/kg) |
|---|---|
| **Metals** | |
| Arsenic | 100 |
| Cadmium | 20 |
| Chromium (VI) | 100 |
| Copper | 100 |
| Lead | 300 |
| Mercury (inorganic) | 15 |
| Nickel | 600 |
| Zinc | 7,000 |
| **Organics** | |
| Aldrin/Dieldrin | 10 |
| Chlordane | 50 |
| Polyaromatic hydrocarbons (PAH) | 20 |
| Petroleum hydrocarbons C16-C35 aromatics | 90 |
| Petroleum hydrocarbons C16 – C35 aliphatics | 5,600 |
| Petroleum hydrocarbons > C35 aliphatics | 56,000 |

### 3.7.1 National Goals of WMAA C&D Division

The main goals of the WMAA C&D Division are as follows.

*Goal 1 – Towards seamless acceptance of fit-for-purpose engineering materials sourced from recycling C&D Waste:*

- improve market awareness of the technical capabilities of using recycled materials in road pavements
- provide guidance on the application of recycled materials to specific conditions
- detail environmental benefits associated with their use, including reductions in greenhouse emissions

- provide performance assurance in the use of recycled materials in road pavements.

*Goal 2 – Improve the operational performance of the industry:*

- develop a 'code of best practice for waste processing in the construction and demolition industries'
- develop a third-party accreditation system for the operational performance of the industry
- gain ISO quality accreditation of industry products
- provide guidelines for asbestos and contaminant control.

*Goal 3 – Provide an information reference and retrieval facility of national and international developments:*

- create an adjunct C&D Division website to the WMAA website to include a library reference to national and international conference papers reports, etc.
- develop technical notes on the use of recycled materials
- provide access to product specifications and standards
- develop specific work practices associated with recycled pavement materials including OH&S issues.

# 4 Facilitated Session

The main question addressed in the facilitated session was how to optimise the use of recycled materials in SA given that lack of source material, the current quiet market and the types of material available, e.g. the closure of landfill sites is bringing more brick into the recycle stream.

Following is a summary of the discussion and key outcomes. Further details of specific comments offered are presented in Appendix C.

- In terms of defining 'optimisation' it was suggested that
    - recycled product should be seen as the same as a quarried product commercially with selection based on price, i.e. a level playing field
    - there is a need to get rid of the prejudice against recycled materials; some government bodies still refuse to use recycled product (probably due to the possible presence of asbestos).
- The aim should be that recycled (C&D and other) materials be recognised as 'another quarry material' capable of producing a range of products that in certain applications (e.g. Class 1, etc.) can compete as an alternative materials source.
- There is a wide difference in quality:
    - an accreditation system is needed which operates within legislature
    - there is a need to 'lift the game' within the industry (problem with controlling small 'cowboy' operators who taint the rest of the industry).
- The perception of recycled materials has in recent years been damaged by issues such as asbestos content and occasional instances of inferior end results (e.g. pock marking of surfaces constructed using waste recycled materials). This could be attributed to a lack of transparency by some suppliers regarding the content of their end product.
- Site-based method specification development is required due to the changing nature of the products in the recycled stream. Consider proof rolling and other performance based measures (reflects Bob Andrews' earlier comment regarding performance based specifications).
- In terms of the purchasers, there is a lot of ignorance (and prejudice) going back 10 years or more, e.g. problem with asbestos in the waste stream. Current requirements in mos States specify a zero tolerance which is impossible for the industry to comply with. As a consequence the national WMAA C&D Division have developed a guideline for the management of asbestos based upon a risk process which requires consideration by legislative bodies.
- A number of small niggling issues have dragged on but have not been brought to the surface enough to resolve more publicly (e.g. asbestos, sulphides, etc.). There is a perceived lack of transparency which could be overcome by resolving these issues more publicly.
- There is a need to come to grips with where the level of technology is currently. There is also a need to appreciate that construction companies have to be open and better educated regarding the differences in techniques needed in using (placing and working) recycled product.

