Australian Government
Department of Industry
Innovation, Science, Research
and Tertiary Education

AUSTRALIA'S SUSTAINABLE AGGREGRATES INDUSTRY

Building our nation through smarter resource use

SUPPLIER ADVOCATES | CLEAN TECHNOLOGIES

PAGE CONTENTS

ISBN 978 1 921916 62 5

FOREWORD

While innovations have occurred in building products, many of the core technologies and systems in the local construction industry have not changed for the past 20 years.

Indeed, the industry acknowledges that when it comes to new technology it behaves more as a laggard than a pioneer. Part of the challenge is the basis of competition across a highly fragmented industry (the largest players only have 4 to 5% of market share), but also the long service life we demand from our buildings and infrastructure.

One area of continuing innovation is in the use of recycled materials. The construction and demolition sector is Australia's biggest creator of waste and some of the 19 million tonnes generated is kept in the commercial cycle of utility as sustainable aggregates. These recycled materials have many applications including concrete, road sub-base, drainage, landscaping and clean fill.

In concrete applications, Green Star ratings will increasingly become a bigger influence. However, at the moment the demand for sustainable aggregates is principally driven by the actual and perceived reliability of the material to meet strict performance standards when compared to virgin materials.

On behalf of the Australian Government, I am proud to promote sustainable aggregates and showcase a number of their applications. This increasing investment in responding to the opportunities of a low carbon economy through local manufacturing and employment, is a priority for many government programs and myself as the Clean Technologies Supplier Advocate.

The Commonwealth Minister for Industry and Innovation appointed me as the Clean Technologies Supplier Advocate to assist Australian clean technology businesses in becoming more competitive, build their capacity and provide them with greater access to project opportunities. There are many Australian success stories around the recycling of materials, and this booklet is a testament to those capabilities.

I encourage you all to consider how such materials can be adopted in your design and construction processes to lower your building cost, enhance the 'green' credentials for future tenants and owners, maintain your commitment to carbon reduction and act as a catalyst for further innovation.

DR MARC NEWSON
CLEAN TECHNOLOGIES SUPPLIER ADVOCATE

SAVE MONEY, SAVE RESOURCES

Australia's sustainable aggregates industry is booming, with millions of tonnes of product being used in some of the nation's most significant civil engineering and construction projects. The aim of this booklet is to showcase a selection of such projects, and highlight the commercial and environmental benefits from using sustainable aggregrate products.

Australia's annual construction activity is valued at around $230 billion, and this economic headline provides one indication of the scale of works being undertaken around the nation. Another indicator is the 19 million tonnes of annual waste by-product associated with our construction and demolition activities.

The construction and demolition sector is responsible for around 40% of all Australian waste material, with the commercial and industrial sector accounting for 30% and the household municipal sector another 30%.

While there is a lot of waste by-product associated with construction activity, the *National Construction and Demolition Waste Status Report* published by the Australian Government in 2011 shows a large portion of this material – about 55% – is already being recovered and recycled. In some states, recycling rates of more than 75% are being achieved.

In November 2009, Australia's environment ministers, through the Environment Protection and Heritage Council (EPHC), released the *National Waste Policy: Less Waste, More Resources*. It sets out a comprehensive agenda for national co-ordinated action on waste, and marks a fundamental shift in the approach to waste management and resource recovery.

As the title suggests, a key theme of the policy is developing markets and systems that mean by-products from one activity can be used as a resource to support another activity, instead of being treated as a 'waste' that needs to be disposed of. By reusing valuable materials, we can avoid the need to manufacture new materials from scratch, providing a host of social, environmental and economic benefits.

Modern recycling activities involve the use of high-tech equipment in order to process and prepare large volumes of materials. But while the industry has become much more organised and sophisticated over the last several decades, it is important to recognise that 'recycling' is just a new term for a very old concept. Throughout the history of human kind, people have benefitted by reusing valuable materials in order to avoid the need to buy or make a new product from scratch.

SUSTAINABLE AGGREGATES

The term 'sustainable aggregates' is used throughout this booklet to describe products manufactured from recycled construction and demolition materials. It is estimated that more than 9 million tonnes of masonry by-products were recycled in Australia in 2008-09 and used to replace the need for virgin crushed rock in a wide range of applications.

