

TRIAL RESULTS REPORT

Illegal Dumping Deterrence Measures – Stage 1 Project Report

A trial of the efficacy of various measures that restrict access to public bushland to reduce incidents of illegal dumping



This project has been assisted by the New South Wales Government through its Environmental Trust



HUNTER AND CENTRAL COAST REGIONAL ENVIRONMENTAL MANAGEMENT STRATEGY



This report was prepared by the Hunter & Central Coast Regional Environmental Management Strategy (HCCREMS) team with financial support from the NSW Government's Environmental Trust.



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1. Executive Summary

Illegal dumping has significant environmental, health and social impacts. It is also a costly maintenance issue for public land managers, with councils often bearing the costs associated with clean up and disposal of illegally dumped waste.

The Hunter and Central Coast Environmental Management Strategy (HCCREMS) team and staff from its 14 member councils have implemented an Illegal Dumping Deterrence Project to trial the effectiveness of a number of different access control measures.

The trial was conducted as Stage 1 of a broader regional Illegal dumping initiative. While not exhaustive in its scope, the trial (and the associated research and consultation that accompanied it) has produced a substantial body of data and information which can effectively inform and guide some of Council's future investments in illegal dumping activities.

Overall the key findings of Stage 1 included:

- Identification of a range of measures successful at restricting access to a range of sites with different physical characteristics – the trial captured details of the site characteristics (close to roads, numerous access locations, hidden from sight, etc.) and mapped these against the efficacy of different deterrence mechanisms, enabling the initial development of a guide to which measures are likely to be effective in different circumstances.
- The apparent cost effectiveness of surveillance cameras – on the basis of the Stage 1 results, surveillance cameras were identified as the most cost effective mechanism for deterring dumping behaviour. Likely causes include the perceived likelihood of getting caught (cameras appeared most effective when coupled with signage notifying of their use in particular areas).
- The efficacy of permanent barriers – such as heavy duty gates, mounds and blocks. These were most successful at completely stopping access to dumping sites (when installed to specifications) although they were significantly more expensive to install than surveillance cameras.
- The usefulness of establishing and maintaining a Regional Illegal Dumping Database to (i) map hot-spot locations, (ii) analyse trends in dumping patterns across the region, (iii) produce detailed reports on typical activities and behaviours as well as the nature and quantity of materials dumped, (iv) and to provide intelligence to inform future enforcement or deterrence strategies of councils.
- The value of information sharing between councils across the region – to keep up to date with key trends, emerging technologies and successful strategies

Following the completion of Stage 1 of the Illegal Dumping Deterrence Project, HCCREMS and member councils will continue to implement and monitor measures and sites to determine the ongoing efficacy of the measures, and the overall impact on the levels of illegal dumping (particularly to ensure the measures are not simply moving dumpers to other locations).

2. Background to the Illegal Dumping Deterrence Project

The illegal dumping of waste is a common problem throughout the world, and the Hunter, Central Coast and Lower North Coast of NSW is no exception. Throughout the fourteen Local Government Areas (LGAs) that make up the region, incidents of illegal dumping occur in each. It is expected that incidents of illegal dumping may increase as the NSW waste levy increases, making a trip to the landfill all the more expensive.

In February 2008 the Department of Environment and Climate Change, now the Office of Environment and Heritage (OEH), released the handbook for Local Government “*Crackdown on Illegal Dumping*”. The handbook opened with the following statement:

Councils play a crucial role in managing and preventing illegal dumping in their local areas. They are most familiar with the local conditions and problems bear significant illegal dumping clean-up costs.

Local government has a considerable capacity to prevent illegal dumping as a result of its multiple roles in the community. Council not only regulate illegal dumping incidents after they have occurred, but also have a crucial role in preventing illegal dumping through environmental planning, community education, providing waste collection and disposal services and managing public land.

Managing and reducing incidents of illegal dumping is, for many councils, another task that utilises vital resources often needed for deployment on other equally important environmental protection activities.

On the assumption that efforts to prevent dumping in the first place are likely to be more cost-efficient than managing the results – OEH recommends that Councils pursue the following mechanisms:

- **Increase the effort:** make access difficult;
- **Increase the risks** of getting caught;
- **Reduce the rewards:** deny financial benefits;
- **Reduce provocations:** don't give them a reason to dump; and
- **Remove excuses:** educate and inform the community.

2.1 Regional history of managing illegal dumping

The councils in the region have a long history of working individually, and together, on battling the issue of illegal dumping. A regional “Illegal Dumping Working Group” operated for many years. The group comprised officers from local councils as well as officers from a number of NSW State Agencies responsible for managing public land. This working group was instrumental in conducting a number of clean-up and blitz activities.

More recently councils have partnered with the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS) team to develop and implement blitzes and community awareness campaigns in an attempt to locate illegal dumping ‘hot-spots’, and raise awareness of the real cost of illegal dumping to the community.

Although there is anecdotal evidence available in the region about the quantity and extent of illegal dumping incidents, there is limited quantifiable information available.

This is due in part to different management systems operating in each council and, therefore, different levels of reporting occur throughout the 14 councils.

HCCREMS has been working with member councils for the past 3 years to capture, collate and map information on illegal dumping incidents. This is being done to monitor trends and better inform councils of the pattern and extent of illegal dumping to ensure appropriate resourcing is allocated to address the issue. A regional Illegal Dumping Database is operating, and councils are encouraged to submit details of dumping incidents for inclusion in this important intelligence tool. Illegal dumping incidents collected from blitzes held to date have been entered into the database.

2.2 The true cost of illegal dumping

Illegal dumping generates some significant risks and costs to the environment, the community and the financial resources of councils and other land managers. The 'true costs' of illegal dumping include the following¹.

Environmental Costs:

- Can degrade the land, including degrading plant and animal habitats;
- Can destroy local bushland, reduce biodiversity value and hinder revegetation;
- Runoff from dump sites may contaminate soil and water sources, such as lakes, creeks and drinking water supplies;
- Dumped items can alter the normal drainage course of runoff and make areas more susceptible to flooding and erosion when waste blocks creeks, stormwater drains and gutters;
- Dumped material could catch fire either by spontaneous combustion or arson, which can damage bushland and property;
- Illegally dumped items are a lost resource. Many items can be recycled, particularly garden organic material, beverage containers, fridges, computers, tyres and car bodies.

