THE BRITE PROJECT

Innovation
Case Study
No 8

Saving Site-Remediation Costs

This series of innovation case studies has been developed by the BRITE Project of the Cooperative Research Centre for ***Construction Innovation****. The case studies demonstrate the benefits of innovation and successful implementation strategies in the Australian property and construction industry. Many highlight the strengths of small and medium-sized businesses in regional areas.*

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Saving Site-Remediation Costs

A number of incremental innovations on the Imago project to clean-up a contaminated site in Western Australia have delivered significant savings for the client. The innovations included:

- in-house designed sprinkler system to control dust
- in-house designed wheel-wash system to manage the spread of contaminated material beyond the site
- in-house designed concrete coffin to encase Class V contaminants and allow their disposal at a Class IV facility
- minimisation of contaminated material through a planned screening program
- adoption of best-practice monitoring equipment.

Together, these incremental innovations and the adoption of best practice are estimated to have saved over $200,000 for the client, compared to business-as-usual.

Loading frame in use

Selected Project Participants

Contractor:	Marsh Civil
Environmental Engineer:	ENV Australia
Contract Superintendent/ Civil Engineering Consultant:	Wood & Grieve Engineers
Geotechnical Engineer:	Coffey Geosciences
Client Representative/ Project Manager:	Clifton Coney Group
Client:	East Perth Redevelopment Authority (EPRA)
Waste Management Facility:	Red Hill Waste Management Facility operated by the Eastern Metropolitan Regional Council (EMRC)

Organisations consulted in preparing this report:
EPRA, Marsh Civil, ENV, Wood & Grieve, Clifton Coney, EMRC.

Cover photo: Bulka bags holding contaminated material

The Project

The East Perth Redevelopment Authority (EPRA) reports to the Western Australian Minister for Planning and Infrastructure and is charged with revitalising under-utilised inner urban land, often contaminated by previous industrial uses. The Imago project was a forward works contract awarded by the Authority to clean-up a small 5,800m2 land parcel in the inner-city precinct, Claisebrook Village, East Perth. The contract was based on Lump Sum and Schedule of Rates components. The tendered sum was $1.35m over a three-month period and, after the unexpected discovery of coal tar, the project was delivered for $1.8m in May 2004, to a six-month program. Although project time and cost increased, 13% of potential business-as-usual costs were saved on this small project, under a conventional contract, due to good organisational and personal relations between the project team.

The Achievement

During the Imago site remediation works, and despite a rigorous environmental testing program, coal tar was unexpectedly discovered. Coal tar is a high level Class V contaminant, and the associated cost and time delays of removing the unexpected find had the potential to disrupt EPRA's land release program. The contractor, environmental consultant, engineer, project manager, and land-fill facility, all small or medium-sized organisations, went beyond business-as-usual to deliver the increased scope of work at minimal cost. They also achieved outstanding environmental outcomes, which were recognised by a National Case Earth Award for Environmental Excellence in 2004. The team was motivated to achieve these outcomes to deliver a cost effective project for the client, thus enhancing their reputations in a small market with few highly qualified participants. The project has created a new waste disposal path for hazardous wastes in WA, suggesting that the savings can be repeated on new projects with similar features.

The Innovations

The key innovation on this project was a new waste disposal methodology, while other significant innovations included new sprinkler and wheel wash systems, together with the adoption of advanced monitoring equipment (eg. SMS-enabled dust monitors). Although none of the innovations are world-firsts, all are largely new to Australia.

Waste Disposal Methodology

An excavator with a skeleton bucket was used to excavate the coal tar material, allowing large lumps of it to be separated from the uncontrolled fill material. The contaminated stockpile was then raked to further separate the coal tar. This process, which was designed by the engineering consultant, reduced the quantity of contaminated material to be removed from the site. The soil screening and recycling plan was based on dividing the soil into three categories: (1) 'easily re-usable on site', (2) 'subject to testing and possible re-use on site', and (3) 'clearly unsuitable as fill material'. Business-as-usual would not have involved this separation process.

Coal tar on the Imago site was in liquid and solid forms, and was classified as Class V waste after testing. In Western Australia, contaminated waste can be classified from Class I to V – with Class V being the most hazardous. There are no waste disposal facilities in Perth that can accept Class V material; the closest appropriate facility is in Port Hedland, 1600 kms away. As a large quantity of this material (250 tonnes) was to be removed, alternative disposal methods were sought. After negotiations with the Eastern Metropolitan Regional Council (EMRC) and the Department of Environment (DOE), the coal tar was placed in 1m^3 bulka bags, which were placed on pallets and loaded onto a flat tray truck and transported to the State's only Class IV disposal cell at the Red Hill Waste Management Facility, where it was encapsulated in concrete.