There are several reasons these products may be considered more 'sustainable' than virgin products:

- Products manufactured from recycled materials are more economical for customers, both in terms of cost per tonne, and in terms of transport efficiencies
- Using recycled materials can help to 'close the loop' on resource use, avoiding the need to mine or quarry more virgin materials and at the same time reducing the amount of 'waste' disposed to landfill.

As Australia grows, the demand for aggregate materials is much greater than could possibly be supplied using recycled products alone, and there will undoubtedly be a mixture of virgin and recycled products used, depending on the specific project and the relative availability of different materials.

Some potential customers for sustainable aggregates, however, are failing to take advantage of the benefits the products can deliver because they incorrectly assume a 'recycled' product cannot be as good as a 'new' product. In some cases these 'perception' issues create a barrier, even though major agencies such as state road authorities have undertaken long-term research and developed detailed specifications to encourage the use of sustainable aggregates in major projects.

Australia's major sustainable aggregate manufacturers adhere to the same stringent testing standards, and produce high quality materials that meet and exceed the same performance requirements demanded of virgin counterparts. Customers can be assured of the quality of sustainable aggregate materials by dealing with reputable business that can demonstrate their products meet the required specifications for the particular application and are tested at an independent, accredited laboratory.

Where two products meet the same performance specification, but one comes with a range of extra social, environmental and economic advantages, the smart decision for customers should be clear.

EXTRACTING VALUE

CHEAPER DOESN'T MEAN LOWER QUALITY; THERE ARE SEVERAL DIFFERENCES BETWEEN THE BUSINESS MODEL OF RECYCLERS AND QUARRY OPERATORS

The Australian Quarrying Industry estimates average consumption of aggregates across Australia at around 7 tonnes per person per annum, and notes demand "is likely to continue at present levels and will most probably grow in the future with the development of infrastructure". Of this 160 million tonne annual demand, sustainable aggregate products that contain recycled material currently supply less than 10%.

WHY SUSTAINABLE AGGREGATES?

- Meets the same specifications
- Costs less than virgin material
- Potential for reduced transport costs
- Supports cost savings in other sectors

In most markets sustainable aggregates sell for slightly less than virgin products, even though they meet the same performance specifications and can offer an additional 10 to 15% product volume, meaning users get more 'bang for their buck'. It is important to realise that cheaper doesn't mean lower quality; differences between the business model of recyclers and quarry operators can mean different production costs for the same quality end product.

The *Inside Waste Industry Report 2011-12* estimates annual sales of sustainable aggregates at $160 million. But many recyclers also charge a gate-fee to accept demolition materials, which helps cover the cost of processing material to produce high-quality products. This is a significant difference from the business model where it can cost a lot to quarry raw materials, even before processing them. The gate-fees recyclers charge depends on the quality of incoming material, demand for finished products, and local landfill disposal costs.

The economic rationale for sustainable aggregates is not just about the construction industry. Recycled steel extracted from crushed concrete offers a 5% saving in steel energy costs as a percentage per tonne of output when compared to steel manufactured from raw materials, and will therefore reduce the carbon permit liability for steel manufacturers from July 2012.

Some of the other economic advantages are brought to life through leadership in the industry and the case studies in this publication showcase what is possible:

- ResourceCo has shown clean technologies can be introduced into traditional processing to create new revenue streams for the business from lighter waste fractions, as well providing a new non-fossil fuel source for heavy industry
- Alex Fraser Group has invested in state-of-the-art processing facilities that can supply thousands of tonnes of high quality aggregates per day in order to service demand for some of Australia's highest profile construction projects
- Metropolitan Demolitions Group continues to demonstrate that producers of sustainable aggregates are generally more conveniently located to city construction activities, and can provide a cost advantage over raw materials hauled from distant quarries
- Capital Recycling is busting the myth that virgin materials out-perform sustainable aggregates.

'SUSTAINABLE AGGREGATES' MADE FROM RECYCLED CONCRETE HAD A 65% LOWER GREENHOUSE EMISSIONS IMPACT THAN SIMILAR PRODUCTS MADE FROM VIRGIN QUARRIED ROCK

THE SMARTER OPTION

If all the surplus materials generated during Australian construction and demolition projects was treated as 'waste', it would keep at least 30 major landfill facilities operating all year round. Thankfully, however, a large portion of this material is being recovered and used to create valuable products, conserving airspace at existing landfills and avoiding the need to develop additional landfills in the future.