Social Costs:

- Reduces aesthetic amenity and deters people from visiting areas where there is frequent illegal dumping;
- Dumped items create physical (protruding nails or sharp edges) and chemical (harmful fluids or dust) hazards for anyone who does visit the site;
- Dump sites attract rodents, insects and other vermin that pose health risks. "Dump sites with scrap tyres provide an ideal breeding ground for mosquitoes, which can multiply 100 times faster in the warm stagnant water standing in scrap tyre castings"²;

¹ DECC (2008), *Crackdown on Illegal Dumping: Handbook for Local Government*, DECC, Sydney Australia.

² United States Environment Protection Agency (1998) *Illegal Dumping Prevention Guidebook*, US, EPA, EPA905-B-97-001, Illinois, United States.

- Thousands of volunteer hours are spent participating in clean up initiatives, such as Clean Up Australia Day, Keep Australia Beautiful and Tidy Towns, at a significant cost to the community's resources;
- Dump sites attract further dumping and other criminal activities, such as graffiti and arson, which decrease community pride and further exacerbate the problem.

Financial Costs:

- NSW local governments are estimated to spend \$10 million a year removing and properly disposing of illegally dumped materials and landfilling. For larger councils, these costs can be as high as \$400,000 annually;
- State agencies, Aboriginal Land Councils and other land managers also bear significant costs of managing and cleaning up dumped materials, as large portions of unoccupied land are not in the care or control of Local Government.
- The community can often bear the cost of lower property prices because affected areas are less attractive to prospective commercial and residential landowners.

2.3 What is typically dumped illegally?

Throughout the region, the types of materials commonly dumped are similar in nature and can commonly be used to identify the sector of the community from which the waste was generated. Typical dumping materials are:

- *Concrete, bricks, tiles, lumber, etc.* – this material is commonly associated with the construction industry or home renovators. The quantity of materials is a common determinant of whether a contractor or home renovator was responsible;
- *Cars* – commonly dumped by previous owners or thieves;
- *Whitegoods* – commonly dumped by either the owners or home clean-up companies paid to take to either a recycling facility or landfill;
- *Mattresses and furniture* – as above;
- *General waste* – small discrete piles typically indicate a residential source, larger piles are typically representative of a commercial or home clean-up contractor;
- *Garden waste* – as above.

OEH reported that 44% of all illegal dumping incidents in NSW (that occurred in 2007-08) were from a residential source, with a further 20% representing the construction industry.

The nature of the waste mix varies from council to council depending on factors such as geographic location, demographics and housing types, availability of disposal services, cost of disposal services, etc. OEH, in their "*Crackdown on Illegal Dumping*" handbook indicate that rural councils are more likely to have household rubbish, garden organic material, cars and tyres dumped compared to urban councils which are more likely to have household furniture, whitegoods and construction and demolition waste.

2.4 Why do people dump waste?

The psychology of people who dump waste illegally has been the subject of many social research studies over the past 20 years. Following is a list of reasons typically provided for why dumping occurs³.

Household Waste:

- waste management facilities opening hours are inconvenient;
- distance from the house or lack of council collections;
- It is easy to dump and get away with it;
- It is easy to add waste to an existing pile of illegally dumped material.

Anecdotal evidence also suggests that the relatively recent introduction of stricter rules, and the rises in NSW waste levies, is also contributing to the problem in the Hunter and Central Coast.

Construction and Demolition Waste:

- Unwillingness to pay landfill costs;
- Uncaring attitude;
- Access to convenient dumping location;
- Rising disposal restrictions and costs;
- Distance to disposal facilities.

Understanding the reasons why people dump materials may assist with the development of appropriate activities to reduce the likelihood of dumping occurring. Appropriate activities will incentivise the appropriate behaviour and de-incentivise dumping.

2.5 Overview of the illegal dumping deterrence project

As part of the NSW Environmental Trust funded Sustainability program, HCCREMS commenced working with member councils and the Hunter Regional Illegal Dumping Network to develop a program that gained further understanding of illegal dumping activities in the region, and assist in the facilitation of deterrence, enforcement and clean up activities.

HCCREMS assigned an officer to the project to commence working on the following activities:

- Development of standard 'Blitz' processes to create a system for conducting illegal dumping blitz activities that provide feedback to compliance officers and clean up crews;
- Development of a regional illegal dumping database to capture, analyse and provide intelligence back to councils on the locations of dumping hot spots and trends across the region;

³ DECC (2008), *Crackdown on Illegal Dumping: Handbook for Local Government*, DECC, Sydney Australia.

- The development of community engagement and awareness materials for use by councils to promote appropriate waste disposal behaviours;
- The trial of different illegal dumping deterrence measures to provide councils with information to assist in the planning of structural works to deter dumping activities in bushland areas; and
- Investigation of models for the *regional* management and enforcement of illegal dumping activities.

Between 2007 and 2011 the following regional activities have been undertaken.

- In 2007, Port Stephens Council conducted an illegal dumping blitz with local police to locate illegal dumping sites, investigate and locate offenders and clean up sites of environmental concern.
- In 2008, Cessnock City Council participated in a HCCREMS co-ordinated illegal dumping blitz in conjunction with neighbouring councils, State Forests, Police and Department of Lands. The blitz was designed to identify illegal dumping hot spots, attempt to identify offenders and enable clean up of sites of environmental concern.
- In 2009, Wyong Shire Council participated in a HCCREMS co-ordinated illegal dumping blitz designed to identify areas of illegal dumping in natural bushland and aboriginal lands throughout the Shire.
- In 2010, Lake Macquarie Council participated in a HCCREMS co-ordinated illegal dumping blitz and associated community awareness campaign. The blitz identified a number of hot spot dumping sites, whilst the community awareness campaign used television and media to let the community know of all the appropriate ways they can dispose of waste.
- In 2011 Muswellbrook Shire Council participated in a HCCREMS co-ordinated illegal dumping audit, designed to identify areas of illegal dumping in the Shire.
- Commenced desktop research into different illegal dumping deterrence measures being utilised by councils and State Agencies.
- HCCREMS worked with six councils to design and implement a number of deterrence measures designed to reduce access to illegal dumping hotspots. The trial of measures was designed to provide an understanding of the usefulness of measures such as gates, blocks, signage, and cameras in different locations and communities.
- All fourteen councils in the HCCREMS region participated in a region wide illegal dumping community awareness campaign over the 2010-11 summer. The campaign included the use of television, newspapers, websites, council office posters and graphics and messages from Mayors in their regular newspaper columns.
- In June 2011, Newcastle City Council, Great lakes Council, Cessnock City Council, Wyong Shire Council and Gosford City Council commenced participation in a system audit to provide information towards the development of a regional illegal dumping management business case.