- There is a need to increase user confidence in the usage of recycled C&D (and other) products. Issues include:
    - the need for national guidelines: the Austroads guidelines for recycled materials will be available in June 2009
    - the lack of field performance data
    - a better understanding of 'greenhouse' issues.
- There are already some Technical Notes available to assist customers and specifiers in choosing and marketing a product, e.g. from the Waste Management Association C&D website.
- There is a need for a national Seminar of 1-2 days duration within about 12 months to give a national perspective and voice to recycled product usage of C&D waste. The Seminar would have to have a specific theme / goal and address the topic of where technology currently sits. It would be conducted in South Australia.

Following the Workshop, Amanda Lewis, Principal Advisor, Waste Reform Project, at the SA EPA submitted C&D waste issues from an EPA regulatory perspective as a follow-up to the presentation given by Steve Sergi. These comments are presented in Appendix D.

As a follow-up to the Workshop, a questionnaire has been distributed to all delegates and other key stakeholders. The purpose of the questionnaire is to provide an opportunity for additional feedback to that provided at the Workshop. A copy of the questionnaire is included as Appendix E.

# Appendix A

## Workshop Program

| Time | Address | Speaker |
|---|---|---|
| 13.30 – 13.35 | Welcome | Paul Morris, ARRB |
| 13.35 – 13.50 | Zero Waste SA Strategy and Project Initiation | Angus Mitchell<br>Zero Waste SA |
| 13.50 – 14.00 | Quarrying and Recycling in South Australia – Industry Overview | Andrew Wilson<br>Institute of Quarrying (SA) |
| 14.00 – 14.15 | Product Specifications | David Poli, DTEI SA |
| 14.15 – 14.30 | Experiences with Recycled Materials – Facilitated Session<br>Shared Project Experiences of Use of Recycled Materials (good and bad) | Facilitator:<br>Kieran Sharp (ARRB) |
| 14.30 – 14.50 | Afternoon tea | |
| 14.50 – 15.00 | Demonstration Project – WA City of Canning | Bob Andrews, ARRB |
| 15.00- 15.10 | Environmental Aspects of Recycled Materials | Steve Sergi and Amanda Lewis, EPA SA |
| 15.10 –15.30 | Aspects of Greenhouse Emissions | Jencie McRobert<br>RMCG Consulting |
| 15.30 – 15.40 | Waste Management Association National C&D Division | Bob Andrews<br>WMAA C&D Division |
| 15.40 – 16.30 | Facilitated Workshop<br>1. Are quarry materials preferable to recycled materials? Why, and under which circumstances?<br>2. What are the fears about using recycled materials – quality, variability, risk, price, workability, environment, asbestos, chemical contaminants?<br>3. Would certification of recycled materials assist in their more common acceptance?<br>4. Is there anything the recycling industry could improve to increase product confidence? | Facilitator:<br>Kieran Sharp (ARRB) |