Clean masonry materials such as concrete, bricks and tiles are relatively simple to recycle, and can be used to create a wide range of high quality products. Choosing products with recycled content not only helps keep this useful material from taking up limited landfill space, but it also means less need to quarry virgin rock.

While there is no physical shortage of rocks in Australia, a range of social and environmental issues can be associated with the quarrying of virgin materials. A life cycle analysis undertaken by the RMIT on Alex Fraser Group's concrete recycling operations found that, across the full product life cycle, sustainable aggregates made from recycled concrete had a 65% lower greenhouse emissions impact than similar products made from virgin rock. This was largely due to avoiding the energy needed to quarry rock, as well as energy savings through recovery of reinforcing steel.

Customers, shareholders and communities also expect a bigger focus on sustainability by developers of major projects, and choosing sustainable aggregates can help to meet these expectations. The *ABS Year Book Australia, 2009-10* shows 82% of Australians are 'concerned' about the environment, and recycling is the number-1 activity they undertake within their own homes. Australians expect businesses to support recycling and efficient resource use.

Choosing sustainable aggregates means choosing the smarter option, extracting value from existing resources that would otherwise be wasted, while reducing the need to dig up more virgin rock. The more demand there is for products with recycled content, the more demand there is for recycling.

WHY SUSTAINABLE AGGREGATES?

- Lower greenhouse gas emissions
- Less quarrying of virgin material
- Reduced need for new landfills
- Smarter use of existing resources

THE $385 MILLION HARRIS SCARFE REDEVELOPMENT IN ADELAIDE'S CITY CENTRE IS CLOSING THE LOOP, WITH RESOURCECO RETURNING VALUABLE INPUTS TO THE RECONSTRUCTION.

CASE STUDY **RESOURCECO, SOUTH AUSTRALIA**

RESOURCE SOURCE

An inner city, seven-story building was demolished to make way for one of Adelaide's biggest and most exciting city centre developments for more than a decade. This precision deconstruction process, undertaken by McMahon Services, generated more than 25,000 tonnes of materials, including heavy items such as concrete and steel, as well as some lighter fractions such as wood and plastic.

RECAPTURING VALUE

ResourceCo is an integrated resource recovery business, operating processing facilities in South Australia and Victoria and manufacturing a wide range of recycled materials.

Heavy material from the Harris Scarfe demolition, predominantly concrete, was delivered to the company's Wingfield site where it was crushed into 10mm and 20mm aggregate products. Reinforcing steel from the concrete was recovered for recycling, where it displaces the need to mine virgin ore and provides energy savings in the manufacture of new steel products.

Through a joint venture with SITA Australia, ResourceCo has invested over $20 million in a facility that can also recover value from lighter waste fractions that would otherwise be disposed to landfill. SITA-ResourceCo operates Australia's first – and only – Processed Engineered Fuel (PEF) manufacturing plant, producing an alternative fuel with high calorific value, which reduces fossil fuel use at the Adelaide Brighton cement kiln.

QUALITY CONTROLS

- ResourceCo and ResourceCo Concrete are accredited with ISO 9001, 14001 and 18001
- 'Green' concrete meets the AS 1379 specification and design for normal class concrete
- Testing carried out by an independent NATA registered laboratory

CUSTOMER BENEFITS

Once deconstruction of the existing building had been completed, McMahon Services then undertook the early civil works package, which required over 3,500m^3 of concrete to construct 665 building and retention piles forming the foundations of the Harris Scarfe redevelopment. This was sourced from ResourceCo Concrete, which maximises the use of sustainable aggregates in the manufacture of its concrete blends.

Depending on customer requirements, ResourceCo concrete can contain up to 45% recycled content, with testing of all blends conducted by an independent NATA registered laboratory to ensure it exceeds the same performance standards demanded of virgin concrete under Australian Standard AS 1379 Specification and supply of concrete.