The development and introduction of the deterrence measures project is the main subject of this report.

3. Introduction to the Deterrence Measures Trial

Making access difficult, to places where illegal dumping commonly occurs, can be an effective way of reducing illegal dumping at these sites. The closure of access to dumping sites increases the effort required to dump and, along with other measures, can effectively communicate to potential offenders that authorities are aware of their activities, which may increase the perceived risk of getting caught.

A number of different access control measures were trialled at bushland and parkland sites with different characteristics and where removal of illegal dumping impacts would have maximum benefits for flora and fauna in the six participating LGAs.

The trial aimed to:

- Provide information on the effectiveness of measures (or combinations of measures) in particular situations through collecting data on dumping instances prior to and after installation of measures;
- Improve knowledge around the benefits, problems, costs and factors contributing to the successful use of a variety of deterrence measures;
- Contribute information to the development of guidance on the selection of appropriate deterrence measures to be used by Councils to make informed decisions about what measures to install at sites with differing needs and characteristics in their LGA.

The project involved the trial of 8 different types of measures at 11 sites over 13 months between February 2010 and March 2011. Where possible the project sought to establish monitoring of dumping levels for a period of at least 3 months prior and post installation of measures at each site (with a view to continuing the monitoring and reporting on these measures beyond the trial that is the subject of this report.)

This report seeks to provide a summary of the information and insights gained from desk top research, broad-based consultation, and the 12 month trial to assist councils with designing and implementing cost efficient and effective site-based deterrence measures for illegal dumping.

3.1 Project methodology

The project methodology comprised seven activities, each of which are described below.

3.1.1 Site selection

In late 2009, councils were invited to nominate bushland and parkland sites, which were known to be dumping hotspots, for inclusion in the trial. The sites were considered against the following criteria:

- Tenure of nominated land – council owned, crown land (council managed), other public or private land;
- Evidence of illegal dumping at site – records of past incidents or a description of the dumping problem in comparison to other sites in the LGA;
- Environmental characteristics of site – description of vegetation and other natural features;

- Site management currently occurring or planned – whether the site was subject to a plan of management or similar;
- Community importance of nominated site – whether there were any groups such as Landcare involved in the management of the site;
- Council commitment to managing and monitoring site – whether an active budget exists for management activities, whether any management or monitoring activities are underway or planned for the immediate future;
- Potential for a variety of measures to be trialled over the region – whether site is suitable for the trial of measures that cannot be trialled at other sites.

20 sites/ localities were nominated by 6 councils. A number of discussions and site visits occurred with each council to fully consider the above factors and to determine the feasibility of individual sites for participation in the trial. Sites were rejected at one council only due to the sheer number nominated and the inability for council staff to contribute to the monitoring required for all of the sites. Early in 2010, 11 sites within 6 Local Government areas were selected for inclusion in the project (see Table 1). Further information on each site is provided in Attachment 1.

Table 1: Deterrence Project Sites and Measures Tested

Local Government Area	Site name	Measures tested
Greater Taree City Council	Kiwarrak State Forest Deterrence Site	Surveillance signage and Bushnell motion sensor camera
	Harrington Deterrence Site	Surveillance signage and Track Snap motion sensor camera
Great Lakes Council	Darawakh Deterrence Site	Earth-mounds
Lake Macquarie City Council	Barnsley Deterrence Site	Revegetation works and log/ rock barriers
	Wyee Rd Deterrence Site	Gates and bollard and cable fencing
Singleton Council	McNamara Park Deterrence Site	Signage and local mail-out
	Herbert Reserve Deterrence Site	Signage and local mail-out
Wyong Shire Council	Lot 642 Lake Munmorah Deterrence Site	Gates – standard model Bollard and cable fencing
	Lot 100 Lake Munmorah Deterrence Site	Gate – heavy duty custom made model Blocks – linked and unlinked
Gosford City Council	Mt Ettalong Deterrence Site	Predator motion sensor camera, dummy camera and surveillance signage
	Katandra Deterrence Site	Predator motion sensor camera and surveillance signage

3.1.2 Deterrence measure selection

The range of measures available to deter access by dumpers was researched through key contacts and information from projects in other areas. Key contacts included council and catchment management officers, managers of crown land, and officers from OEH and Keep South Australia Beautiful (KESAB). Specific reference was made to case studies and project results from the following sources:

- The NSW Government Clean Up and Deterrence grant program during 2002-2004;
- OEH's illegal dumping handbook "*Crackdown on Illegal Dumping*";
- NSW Government grant program for Aboriginal Communities for Illegal Dumping Prevention and Clean Up;
- KESAB illegal dumping prevention trials with South Australian councils;
- A joint project between Liverpool, Sutherland Councils, the RTA, Defence and the Local Aboriginal Council for reducing illegal dumping on Heathcote Road.

Research was limited by a lack of data available on the actual cost effectiveness of measures, with most evidence being anecdotal.

The research was used to develop a list of types of measures and measure specifications for use in the trial. The trial aimed to build on existing information and further test the effectiveness of the following measures:

- Gates, bollards and cable fencing – Models of gates designed to deter vandalism and known to have survived intact for a number of years were identified as worth trialling, as well as cheaper, standard heavy-duty gates;
- Concrete blocks – Blocks had been used successfully by some councils and were known to be relatively cheap. However supplier details were not easily available and reports of 4WDs belt winching blocks out of place prompted the need for further investigation and trialling of this measure;
- Earth mounds - These were measures that were reported to be useful in some cases in the Sydney region however information did not exist on the specifications (e.g. shape and height, and necessary environmental considerations) that made the mounds successful. As part the process of selecting this measure for trialling an environmental consultant was engaged to inform the development of Earth Mound Design Considerations (refer to Attachment 2);
- Revegetation – HCCREMS was interested in trialling the effectiveness of mounds and revegetation as a method of track closure (limiting dumper access) in areas adjacent to sensitive environmental sites;
- Signage – Past grant programs had reported that signage can have very mixed results but results were better when other educational methods were used in conjunction with them. This trial tried to obtain more definitive results on signage in conjunction with other methods;
- Cameras - Reports from other users of surveillance cameras determined three models (with different specifications) that had achieved reportedly positive results elsewhere, and that could be tested further as part of this trial.