# Appendix B

## List of Delegates

| Name | Organisation |
|---|---|
| Matt Adam | Hallett Resources |
| Geoff Allen | PG Enterprises |
| Bob Andrews | ARRB Group Ltd. |
| David Bartlett | Department for Transport Energy & Infrastructure |
| Peter Bayetto | FMG Consulting |
| Adam Betterman | Boral Resources |
| Paul Bowden | WMAA SA |
| Simon Brown | Resourceco |
| Rob Canizzaro | All State Group Pty Ltd |
| Harold Carn | Department for Transport Energy & Infrastructure |
| Mario Catalano | Burnside |
| Len Condo | J Davison Nominees Pty Ltd |
| David Crossley | Department for Transport Energy & Infrastructure |
| Paul Davison | J Davison Nominees Pty Ltd |
| Anne Ellson | Environmental Protection Authority |
| John Fisher | Local Government Corporate Services |
| Tom Forde | URS Australia Pty Ltd |
| Andrew Geue | Lucas Earthmovers |
| Andrew Graetz | Penrice Quarry and Mineral |
| Diane Harris | Local Government Corporate Services |
| Mike Haywood | Resourceco |
| Greg Hill | EPA |
| Hugh Hocking | Adelaide Resource Recovery |
| Ramon Hodge | Hallett Concrete |
| Ian Hunter | Onesteel Recycling |
| Andrew Iannos | Department for Transport Energy & Infrastructure |
| Stan Kapoulitsas | All State Group Pty Ltd |
| David Kingston | FMG Consulting |
| Mark Konecny | Tea Tree Gully Council |
| Amanda Lewis | SA EPA |
| Peter Little | PG Enterprises |
| Phillip Mayes (Dr) | SA EPA |
| Grant Miller | Ancon Lab SA |
| Angus Mitchell | Zero Waste SA |
| Sally Modystach | URS Australia Pty Ltd |
| Brenton Moule | City of Burnside |
| Richard Olesinski | ECO Marketing |
| Aaron O'Malley | Golder Associates |
| John Phillips | KESAB |
| David Poli | Department for Transport Energy & Infrastructure |
| Alan Pollitt | Bardavcol Pty Ltd |
| Paul Robinson | ARRB Group |
| Tom Rozenbilds | Cat Con |
| Dick Sander | Hallett Resources |

| | |
|---|---|
| Steve Sergi | SA EPA |
| Daniel Scott | ADCIV |
| Kieran Sharp | ARRB Group |
| Dave Starsky | Vinnie Brothers Earthmoving Contractors P/L |
| Hayden Thom | Hedgehog Constructions Services |
| Mike Van Alphen | Asbestos Research Project CRC CARE |
| Marina Wagner | SA EPA |
| Lydon Watson | Lucas Earthmovers |
| Anne Welsh | Department for Transport Energy & Infrastructure |
| Andrew Wilson | Resourceco |
| Cip Wingrove | URS Australia Pty Ltd |
| Alecia Wright | Department for Transport Energy & Infrastructure |

# Appendix C

## Comments Offered in Facilitation Session

**Tom Rozenbilds – Cat Con**

Tom observed that acceptance of recycled materials seems to have diminished in recent times. He felt that a possible explanation for this may have been that the 'ball had been dropped' with respect to the promotion of recycled materials. Is it possible that the quality of the materials has declined?

**Andrew Wilson – Resourceco**

Andrew's response to this observation was that materials should be acceptable. A possible reason for this perceived decline was that occasionally a 'cut and paste' occurs with respect to product specifications. Perception is an issue, as is fear. These topics need to be addressed within the industry. It should never be assumed that a product meets specification and all output should be approved before distribution to the client.

Another issue is that some 'stalwarts' within the industry are perhaps set in their ways and do not have an open mind to the concept of using recycled materials.

**David Crossley – DTEI SA**

If DTEI specifies the use of (for example) PM20, they are not necessarily concerned whether the product originates from a quarry or from recycled materials. David cited a recent project whereby cost was the dominant factor in the purchase of certain material(s). The issue of origin was secondary as long as the product met specifications and regulation.

**Kerry Whitehead – Fairfield City Council, NSW**

Kerry cited the issue of acceptance of recycled products within the industry, local government and the broader community. Specifically, Fairfield City Council has made a conscious decision to favour recycled products; during the last five years 75% of the asphalt used within their constituency has been recycled material.

Quality is, however, a problem in NSW. A heavy testing regime is in place but there is no associated marketing push to give a 'big tick' to those organisations doing the right thing compared to the small number of 'cowboy' operators. Overall adherence to agreed standards is essential.

**Mark Konecny – Tea Tree Gully Council**

Mark stated that, four to five years ago, there were issues with recycled materials regarding 'dust' and 'watering in'. Around this time, the cost of quarried and recycled materials was comparable and there was no financial benefit to Councils regardless of which products they chose to use, as long as they met existing specifications and complied with regulations. Since then, the issue of 'carbon footprint' has become more widely known and this would be a governing factor if prices for quarried and recycled products were similar. He felt, however, that recycled materials were better placed in lower-grade works such as car parks, etc.