Aggregates produced by recycling material from the demolition works were also re-used during civil works to construct temporary piling platforms to allow the piling rigs to manoeuvre the site and construct the building and retention piles. Recycled aggregates were also used to construct the rubble platform beneath the new basement concrete slab.

CASE STUDY **ALEX FRASER GROUP, VICTORIA**

ALEX FRASER GROUP SUPPLIED 200,000 TONNES OF SUSTAINABLE AGGREGATES TO ABIGROUP FOR THE $759 MILLION PENINSULA LINK PROJECT.

RESOURCE SOURCE

Alex Fraser Group has been in business for more than 130 years, and is Australia's largest construction and demolition recycler. The company reached a major milestone in 2008, when it produced 20 million tonnes of recycled materials. To put that volume in perspective, if you were to fill the Melbourne Cricket Ground with this recycled material it would form a tower 812 metres high.

A life cycle analysis conducted by the RMIT on Alex Fraser's recycling processes found that producing aggregates from recycled concrete produces 65% less greenhouse emissions than producing similar virgin quarried products.

RECAPTURING VALUE

Alex Fraser is supplying aggregates for Peninsula Link from its Clayton site, one of Australia's first construction and demolition recycling facilities constructed in a fully enclosed shed to help reduce noise and dust issues. The Victorian EPA described the site's dust management technology as 'beyond world's best practice', with sensors located throughout the site to deliver minute-by-minute information on dust levels.

QUALITY CONTROLS

- Facility accredited with ISO 9001
- VicRoads Standard Specification Section 820
- Testing carried out by an independent NATA registered laboratory

The $23 million facility is located just 50m away from its closest neighbour, a high school. This proximity to residents drove the company to set a new standard in best practice design and operation. Some 86,000 trees and shrubs planted around the site's perimeter reduce its visual impact, while 95% of water used at the site is recycled.

CUSTOMER BENEFITS

Peninsula Link is a 27km road that will see an average trip between Mt Martha and Carrum Downs take just 17 minutes – a saving of up to 40 minutes in peak periods. Abigroup chose Alex Fraser Group to supply sustainable aggregates for this prestigious project for reasons including:

Location: Freight costs were very competitive because the Clayton facility is close to the construction site.

Capability: The Clayton facility had capacity to cope with the large volume required for the project.

Quality: Track record supplying tested and specified Class 3 and 4 road base and aggregates to similar projects.

Logistics: The ability to deliver up to 3,000 tonnes per day (6,000 truckloads of product required in total).

MATERIALS METROPOLITAN DEMOLITIONS RECOVERED WHEN THE BEECROFT ROAD BUS RAMP CAME DOWN ARE BEING REUSED IN THE SYDNEY AIRPORT TAXIWAY UPGRADE.

CASE STUDY **METROPOLITAN DEMOLITIONS GROUP, NEW SOUTH WALES**

RESOURCE SOURCE

As part of Leighton Contractor's Hills M2 Upgrade in Sydney, the Beecroft Road bus ramp was demolished and removed by by Metropolitan Demolitions between 8pm Friday February 10 and 5am Monday February 13, 2012, allowing the motorway to be widened to three lanes in each direction. Approximately 4,900 tonnes of steel and concrete rubble was produced, and transported to their St Peters facility to be recycled.

RECAPTURING VALUE

Metropolitan Demolitions Group has been involved in the Sydney construction industry since the 1970s. It operates a $4 million stationary concrete crushing plant at St Peters, with capacity to crush over 1,500 tonnes of concrete rubble each day.

The facility has a footprint of just 8,000m^2, is nestled in close proximity to businesses including a fast food outlet and car wash café, and is a showcase of the potential for materials to be produced close to the demand for construction products, reducing impacts associated with mining and transporting virgin materials from distant quarries.

CUSTOMER BENEFITS

Fulton Hogan, a major Australasian civil contracting company, is upgrading the Sydney Airport Taxiway. Given the huge weight of modern aircraft, the engineering specifications associated with airport pavement designs are very demanding.

After many years using recycled materials, Fulton Hogan has complete confidence in the quality and performance of high quality recycled materials in airport applications, and contracted Metropolitan Demolitions to supply around 27,000 tonnes of recycled road base for this particular project – including products made from materials recovered during the Beecroft Road bus ramp demolition project.