The 11 sites involved in the trial were visited, with officers responsible for management of dumping at the site, to consider which of the potential deterrence measures might be appropriate for the site. The choice of measure was ultimately determined by the sites physical characteristics and the level of access required.

3.1.3 Development of trial monitoring processes

In order to determine the effectiveness of deterrence measures, monitoring of dumping before and after measure installation was required. Ideally this monitoring should have occurred over a long period (12 months) to allow for any seasonal/ annual variations in dumping. However a number of practical constraints determined that monitoring periods be shorter with a minimum of three months of monitoring prior and post installation.

A consistent monitoring procedure was developed drawing on Incident Reporting Forms used in previous blitz events and requiring data on the following:

- Location – description of area of incident (track name) and coordinates;
- Date, time and inspecting officer details;
- Waste type – which type/ types of waste are present in dumping (mixed household refuse, building and demolition, organic-vegetation waste etc);
- Waste amount – an estimation of the volume (in cubic metres) or number of items (for vehicles, mattresses etc);
- Photos – to provide a visual record of the incident;
- Additional volume/ items and photos (on subsequent dates)- An indication of changes to the incident/ further dumping (for large sites where incidents were not cleaned up within the project timeframe);
- A description of any damage to deterrence methods;
- An indication of how well the deterrence measures are performing and why.

A supporting document was developed to assist with the more complex monitoring situations such as large sites with numerous incidents that were not cleaned up within the project timeframe.

Please refer to Attachments 3 and 4 for monitoring forms and guides associated with the trial.

3.1.4 Pre-installation monitoring

To establish dumping pressures (volumes and frequency of incidents) at trial sites and provide a baseline for potential changes to these pressures, monitoring over a period of at least 3 months was required. Officers (often regulatory or area management staff) were requested to conduct regular monthly monitoring and provided with monitoring forms and guidance. All monitoring data received was incorporated into a regional illegal dumping database.

3.1.5 Project agreement and installation of measures

A process was developed to ensure all necessary considerations associated with installing measures at each site were considered and managed appropriately, including:

- Obtaining necessary permissions;
- Notifying affected land owners/ managers;
- Following appropriate procedures for engaging suppliers/ installing measures;
- Nominating a staff member responsible for monitoring illegal dumping and the condition of works during the trial period;
- Occupational health and safety issues.

A project management checklist was developed to confirm the measures to be funded at the nominated site and to guide council through all issues requiring consideration (refer to Attachment 5).

3.1.6 Post-installation monitoring activities

In order to determine if the measures had made any immediate/short term affect on dumping pressures at the trial sites, monitoring continued for approximately three months after measures were installed.

After the post-installation monitoring was complete, the deterrence measures became the property of council or the land owner. It is intended that measures would continue to be maintained and monitored, wherever possible, at the selected site (or moved to other dumping hotspots in the case of cameras) so that information can be collected and collated by HCCREMS and inform future positive deterrence strategies.

3.1.7 Analysis of results and development of guidance

The trial aimed to assess the initial/short-term cost and effectiveness of particular deterrence measures in certain situations by comparing data of dumping pressures prior to and post installation. Monitoring data was received and analysed after measures were installed for at least three months. The analysis considered the following factors:

- Differences, positive or negative, between average monthly dumping incidents and volumes, before and after measures were installed;
- Evidence of access breaches or attempts to gain access despite the measures in place;
- Evidence of vandalism, theft or damage of measures;
- Community feedback/complaints/enquiries regarding measures;
- Feedback from council staff involved in the trial regarding the usefulness, perceived effectiveness and ease of management of measures;
- Costs for design, installation and maintenance of measures;
- Difficulties encountered in design, installation, monitoring and management of measures;

-
- Potential cost savings that measures may have contributed to (e.g. removal of need for clean-up and tipping costs);
 - Successful fines and prosecutions that may have been assisted by measures.

Results are provided in this report on a site by site basis (see Attachment 1) and by each measure type (see Section 4). All results have been used to develop guidance included in Attachment 7, which aims to provide assistance to Councils in selecting appropriate deterrence measures for dumping situations similar to those encountered in this trial.

4. Deterrence Measure Trial Observations

A variety of measures were trialled during this project, including surveillance cameras, earth mounds, revegetation of access points, gates with bollards and cabling, signage, and blocks with cabling. The efficacy of each is discussed in the following section (individual site results are included in Attachment 1).

4.1 Gates, bollards and cabling

Locked gates were included in the trial as a method of preventing access from unauthorised vehicles, whilst still allowing access to authorised vehicles and personnel. The effectiveness of the gate in fulfilling this role depended on the following factors:

1. The sturdiness and quality of construction (of lock, gate and associated bollards) and the ability of it to withstand access attempts / vandalism;
2. The consistent and correct use of the gate and lock (i.e. keeping gate closed and locked at all times and careful distribution of keys);
3. The ability to consider and address surrounding access points (i.e. either side of the gate, other points at the back/ side of area to be secured).

Gates of varying levels of 'sturdiness' and cost were trialled across a number of sites (see table 1 for location details), to determine effectiveness against the three criteria above. It is worth noting that readily available, light weight gates were not included in the trial as research indicated these were typically damaged and ineffective at long term access control.

4.1.1 Gate specifications

Gate 1 - Wyee Road, Lake Macquarie City Council

A standard heavy duty gate was built and installed by Lake Macquarie City Council. The gate has a reinforced hot-dipped galvanised steel frame with a semi-enclosed lock. Gate and bollard measurements are:

- Gate - 4m wide and 1 m high.
- Gate posts - 2m long, with 1m cemented into the ground with high strength concrete.
- Crossbar rails – 100mm x 50mm x 6mm.
- Fencing - 5m of fencing was used beside one of the gates and 10m beside the other, to prevent vehicles driving around the gates. Cable is 20mm galvanised steel.
- Bollards - 100mm galvanised steel posts (see Figure 1). The bollards are concreted approximately 500mm into the ground and stand almost 1m above the high. Bollards installed with spacing no greater than 1.5m (to stop cars driving between bollards).

The building and installation costs for this gate system (2 gates and associated 15m of bollards and cabling) were \$7,420.