**Peter Bayetto – FMG Consulting**

Peter raised the issue of sulphide-bearing aggregates turning up in recently-produced mixes and this has raised concerns about the exact content of recylced materials. He asked how the industry was going to address this issue and what measures it would take to prevent contaminants making their way into recylced products.

**Harold Carn – DTEI SA**

Harold stated that two recent projects conducted by DTEI involved the use of recylced materials. The result with one project was very good, whilst the result with the second project was mediocre.

Harold also raised the issue of the contractors' ability to work with the materials and that problems may (occasionally) be more attributable to a deficiency in this area, rather than the materials themselves being of a sub-standard nature.

**Kieran Sharp – Facilitator (ARRB Group Ltd.)**

Kieran suggested that this came down to increasing the awareness and acceptance of recylced materials within the industry and the broader community and that this issue should be examined in greater detail further into the Workshop.

**Mike Haywood – Resourceco**

The desired outcome for the industry as a whole would be that recylced materials would be regarded with the same esteem as materials originating from quarries. The choice should ideally come down to pricing comparison alone.

# Appendix D

# C&D Recycling: Issues from an EPA Regulatory Perspective

## Issue: Product Versus Waste

The issue that the EPA faces is claims made by operators that, since a waste has been through a process, then at the end of that process that material is automatically no longer a waste but a product and hence placement of this product should be of no concern to the EPA. However, in reality, these products may in fact be bi-products, including mixed residual waste and soil that are amalgamated and, on occasion, mixed though fill material to be called an engineered fill product.

The EPA asserts that the product must be made to accepted specification, must be beneficial, must not involve the dilution of waste, must have an end-market and must not cause, or have the potential to cause, harm to the environment or human health to be an acceptable product. Thus, in many cases, the EPA believes that this fill is in fact still a waste and hence receipt and filling of land with such material is actually disposal of waste. This has been highlighted by examples of post-processing material as a 'product' stockpile in which there is clearly visible large amounts of waste contaminants including timber, wiring, insulation and household waste such as jam tin lids, computer parts, spark plus, dolls heads, etc. These have been claimed to have been 'processed' into an engineered product. Some of this is the subject of ongoing action by the EPA.

## Issue: Contamination

The issue of contamination of crushed concrete by other inert materials such as bricks that may affect the performance of the product are not necessarily raised as a key concern for the EPA, nor the size specifications and other performance testing conducted to ensure a sound product.

The EPA does have issues with asbestos contamination and the inclusion of mixed waste in the processing of C&D waste. This means that the 'products' risk being contaminated with unsuitable waste and hence both the physical and chemical quality of the final products is the concern, for which there is a lack of QA/QC.

The concerns include the risks of creating new site contamination, risks to human and environmental health, disposal of waste 'by other means' not meeting the principles of best practice waste management, and risking conflict with the objects of the Act and inconsistent regulation.

## Issue: Market Distortion

The EPA believes that a percentage of material that is being subjected to processing and inclusion in recycled products should have in fact been sent to landfill. This may then lead to distortion of the market. In addition, true figures on diversion and recycling will also be affected. Diversion for its own sake is not acceptable and products must be fit-for-purpose, must not cause harm and must be produced using best practice waste management principles including segregation rather than amalgamation, size reduction and dilution.

## Contributing Factors

- A lack of QA/QC for materials received, the manner of processing waste and a lack of QA/QC for final product, have contributed to unacceptable fill products from C&D recycling facilities.