Project Manager Michael Terry says he finds recycled materials easier to work with than processed rock. More importantly, he says "it's economical and readily available within Sydney metropolitan area".

Metropolitan Demolition's processing facility is only 5km from Sydney Airport, which greatly simplified the transport logistics task compared with trying to source high volumes of material from a distant quarry. Fulton Hogan has found that, in other markets too, the producers of sustainable aggregates are generally more conveniently located and therefore easier to work with on big projects.

QUALITY CONTROLS

- Product meets NSW EPA (Specific) Resource Recovery Exemption standards
- Roads and Maritime Services QA Specs 3051/3052 for DGB20
- Engineered to meet customer stabilment requirements
- Testing carried out by an independent NATA registered laboratory

THE CITY OF CANNING IS USING RECYCLED MATERIALS IN 95% OF ITS ROAD CONSTRUCTION ACTIVITIES, AFTER THEY PASSED THE TEST ON BUSY WELSHPOOL ROAD.

QUALITY CONTROLS

- Aggregates meet Main Roads WA Specification 501 – Pavements
- Testing carried out by an independent NATA registered laboratory

CASE STUDY **CAPITAL RECYCLING, WESTERN AUSTRALIA**

RESOURCE SOURCE

The City of Canning has entered a 'double ended' contract with Capital Recycling, which now accepts all the council's construction and demolition waste materials (about 9,000m^3 to date) and produces sustainable aggregate products from them. The council has so far purchased back 11,000 tonnes of product under the contract.

RECAPTURING VALUE

Welshpool Road is one of Perth's major arterials, carrying approximately 8,000 vehicles a day. Around 15% of these are trucks (including road trains), giving a design traffic of approximately 20 million standard axles over a 30 year life. In 2007, a 860m section of the road was upgraded, and the council took the opportunity to trial and monitor the performance of sustainable aggregate products.

Roadbase was manufactured from recycled demolition material, containing mainly concrete with some brick, tile and asphalt. The mix, which had a slightly lower Maximum Dry Density than conventional roadbase (1.95t/m3 compared to 2.21t/m3) and higher Optimum Moisture Content (11% compared to 6%), was easily worked and compacted well.

Different configurations were trialled, including one road section constructed with a recycled sub-base and conventional roadbase, another section using recycled material as a sub-base and base layer, and another section containing pure recycled concrete for the full pavement depth.

Several peer-reviewed papers report detailed results of the performance testing (available through Curtin University).

Overall, sustainable aggregates performed equally, and in some cases better than, their virgin counterparts. The material is highly stable at a range of moisture contents, is easily worked and compacted, has better curvature characteristics, and withstands the effects of turning traffic extremely well.

The Welshpool trial gave the council confidence to now use sustainable aggregates in all its road works.

CUSTOMER BENEFITS

There is an abundance of accessible limestone in Perth, which means customers have access to relatively cheap aggregates. But the City of Canning recognises its community wants options to recycle their waste materials, and therefore the council must provide leadership in creating market demand for the products. There is no point in operators recycling materials if there is no market demand for them.

SUMMARY PRODUCTS TABLE

SOURCE	PROCESSING DESCRIPTION	PRODUCT EXAMPLES	
CONCRETE recovered during demolition works	Large items of concrete are broken down to a size that can be fed into a crusher, with reinforcing steel recovered for recycling. A variety of fixed and mobile crushers are used across industry	Recycled crushed concrete pavement material is used in the same circumstances as other crushed rock products. Principle use is in medium/ heavily trafficked flexible base-course and sub-base	
MIXED BUILDERS RUBBLE mainly concrete, bricks and tiles	Large items are broken down, with material such as metal and timber recovered for recycling before mixed masonry materials are fed into a crusher to produce blended aggregate products	Aggregates in pavement sub-bases (such as roads), drainage, irrigation, and landscaping applications	
SOIL AND SAND from site preparation and excavation works	May be screened to produce consistent size profile, depending on required product specification	Certified Virgin Excavated Natural Material can be used as 'clean fill'	
ROCK AND EXCAVATION STONE recovered during civil or site preparation works	This material may be identical to that which is produced at a commercial quarry, and will be processed using the same crushing and screening techniques	Products generally bear no difference to aggregates made from virgin quarried materials