The contractor proposed the bulka bags as they reduced the volume of waste by compaction and were safer than loading the waste directly into a lined truck. Rather than placing the 200 bags in one large concrete chamber at Red Hill, the EMRC and the environmental consultant designed 67 smaller concrete coffins with a minimum of 150mm of concrete walls to contain only three bags each, which reduced tortional cracking. This encapsulation brought the classification of the material down to a Class IV waste, allowing it to be processed at Red Hill. Using the local facility, rather than Port Hedland's, saved extensive transport costs.

Treating material to make it less hazardous and therefore acceptable at local landfill facilities (which are typically not licensed to accept Class V materials) is not uncommon on the east coast of Australia. It is however, relatively new to Perth. The method used on the Imago site was concrete encapsulation, whereas on the east coast, a more expensive pelletisation process is used, mixing coal tar with concrete to immobilise it. A number of industries across the world encapsulate toxic waste in concrete and bury it in landfill. However, this method is used rarely in the Australian construction industry, and appears to have never been undertaken by the civil industry in WA.

Sprinkler

The contractor designed, constructed and implemented a watering system to control nuisance and contaminated dust emissions on the site and to compact the ground. A 63mm poly distribution line was attached to the perimeter site fencing. Minor lines feeding sprinklers on star pickets were placed on the distribution lines. The six large sprinklers were connected to the pipe by tapping bands and could be shut off and moved around to suit weather conditions and construction activities. The pressure at each sprinkler head could be varied.

The sprinkler system ensured that all the exposed surfaces were wetted down at all times, eliminating the chance of fine particles getting into the air. Because the sprinklers could be moved easily, they were used to water newly exposed areas during excavations.

Such sprinkler systems are new to both WA and the east coast of Australia. Standard practice is to use watering carts, which would have been more expensive on the Imago project, and problematic because of their size relative to the small site. The sprinkler system is more flexible, as each head can be adjusted to suit the pattern of work.

Wheel Wash

To ensure that no contaminated material left the site on truck undercarriages, the contractor designed, constructed and implemented a specialised wheel washing system, which was placed at the site exit. Trucks were driven onto a raised removable metal grate over a holding tank. The tyres, undercarriage and body were cleaned automatically by high pressure sprays. The excess material and water passed through the grate into the holding tank. As the base of the tank was installed on an angle, the contaminated material fell to one end, allowing it to be appropriately managed. Water in the tank was pumped out and used to control dust in remediation areas.

Automated wheel wash systems are often used on the east coast of Australia, and occasionally in WA. However, the contractor opted to build their own system because:

- current systems are too large and inflexible to work efficiently on cramped sites
- there are few suppliers leasing such systems in WA, and none were available at the time
- they could produce it at minimal cost in their own workshop
- the compact modular pieces used in construction can be easily transported and erected on future sites, which will save leasing costs.

None of the above innovations contravened existing intellectual property rights, nor gave rise to new rights. The disposal methodology was an organisational innovation, with 'soft' intellectual property, which has no legal status. The contractor has not sought to patent the sprinkler or wheel wash innovations, possibly because they are simple advancements that would be difficult to protect under a patent.

The Benefits

Collectively these innovations saved $227,000 on the project, representing 13% of the final project sum.

Waste Disposal Methodology – saved $118,000

The coal tar was separated from other material to minimise the amount of waste, because every kilogram saved offered a significant reduction in disposal costs. At Red Hill, disposal costs were $512 per tonne, while at Port Hedland, they would have been $984 per tonne. Without the screening process, there would have been roughly five times the volume of contaminated material. Even calculating the benefit of the waste disposal methodology conservatively, (assuming the same quantity for disposal), the client saved approximately $118,000.

Sprinkler – saved $61,000

The new sprinkler system provided dust control and ground compaction, where standard practice was to hire a water cart. The sprinkler saved approximately $71,000 in water cart hire charges on the project, while costing only $10,000 to set-up and maintain.

A further benefit of the sprinkler system was safety. The site is very small (80m x 70m), with up to 15 staff active at any time. The elimination of a large machine like a water cart reduced the hazard of mobile machinery working around site staff.