- Recycling facilities casting their net very widely in the range of materials they seek to receive and process further than 'clean' loads of C&D.
- The nature and manner in which the material is often received. This can be mixed skip bins that are from construction and demolition sites, which are not traditional C&D materials, but contain residual waste, carpets, insulation, fittings and other general waste such as from household clean ups. As a result, facilities may receive waste they should not and/or facilities do not have appropriate processes in place to segregate and manage these materials.
- Following on from this, having received inappropriate waste with a market advantage in being able to receive that material at a lower rate than landfills, there is a drive to include this in a product rather than have to pay for subsequent disposal. This may also emanate from a drive that everything can be diverted and recycled. Hence figures claiming that 99% of all materials received are processed into products and only 1% of material is sent to landfill, whereas a percentage of that waste should in fact have been disposed.
- Inappropriate processes that receive, amalgamate, and size reduce waste so that, at a glance, make it appear soil-like but in fact is mixed waste – rather than using the approach to segregate and remove waste from recyclables prior to processing.
- The apparent use of bi-products from C&D waste processing as a fill product which therefore contains mixed waste.

## EPA SA Actions

*Protocols:*

The EPA is developing Protocols for the development and use of waste-derived products that must be adhered to if a waste is to be recognised as a product and not require regulation as a waste (link – Protocols). These protocols will be linked to Clause 4 of the *Environment Protection (Waste to Resources) Policy* once released (link – EPP). There is also a publication on Guiding Principles for recycled products and a guideline on stockpiling of waste and waste-derived products. Currently, where direct reuse of waste is proposed, this is implemented by way of a declaration of limited purposes under activity 3(3)(i) of Schedule 1 to the Environment Protection Act 1993. However, this is not effective for products from recycling facilities as that then enters the realms of debate on product versus waste and hence the ability of the EPA to regulate that material.

The need to develop these protocols and specifications was identified by a Subcommittee of the Board of the EPA as a result of some of the industry practices, including the issues described above.

This protocol will specify the 'Waste Fill' criteria, (as specified in the *Environment Protection (Fees and Levy) Regulations*) as the base line quality criteria for reuse of waste derived fill materials. The Protocol is soon to be released for consultation. Part of this proposes a requirement for operators of recycling facilities to develop and submit '*recovered product plans*' that will detail the quality and procedures for producing their recycled products that will need to be approved by EPA in line with the protocol and managed through the licence for the site.

When these criteria are exceeded, consideration will be given to site-specific proposals (up to 'Intermediate' criteria) provided a site contamination auditor appointed under either the SA or Vic EP Act is engaged to endorse a site management plan, determine suitable criteria (up to but not exceeding Intermediate) and subsequently produce an audit report that will certify that the use will not cause harm. Material exceeding Intermediate (i.e. Low Level Contaminated material or above) may not be reused – two dedicated landfill facilities are authorised to receive this material for disposal in SA.

*Other*

In this regard, there may be issues with specifications determined, for example, by the Transport Authority which do not match EPA's position and for which the EPA is not aware of their involvement in their development. Thus any work to develop criteria will need to meet the requirements of a being a recycled product rather than a waste.

A similar process has been undertaken in NSW, which was mentioned during the workshop. These NSW criteria are released as exemptions in order that the material does not need to be regulated as a waste and unless and until a material meets that exemption, then it is a waste that requires relevant authorisation (link – NSW exemptions). The NSW model has material-specific exemptions developed; for example, for the reuse of *aggregates*, *virgin excavated natural material* and for *fines from C&D processing.*

Finally, although the desire voiced at the Workshop is to have the product recognised in the same light as quarried products (where their quality can stand up to comparison) the EPA advises that recycling facilities will still require EPA authorisation for the receipt and processing of waste and will not be classified as a quarry.

A project that will assist in ensuring the onus is on operators to ensure they:

- only receive suitable materials at the site
- have best practice processes on site
- have QA/QC processes that will verify the quality of the product
- ensure appropriate management and disposal of waste

…would be welcome as a complimentary instrument to improve practices and product quality and hence, in the EPA's opinion, improve the confidence and increase uptake in reuse of ***appropriate*** recycled materials.