Figure 1: Standard Heavy Duty Gate at Wyee Rd Deterrence Site



Gate 2 - Lot 642 Lake Munmorah, Wyong Shire Council

Standard heavy duty gates, as used by NSW National Parks & Wildlife Service (see Figure 1), were used at this site. The construction is similar to that installed at the Wyee Road site (see above), except the top cross bar is slightly thicker and an extra end post beside the gate hinges provides further strength.

The build and install costs for this gate system (2 gates and associated bollards and 40m of cabling) was \$8,000.

Figure 2: Gate at Lot 642 Lake Munmorah Deterrence Site



Gate 3 - Lot 100 Lake Munmorah, Wyong Shire Council

This gate utilised a design used successfully by Gosford City Council, to specifically overcome common vandalism activities such as the cutting of locks or gates being torn off their hinges. As with the previous designs, this gate has a reinforced hot-dipped galvanised steel frame with a fully-enclosed lock (see Figure 3):

- Gate – 4m wide and 2m high, with 10cm² cross bars.
- Gate posts - 2m high, with buried 0.8m within 1m³ cement connected with a 40cm wide cement trench and deformed bar. Posts are 25cm² square bar.
- Lock access – 12cm² hand access box only.

No associated fencing, cabling or bollards were used with this gate. The cost for supply and installation of the gate was \$4600.

Figure 3: Gosford City Council Custom Designed Gate



4.1.2 Summary observations of the gate trial

The following observations were made during the trial period.

Gate 1 - Wyee Road, Lake Macquarie City Council

This site was experiencing a number of dumping incidents per month. The number of incidents that occurred at this site was reduced following the gate installation but a number of issues were observed, that reduced the efficacy of the gate and bollard system:

- The bollards and cabling were not initially installed to specification (bollards over 2m apart), leading to the cable being cut and cars driving through the opening created.
- Keys being provided to too many people, or the gate being left unlocked (padlock was physically removed at one stage).

Once the bollards were re-installed to specifications, and the padlock replaced, no further breaches occurred and the gate and bollards systems successfully restricted access to the site.

A dumping incident did occur in front of the locked gate, enabling Council to consider installing a surveillance camera at this point to catch those offenders no longer able to access the site, but still wanting to dump their waste illegally.

Gate 2 - Lot 642 Lake Munmorah, Wyong Shire Council

During the monitoring period prior to the installation of gate and fences, this site received some 14.5m³ of illegally dumped waste. Following the correct installation of the gates and associated bollards and cables, no further dumping incidents occurred at this site, and no breaches of access were recorded.

Gate 3 - Lot 100 Lake Munmorah, Wyong Shire Council

During the monitoring period prior to the installation of gate and fences, this site received some 58m³ of illegally dumped waste. Following the correct installation of the gates and associated bollards and cables, no further dumping incidents occurred at this site, and no breaches of access were recorded.

4.2 Concrete blocks

Concrete blocks, placed directly over access points to areas of illegal dumping, were trialled in Wyong Shire Council. Blocks were included in the trial as it was felt their size, weight and construction would enable them to withstand vandalism.

Blocks were installed along areas of sparse vegetation at one of the Lake Munmorah sites, meaning access could only be gained by landholders and Agencies through the legal access, controlled by the gate.

4.2.1 Concrete block specifications

The concrete blocks included in the trial were made to the following specifications:

- Block – approximately 1m x 1m x 1m, solid concrete, with a large metal hook cemented into the block (see Figure 4).
- Cable - 18mm steel cable, secured with galvanised eye and bolt chemsets.

The blocks were constructed at a cost of \$250 per block, each join of cable cost \$200.

The hook cemented into the block was included to aid in lifting and placement of the blocks, and to secure the blocks to its neighbours. The blocks were secured to each other to reduce the likelihood that blocks would be individually moved by 4WD seeking to gain illegal access to the site.

Figure 4: Blocks in place (left) and blocks with cable joins (right).



4.2.2 Summary observations of the concrete block trial

Once in place, the concrete blocks were not moved, and were successful in stopping access through the previous access points, where they were installed, although the following issues were observed during monitoring inspections:

- The blocks were initially placed too close together and not joined by cables (as specified when ordered). The installation company returned to the site and spread the blocks and attached the cables.
- A number of new illegal access points were created through areas of limited vegetation in response to the installation of the blocks at common access points (and the gate at the legal access).
- One complaint was received from the general public about the perceived “ugliness” of the blocks compared to the natural environment.

4.3 Earth mounds

Earth mounds, placed directly across illegal access points to areas of illegal dumping, were trialled in Great Lakes Council. Mounds were included in the trial as they, like concrete blocks, pose a difficult barrier to move, but are considered to be more environmentally sensitive and aesthetically pleasing than blocks due to their ability to be planted on, and built into the existing site drainage system. Like concrete blocks, mounds are a significant structure, and are expected to withstand vandalism and other access attempts.

4.3.1 Earth mound specifications

Earth mound design guidance was provided (Attachment 2) to assist council to design, cost and install mounds around key sites in the Darawakh Wetlands. The mounds actually installed were as follows:

- Size - approximately 1.6m high with a steep front face and 7m in length (see Figure 5).
- Materials - mounds were constructed of compacted clay, layered over broken concrete pieces (sourced from a concrete pad removed as part of the works).
- Vegetation - Native tube stock was planted on the surface of finished mounds.
- Additional materials - Four large bush rocks were placed beside mounds, and existing adjacent large trees.

The mounds cost approximately \$10,000 each (including materials and installation). An additional \$880 was spent at this site to rip the gravel road leading to the newly installed mound, to further hamper vehicular access.

Figure 5: Earth mound constructed at the Darawahk deterrence site.



4.3.2 Summary observations of the earth mound trial

Once in place, the earth mound was unable to be moved, and its steep face made it difficult for 4WDs to gain access through these common illegal access points. Vehicles did 'drive around' the mounds highlighting the need for the mounds to have additional barriers, like large bush rocks, installed adjacent to them to hamper access around the edges. However, no dumping occurred as a result of these access breaches.

The mounds were not extended to reduce the need for bush rock to be installed, as the mounds would have then encroached on the root systems of nearby trees, likely causing the trees to die off. The installation of additional measures such as rocks or bollards is essential to ensure the integrity of the surrounding environment.

Following the installation of the earth mounds and bush rock, no further access breaches were encountered.

4.4 Revegetation

Revegetation of access points into illegal dumping hot spots was trialled in Lake Macquarie City Council, in conjunction with the installation of additional log barriers, to protect the plant stock from being driven over, whilst the plants are establishing.