Wheel Wash – saved $48,000

The only available alternative to the in-house system was to manually clean the trucks on-site with a high-pressure hose, which is business-as-usual on small sites. This however, would have resulted in a less thorough job than the automated system, requiring more sweeping of neighbouring roads. The manual system would have been backed-up by the use of a road sweeping truck operating once a day, whereas the automated system only required back-up road sweeping once a week. On this basis, the innovation saved the client approximately $48,000.

Dust Monitor – reduced dust complaints

The cutting-edge SMS-enabled dust monitor, which was specified by the environmental consultant, provided direct messaging to the environmental consultant and other team members when dust levels rose above warning levels. Common practice is to use a flashing light, which is difficult for an environmental consultant to monitor. The SMS system notified multiple project participants immediately, and was expected to prompt more careful behaviour from the contractor, due to increased transparency. Indeed, a comparison of the number of dust complaints from the public during the Imago project and a similar project, showed two complaints on Imago and 23 on the other project. It is likely that the SMS system played a role in this difference.

Maximising the Benefits

The value of all the innovations will be maximised through on-going diffusion. The encapsulation process to reduce Class V waste to Class IV has now become part of the standard service offered by the waste facility, while the contractor intends to use the sprinkler and wheel wash systems on future projects, and the environmental consultant is now specifying SMS-activated dust alarms on all projects where a dust alarm is needed. The waste facility is also designing an improved Class IV cell to help meet the expanding demand.

The Implementation Process

Waste Disposal

The overriding driver for the innovations was a crisis – the surprise discovery of large amounts of coal tar and the high costs associated with removing it. The problem nearly doubled the original project sum and term, even with the innovations. When the coal tar was discovered there was a risk that the costs of site remediation would exceed the value of the property.

Remediating former industrial land in an existing built environment is a challenging task, which often requires innovation to be pulled through the supply chain. The team working on the Imago project were able to build on their existing relationships to make this task easier. The coal tar issue had to be dealt with quickly and under pressure, and that it was effectively resolved is testament to the quality of relationships underpinning the team. EPRA is a repeat client in the industry and all the team members had worked for them before, and wanted to do so in the future. The team was very keen to minimise the impact of the problem on the client, and the client was happy with their performance.

The waste disposal methodology was the most important innovation in terms of risk and potential cost reduction, and the most difficult to implement. The project team wanted to avoid the very high costs of transporting the waste to Port Hedland, and needed instead to make it acceptable to the local Class IV facility. This meant activating a largely dormant route in the regulations, and satisfying the relevant agencies.

Extensive building foundations were found when the coal tar was discovered. The fact that the contractor was busy removing the foundations reduced the cost of the time it took to negotiate access to the Red Hill facility for the coal tar. This was because under the contract, the contractor had to be paid for labour and equipment, whether they were working or not. The team was under pressure to 'think quick' and keep the contractor moving. Indeed, without the geotechnical problems to usefully engage the contractor, cost may have been minimised by sending the contaminants to Port Hedland. The Port Hedland facility operates under an old approval and before Imago there had been no incentive to seek a new approval.

It took about six weeks for the project to receive the approval to dispose of the coal tar in a new way. On the east coast, similar approvals can take six months. This difference in time is probably due to the urgent nature of the Imago situation, together with the cooperative approach taken to negotiations between the environmental consultant, project manager and the agencies setting regulations or guidelines – Environmental Protection Authority, DOE and EMRC.

The disposal methodology innovation was developed 'on the run'. Seeking an approval for a largely new methodology, under considerable time pressure, was a highly problematic task. It was the scope of the expected savings that underpinned the client's support of the negotiations. The other innovations – sprinklers, wheel wash and monitoring equipment – were more straightforward and therefore easier to implement.

Phillip Marsh, Managing Director, Marsh Civil

'it's all about putting a bit back into the industry we depend on'

Wheel wash in use

Sprinkler and Wheel Wash

The sprinkler and wheel wash innovations were partly driven by delays in the start of the project, which meant that conditions were drier and windier than expected, however the material being removed also contained asbestos fibres, making dust control an essential component of the works. The contractor had time to plan their response to these difficulties. They also have an in-house design team and workshop, which allows them to efficiently produce simple money-saving innovations.