# Appendix E

## Questionnaire Issued to Delegates and Key Stakeholders Following the Workshop

**QUESTION**

| 1. Workshop Objectives | | | | |
|---|---|---|---|---|
| **(Yes / No / Don't Know Answers - Please tick or highlight)** | i.e. highlight | **Yes** | **No** | **Don't Know** |
| Although registered, did you attend the Workshop? | | | | |
| Did you find the Workshop gave information that was useful to you or your organisation? | | | | |
| How would you rate the Workshop in general? | | | | |
| Prior to attending the Workshop, would you have considered using recycled products if they were offered to you for a road project? | | | | |
| Following the Workshop, have you now changed your view on recycled products in roadworks? | | | | |

| 2. Environmental Considerations | | | | | |
|---|---|---|---|---|---|
| **Considering the following criteria, please rate the importance of various benefits of using recycled products: (circle or highlight a number next to each question with 1 being not important and 5 being important)** | **Rating** | | | | |
| Saving on landfill space | 1 | 2 | 3 | 4 | 5 |
| Saving on energy use | 1 | 2 | 3 | 4 | 5 |
| Reduction of green house gas emissions | 1 | 2 | 3 | 4 | 5 |
| Conservation of resources | 1 | 2 | 3 | 4 | 5 |
| Reduced habitat loss | 1 | 2 | 3 | 4 | 5 |
| Re-use of materials because it makes sense | 1 | 2 | 3 | 4 | 5 |

## 3. Cost Considerations (based on delivered price)

**Considering the following cost implications, please answer the following with a tick or highlight for yes / no / don't know:**

| | Yes | No | Don't Know |
|---|---|---|---|
| I would use recycled materials only if they were cost neutral | | | |
| I would use recycled materials if they were cheaper than new materials | | | |
| I would use recycled materials even if they cost more than new materials | | | |
| If you would pay more, what percent more would you consider reasonable? | % | | |

## 4. Technical Considerations

**Considering the following performance criteria, please indicate your level of confidence:**

| **(Circle or highlight a number next to each question with 1 being not confident and 5 being confident)** | **Rating** | | | | |
|---|---|---|---|---|---|
| How confident are you in the performance of recycled products? | 1 | 2 | 3 | 4 | 5 |
| How confident are you in the quality control of recycled products? | 1 | 2 | 3 | 4 | 5 |
| At the present time would you reject using recycled products due to performance or quality concerns? **(YES/NO - Please circle or highlight)** | | **YES** | | **NO** | |
| Are you confident that recycled materials can be supplied in sufficient quantities? **(1 not confident / 5 confident)** | 1 | 2 | 3 | 4 | 5 |

## 5. Balanced cost implications

**Considering the way you currently do business:**

| **(Yes / No / Don't Know Answers - Please Tick or highlight)** | **Other** | **Yes** | **No** | **Don't Know** |
|---|---|---|---|---|
| Do you currently consider materials supply tenders or quotes on cost only? | | | | |
| ***If you answered <u>No</u> above, which of the following factors do you currently consider?*** | | | | |
| Material quality or specification ?? | | | | |
| Embodied energy of the product e.g. reprocessing or quarrying energy use | | | | |
| Greenhouse gas emissions | | | | |
| Conservation of resources | | | | |
| Other (Please insert in comments section) | | | | |

## 6. Considering the way you will do your future business:

| | **Other** | **Yes** | **No** | **Don't Know** |
|---|---|---|---|---|
| Following the workshop, will you change the way you assess tenders? | | | | |
| **If you answered Yes above, which of the following factors would you include as selection criteria?** | | | | |
| Energy used in production | | | | |
| Transport energy usage | | | | |
| Total greenhouse emissions | | | | |
| Use of recycled materials | | | | |
| Commitment to research and development | | | | |
| Other (Please insert in comments section) | | | | |

**7. Considering the information presented, would you consider using the following products in road construction? If Yes, please rate how confident you are for each use?**