Revegetation was included in the trial as an aesthetically suitable option for access restriction. The success of the revegetation measures is dependent upon the survival rates of plants, speed of plant growth and installation of additional measures during plant establishment.

4.4.1 Revegetation specifications

Planting of 1250 locally indigenous tube stock within mulch occurred at the Barnsley Deterrence Site, species utilised included:

- *Acacia falcata* - Sickle-leafed Wattle;
- *Acacia longifolia* - Sydney Golden Wattle;
- *Callistemon salignus* - Willow Bottlebrush;
- *Casuarina glauca* - Swamp Oak;
- *Corymbia maculate* - Spotted Gum;
- *Melaleuca linariifolia* - Snow-in-Summer;
- *Melaleuca nodosa* - Ball Honey-myrtle.

The revegetation and mulching was concentrated at track ends (where logs and rocks were used to prevent vehicles from driving on vegetation), along the creek bank and in widely cleared areas (to gradually narrow the track to a walking track only).

The accumulated costs for plants (1250 plants), labour (3 officers) and machinery (2 day hire of mechanical auger) were \$3760. A standard telegraph pole (already available at the site) was placed in-front of the plants with sandstone boulders (costing \$50 per tonne) arranged on either side of the pole, to further deter vehicle access over the top of the log and plants (See Figure 6 and 7).

Figure 6: Revegetation immediately behind log and rock barriers



Figure 7: Revegetation and mulching along rock stabilised creek bank.



4.4.2 Summary observations of the revegetation trial

Following planting of tube stock and the placement of the log and rock barriers, no further incidents of dumping occurred at the site. However, it was observed that one incident of dumping did occur in front of the log, indicating again, that councils could consider placing surveillance cameras near newly installed deterrence barriers to deter or catch people dumping at these sites.

4.5 Surveillance cameras

In addition to 'hard engineering' deterrence options, the use of overt and covert surveillance cameras was trialled in this project. Typically the cameras were used in conjunction with signage.

Surveillance cameras were included in the trial as this technology is being used more often in law enforcement activities, and can provide councils with more details on offenders and assist with material evidence in legal proceedings.

Research indicates that the effectiveness of cameras as a dumping deterrence mechanism relies on the following factors:

- Evidence of the presence of cameras (fake or otherwise) and associated signage with a clear positioning;
- The veracity of the installed camera's protection from theft, damage and vandalism
- Positioning and technical abilities of the camera to capture quality information/adequate evidence;




-
- Acceptance, by users of the area, of this form of illegal dumping management;
 - Communication of successful identification of offenders through use of the technology (through media and/or word-of-mouth).

The trial included the use of three different motion sensitive camera models (the Bushnell Trophy Cam, Track Snap Digital Eye, and the Predator Evolution XR), so that information on different functionality could be provided to councils considering employing cameras into their illegal dumping deterrence programs. An additional 'OzSpy' dummy or fake camera was also trialled to determine if the threat of a camera was enough to deter dumping.

4.5.1 Surveillance camera specifications

Table 2 provides specifications on each of the motion sensor camera models included in the trial. More specific details on the usability of each model is included in Attachment 6

Table 2: Specifications of the motion sensitive cameras trialled.

Camera model	Bushnell Trophy Cam	TrackSnap Digital Eye	Predator Evolution XR
Pictures of camera			
Accessories	<p>Standard belt provided to fix to pole / tree (no security)</p> <p>Need to purchase separately:</p> <ul style="list-style-type: none"> - SD card; - SD card reader also needs to be purchased to avoid the need to remove camera to plug into computer; - Batteries (4AA). 	<p>4G memory Stick,</p> <p>Camouflage casing and locking cable, 9V battery included</p>	<p>Universal mount extra cost. Comes with limited memory.</p> <p>Need to purchase separately:</p> <ul style="list-style-type: none"> - Memory stick; - 10 AA batteries.
Resolution	Up to 5MP	Up to 12MP	Up to 2MP

(Megapixels)			
Optimum distance for number plate	Photos - <10m Video - <5m	Photos <25m Video <5m	Video 5-10m Photos - untested
Activation time (between triggering motion and taking photo)	Said to be 1sec Field tests indicate activation occurs when cars are about 15m past (at 20kmph)	Said to be <1sec Field test indicate activation occurs when cars are about 15m past (at 20kmph)	Tests at sites indicate activation occurs when cars are about 5-10m past (at 10-20kmph)
Night use	Yes (red LED).	Yes (optional infrared flash)	Yes (infrared flash).
Anti Theft Features	Small unit easy to hide.	Lockable cable for attaching to trees/ poles Camouflage casing	Camouflage casing Pin number required to access camera information and settings – so it will be effectively useless to thieves
Battery life	Said to be several months (180 days) Field tests show batteries last anywhere from a week to 4 months (the latter when taking up to 3000 photos a week but using 4 lithium batteries).	Said to be 370 shots Field tests show batteries seem to last a highly variable amount of time (even when similar numbers of photos are being taken) and was often flat after one week of use.	Depends on usage and settings. Tests at one site suggest around two weeks. Tests at another site suggest batteries can last a couple of months.
Indicative cost (incl. GST)	\$495 - \$550	\$950 - \$1100	\$995 - \$1350

The OzSpy dummy camera is a fake camera unit of approximately 25cm in length with a waterproof metal housing and fake wires (\$60 per unit).

4.5.2 Summary observations of the surveillance camera trial

The cameras were installed in a number of different locations at all sites during the trial period, signage was installed at the legal access points to the sites indicating that cameras were being used to target illegal dumping. In addition, at one site, the Predator camera (and a dummy camera) was installed in an obvious position and a notification sign placed near the camera, clearly indicating the camera was there to catch illegal dumpers.

The sites selected for trialling the cameras, were large bushland areas, with numerous entry points, and many areas where dumping had previously occurred, making the selection of sites to place the cameras in hope of filming dumping difficult. During the trial no offenders were caught on film, although most sites did report a decrease in dumping incidents inside the trial area.

Reports on the ease of use of the cameras indicated the following:

- The Bushnell camera was easy to use and easy to relocate. The Bushnell clearly recorded number plate images when the vehicle was within 20m. Battery life is good, with 2000-3000 images captured each month for 9 months on one set of batteries.
- The Track Snap camera was easy to hide due to the camouflaged housing. The photograph settings captured clearer images than the video settings. Images clearly showed licence plates when vehicles were within 10m. Batteries needed to be replaced weekly.
- The Predator camera was described as being easy to use, but difficult to obtain consistent image quality. The Predator also had limited battery life. Best quality images were captured when the camera was placed close to the ground, facing in the direction of vehicle movement.
- The dummy camera an obvious surveillance presence and required no maintenance. No vandalism was encountered during the trial.