The contractor directly employs staff, rather than using a labour subcontractor or casual day labourers, and they believe this is a key part of their ability to generate ideas for innovation. The contractor notes that although direct employment can be more expensive in up-front costs, having a stable, experienced workforce saves them money in the long run as 'the policy protects the company's reputation'. Whereas subcontracted or day labourers may lack the incentive to pass on ideas for improvement, the contractor relies on loyalty and a formal 'Idea of the Month' program to drive innovation. The idea program appears to reinforce advantages over competitors who rely on external labour, and resulted in the sprinkler and wheel wash innovations.

The three or four ideas put forward each month are discussed by management; implemented if appropriate; advertised in a quarterly internal newsletter distributed to all staff; and stored in a database. Each 'Idea of the Month' winner is rewarded with a prize. Management also de-briefs staff who nominate unsuccessful ideas. This is done to underline the value of all ideas, even unsuccessful ones, so that staff maintain their enthusiasm to contribute.

John Fisher, Project Manager, Clifton Coney Group

'there's nothing desperately high-tech about any of this – yet it paid off well'

Dust Monitor

The idea to use best practice monitoring equipment on the Imago project was not driven by the contractor's site staff, but rather by:

- Rising costs of environmental pollution
- Increasing community concerns
- Increasing pressure on regulators
- Tighter regulations
- Demand-pull innovation by machinery manufacturers
- Education of suppliers by manufacturers
- Recommendations from suppliers to consultants and contractors.

Beyond this, the features of the Imago site also drove the adoption of best practice monitoring equipment. The site is in a very congested urban area and the proposed redevelopment had raised some community concerns, so that dust movement was a sensitive issue.

The environmental consultant and the contractor have good relationships with a Perth supplier of advanced occupational health, safety and environment monitoring equipment. The supplier is linked to a large Australian company with international operations, providing 'risk management solutions'. Hence, the supplier acted as a conduit for information from around the world about advanced equipment. The supplier also works for transnational mining companies in WA, facilitating transfer of knowledge between industry sectors. The Imago team exploited the supplier's knowledge and adopted the latest equipment to maintain the reputation for advanced practice they had earned with the client on previous projects.

Scott Bird, Managing Director, ENV Australia

'in this crisis, relationships were everything'

Overcoming Difficulties

Team Challenges

The process underpinning the new waste disposal method was not straight forward. The officers initially encountered by the Imago team at the local facility were understandably sceptical – nervous about making technical decisions outside standard practice. However, considerable time was spent by the team in meetings with the facility to change attitudes. The main issue then became searching for an engineering solution that would meet the facility's needs and the requirements of DOE. Once these agencies were on board, they moved quickly to assist with the team's proposal.

Contractor Challenges

The contractor found that they had relied too heavily on verbal understandings and the coal tar crisis has encouraged them to rethink their procedures and keep better records. They also plan to improve their approach to time management by reducing the 'down time' of on-site staff through more efficient human resource planning. Indeed, efficient time management is important, as extra risks such as poor weather and accidents are associated with a longer project period. These changes are expected to help the company 'to better cope with surprises'.

Client Challenges

There are strong drivers in place that encourage clients to manage risk within a single project. However, the Imago project highlights that risk might be best managed across a portfolio of projects.

Waste Facility Challenges

In the past, the local waste facility has experienced problems with waste being treated before disposal at the facility. In several instances, such pre-treatment has been poorly conducted. To prevent this potential problem on the Imago project, they treated waste themselves – this time with concrete encapsulation. This in-house treatment gave the facility better control over quality, which is important to them as they have infinite responsibility for the waste. By encapsulating on-site, transport costs were also reduced.

Lessons Learned

- project crises can be a key driver of innovation
- a small market with few advanced participants can lead to closer relationships, loyalty and innovation to deliver savings for clients
- site based problems are a key driver of innovation, especially when contractors directly employ staff, rather than subcontract them, and when contractors have implemented formal 'idea schemes'
- formal idea schemes operated by a project-based business help it integrate learnings into business processes and diffuse innovations (which maximises their value to the business)
- in running idea schemes, it is important for a business to value unsuccessful ideas, to maintain the enthusiasm of staff
- in-house capabilities, such as highly skilled staff and well-resourced workshops, support the innovation efforts of a business
- challenging projects pull innovation through the supply chain
- changing community values and associated regulatory changes are key drivers of innovation
- manufacturers are a key driver of innovation because their on-going production methods are better able to support R&D, giving them an advantage over businesses engaged in project-based production
- suppliers are key knowledge brokers, passing on ideas from manufacturers to project-based businesses
- front-line staff appear less able to entertain innovative ideas than more senior staff and this can cause problems for innovation champions seeking support for their ideas

Sprinkler on site

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