**(Circle or highlight a number next to each question with 1 being not confident and 5 being confident)**

**Recycled pure crushed concrete**

| | Rating | | | | |
|---|---|---|---|---|---|
| Sub-base in light traffic roads | 1 | 2 | 3 | 4 | 5 |
| Sub-base in heavy traffic roads | 1 | 2 | 3 | 4 | 5 |
| Base in light traffic roads | 1 | 2 | 3 | 4 | 5 |
| Base in heavy traffic roads | 1 | 2 | 3 | 4 | 5 |

**Recycled demolition materials as per DTEI Part 215 (concrete with brick, asphalt, tiles)**

| | Rating | | | | |
|---|---|---|---|---|---|
| Sub-base in light traffic roads | 1 | 2 | 3 | 4 | 5 |
| Sub-base in heavy traffic roads | 1 | 2 | 3 | 4 | 5 |
| Base in light traffic roads | 1 | 2 | 3 | 4 | 5 |
| Base in heavy traffic roads | 1 | 2 | 3 | 4 | 5 |

**Recycled crushed glass**

| | Rating | | | | |
|---|---|---|---|---|---|
| As part aggregate replacement in asphalt | 1 | 2 | 3 | 4 | 5 |
| As part aggregate in sub-base | 1 | 2 | 3 | 4 | 5 |
| As part aggregate in base | 1 | 2 | 3 | 4 | 5 |

**Recycled crumbed rubber**

| | Rating | | | | |
|---|---|---|---|---|---|
| As binder supplement in hot bitumen | 1 | 2 | 3 | 4 | 5 |
| Added to aggregate in asphalt plant | 1 | 2 | 3 | 4 | 5 |

Have you uses old tyres as a structural medium, e.g. erosion protection, retaining walls, etc. **Yes** **No**

**8. Considering the case studies presented, would you consider using the following products in concrete for footpaths and structural concrete**

| | Yes | No | Don't Know |
|---|---|---|---|
| Recycled crushed demolition materials | | | |
| Recycled crushed glass | | | |

Recycled aggregates in structural concrete

**9. Landfill Operations**

**Considering landfill operations, please answer the following:**

| **(Yes / No / Don't Know Answers)** | **Yes** | **No** | **Don't Know** |
|---|---|---|---|
| Do you consider a landfill levy as being a good way of diverting products from landfill? | | | |
| Do you think a levy should be a flat rate for all materials? | | | |
| Do you think a levy should be higher for products that can be easily recycled? | | | |
| Do you think a levy should be lower for products that are difficult or cannot be recycled? | | | |
| Have you noticed a relationship between landfill costs and illegal dumping? | | | |
| Do you think that regulation to prevent recyclables being landfilled is desirable? | | | |

**10. Further Information (If answer is yes, please include contact details below)**

| **(Yes / No Answers)** | **Yes** | **No** |
|---|---|---|
| Would you like to receive any follow up information subsequent to the workshop? | * | |
| Can you suggest any research issues that need to be addresses with recycling in infrastructure | | |
| Aggregates & crushed rocks — Describe in comments below | | |
| Glass — Describe in comments below | | |
| Tyres — Describe in comments below | | |
| Would you like to receive further technical information and support from ARRB in relation to recycled material applications and specifications | | |
| Would you use a tool that enables you to calculate the relative embodied energy and greenhouse emissions from materials alternatives - if it were available and easy to use? | | |
| Would you like to receive relevant on-going information from the C&D Working Group? | | |
| Would you like to inspect ARR and/or Resourceco recycling facility? | | |
| | | |

**Contact for enquiries or discussion: bob.andrews@arrb.com.au; mobile: 0438 827 432**

| **COMMENTS:** |
| --- |
| |

| **Contact Details *(if you answered yes to final question or otherwise wish to be contacted):** |
| --- |
| Name: |
| Company: |
| Position: |
| Email Address |
| Telephone No. |