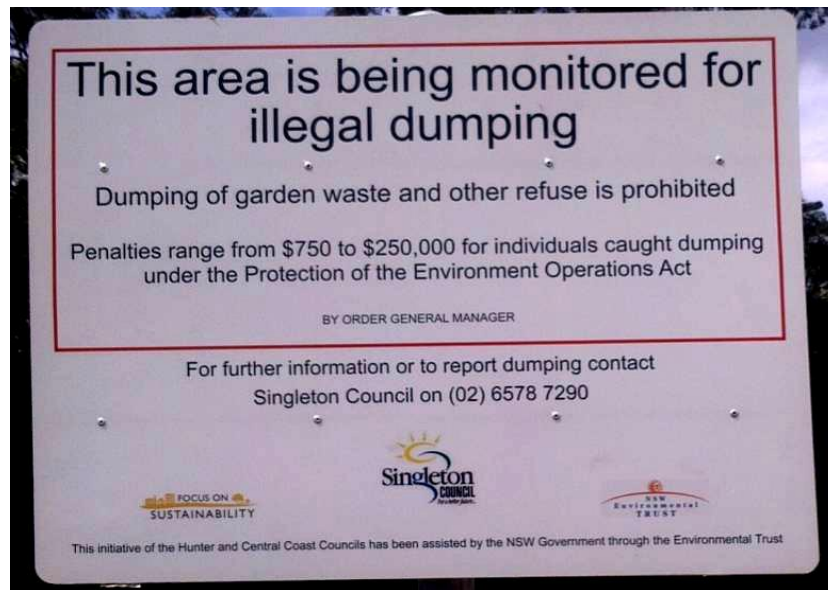
4.6 Signage and community awareness

Signage and engagement with nearby communities to assist with deterrence of illegal dumping activities was also trialled. Singleton City Council sent letters to residents neighbouring the trial site to explain the problems with dumping waste and ask for their assistance in reducing the incidents of illegal dumping. Signage was installed at entrances to the trial areas to notify offenders that Council was monitoring for illegal dumping activity.

4.6.1 Signage specifications

Signage consisted of a 600 x 800mm aluminium sign (Figure 8) installed on two 3m posts, cemented into the ground. Signage was installed by council staff. Total cost for the construction and installation of the signage was \$812. A copy of the letter mailed to residents is included in Attachment 1.

Figure 8: Signage installed at Herbert Reserve and McNamara Park deterrence sites.



4.6.2 Summary observations of the signage trial

Signage and mail-outs to residents appeared to have little impact on dumping pressures over the trial period. Although an increased number of calls were received by council in relation to the letters, no offenders details were recorded, and the signage did not act as a significant deterrent to dumpers.

Indeed, one of the signs was vandalised soon after installation, and was not repaired until after the trial period, possibly reducing the effectiveness of the deterrent at the site.

5. Key Findings of the Stage 1 Project

The Stage 1 trial of measures has provided some valuable observations on the efficacy of different deterrence measures when used in different situations, considering the site characteristics and dumping characteristics.

5.1 Use of site and dumping characteristics to select deterrence measures

Table 3 below provides details on the sites included in the trial noting characteristics of the site, dumping incidents and the measures trialled. Measures trialled at each site were selected based on site visits, discussions with council staff and reference to research conducted on the different measures available (as discussed in Section 4).

Table 3: description of the site characteristics, dumping characteristics and measures trialled.

Deterrence Site	Site Characteristics	Dumping Characteristics	Measures tested
Greater Taree City Council - Kiwarrak State Forest	<ul style="list-style-type: none"> • Close proximity to the Council Waste Facility and the suburb of Purfleet • Heavily vegetated with large trees • Relatively flat. • Numerous access points, used as a thoroughfare to access the Forest. • Includes a main road and a number of remote trials. 	<ul style="list-style-type: none"> • Known dumping hotspot for the last several years. • Several tonnes of general waste removed from the site prior to the installation of measures. • Typical waste types dumped include mixed household refuse, garden waste, tyres, sofas, plastic and abandoned vehicles • Common dumping locations are scattered throughout the site on either side of the main tracks (Lantana Crossing Road and Purfleet Rd) – or on side tracks within a few metres of the main track. 	Surveillance signage and Bushnell motion sensor camera

Deterrence Site	Site Characteristics	Dumping Characteristics	Measures tested
Greater Taree City Council - Harrington	<ul style="list-style-type: none"> • Located on Crowdy Head Rd and is part of a 400m long beach access track with a small turning bay / car park at the site entrance • Frequented by the public for recreational purposes. • Site entrance bordered by dense, low coastal vegetation. • Site is relatively flat. 	<ul style="list-style-type: none"> • Regular dumping site for small loads of domestic or garden waste. • Most incidents occur less than a few metres from the track access / car park area within the low vegetation and in grassy areas. 	Surveillance signage and Track Snap motion sensor camera
Great Lakes Council - Darawakh	<ul style="list-style-type: none"> • Located to the north of the Tuncurry Waste Management Facility. • Stretches for most of the length of Tip Road (a private dirt road), extending approximately 200m on either side of the road where a number of tracks exist. • Used by members of the public to use the Nature Reserve and neighbouring beach for recreational purposes. • The dirt road has deteriorated significantly in recent years, making the Site more remote with less frequent use. 	<ul style="list-style-type: none"> • Most noted dumping hotspot in LGA. • Network of tracks throughout site. • Commonly dumped materials include household, garden and building waste and abandoned vehicles • Dumping occurs throughout the tracks on the site. 	Earth-mounds

Deterrence Site	Site Characteristics	Dumping Characteristics	Measures tested
Lake Macquarie City Council - Barnsley Deterrence Site	<ul style="list-style-type: none"> • Located at the end of Cliffbrook St and is bordered by an electricity easement on the western side and by Cockle Creek on the east. • The site includes a creek-side track with two access points to the electricity easement. • Used for recreational pursuits. • Vegetation is of good condition, containing reasonably dense trees and shrubs. • Relatively flat 	<ul style="list-style-type: none"> • Known dumping hotspot for a number of years. • Dumping activities occur out of line of sight from the road. • Commonly dumped materials are household, building and garden waste. 	Revegetation works and log/ rock barriers
Lake Macquarie City Council - Wye Road	<ul style="list-style-type: none"> • A track through an electricity easement track on the eastern side of Wye Rd along the side of the railway line. • vegetation surrounding the track includes reasonably dense trees and shrubs and a high incidence of weed infestation • relatively flat and not easily seen from the busy Wye Rd • used recreationally by 4WDs, although this is not a legal use. 	<ul style="list-style-type: none"> • Commonly dumped materials are household, building and garden waste as well as a number of large items such as mattresses, sofas and tyres. • Most of the dumping occurs on the sides of the access track between 20m and 80m into the site. 	Gates and bollard and cable fencing

Deterrence Site	Site Characteristics	Dumping Characteristics	Measures tested
Singleton Council - McNamara Park and Herbert Reserve	<ul style="list-style-type: none"> • Located on either side of the Wollombi Brook with McNamara Park on Broke Rd and Herbert Reserve on Milbrodale Rd. • Relatively flat, open and sparsely vegetated with large trees. • Sites used for regular community events like the Broke Fair and for camping. • Easy access to McNamara Park site is offered due to open vegetation along roads; however a loop road within the site exists which most vehicles use. • There is a single access to the Herbert Reserve with access restricted by a ridge along the front of the Site, the river on one side and fencing on the other. 	<ul style="list-style-type: none"> • Commonly dumped materials are household and trailer loads of garden waste and general camping waste. • Illegal dumping of garden waste at McNamara Park has been exacerbated by historical use of the Site by Council works crews as a temporary storage place for vegetation waste. This practice ceased prior to the trial commencing in June 2010. 	Signage and local mail-out
Wyong Shire Council - Lot 100 and Lot 642 Lake Munmorah	<ul style="list-style-type: none"> • Located within the properties on either side of Chain Valley Bay Rd and front the Pacific Hwy. • Vegetation is in good condition containing some trees but predominantly shrubby vegetation, at times dense. • Sites are directly opposite the Munmorah State Conservation Area. • The sites are relatively flat and the perimeters are somewhat open and are visual to passing traffic. The two properties are owned by Darkinjung Local Aboriginal Land Council (DLALC) and access by the public is illegal. 	<ul style="list-style-type: none"> • Large scale dumping. • Commonly dumped materials include both domestic and commercial wastes and are usually in large quantities (trailer and truck loads). • Dumping is spread throughout the sites, mainly occurring on the sides of tracks towards the front of the properties. 	Gates – standard and custom designed heavy duty models Bollard and cable fencing Concrete blocks

Deterrence Site	Site Characteristics	Dumping Characteristics	Measures tested
Gosford City Council - Mt Ettalong	<ul style="list-style-type: none"> • Located off Patonga Drive and is a small public car park for users of the Mt Ettalong Reserve and lookout (a popular picnic and bush-walking spot) as well as providing access to the water tower. • The access road to the Site is quite steep with vegetation on both sides. 	<ul style="list-style-type: none"> • Litter and rubbish removed on a weekly basis. • Regular dumping types include garden waste, household goods, tyres, cars, etc. • Regular dumping of domestic volumes (car trailer loads or less) of household and garden waste. • Dumping occurs around the edges of the car park area. 	Predator motion sensor camera, dummy camera and surveillance signage
Gosford City Council - Katandra	<ul style="list-style-type: none"> • Located on Toomeys Rd, parkland area overlooking the plateau (including St John's Lookout) to numerous bushwalks and the Katandra Reserve. • Site is utilised regularly by the public for recreational activities such as picnicking and walking. • Contains many large trees and open grassy areas • Flat but drops off steeply at the South-eastern edge of the site. • Existing access controls are in place to prevent vehicles from accessing the Site (pole and rock barriers). 	<ul style="list-style-type: none"> • Dumping at this Site had been occurring for a number of months prior to the trial and was of particular concern to council due to the majority of dumping occurring over the lookout and presenting a safety issue to bushwalkers and council staff. • Commonly dumped waste is E-waste such as computers and televisions, and general household waste. 	Predator motion sensor camera and surveillance signage

5.2 Key considerations for use of deterrence measures.

Observations made during the trial on the effectiveness of the different measures trialled in different situations has provided some key findings that may be useful to consider prior to commissioning the installation and use of the measures. These key considerations are discussed below.

Nature of site characteristics

General findings from research and considered discussion with officers during site visits determined the following site and dumping characteristics most highly impacted on measures installed.

- Sites with limited or no need for public to access could be permanently closed by hard engineering methods (e.g. gates, fences, mounds, revegetation, etc.).
- Sites that need to allow access to specific groups (e.g. utility providers, Rural Fire Service, etc.) could be closed using gates with keys only provided to appropriate users.
- Sites needing to allow some public access most appropriately would utilise soft engineering methods such as signage and surveillance cameras.
- Where sites are commonly experiencing dumping in small household loads (cars or 4WD) measures should be developed to reduce the likelihood these vehicles can cross the barrier (i.e. steep mounds, cabled concrete blocks or bollard fencing and gates).
- All hard engineering options trialled, when installed to specifications, stopped access through these previous access points.

Further details on site characteristics and measure suitability are included in Attachment 7 developed as guidance for the selection of deterrence measures.

Gates, bollards and cables

When gates, bollards and cables are installed to specifications, and access to keys for gate padlocks are appropriately controlled, the trial found the installation of these barriers effective at completely restricting vehicular access to the sites.

Gates and fencing can be expensive, depending on the length of fencing required to ensure vehicles must utilise the gate to gain access to the site. Careful consideration should be given to the appropriateness of this measure to the site in question, as fencing long stretches may not be a cost effective solution.

When utilising gates (with associated fencing) it is important to consider the following:

- Ensure gates are constructed and installed to specification. Pay close attention to the spacing of bollards to ensure they are less than the width of a car, so even if cables are cut, vehicles cannot drive between the bollards.
- Access to keys should be closely controlled.
- Ongoing monitoring of the site should occur to quickly record and respond to any vandalism or access issues.

Concrete blocks

The concrete blocks, being so large and heavy, were effective at stopping access through the specific sites where they were placed. New access points were created in areas where adjacent vegetation was sparse, suggesting that the use of blocks in areas with limited vegetation cover would require the use of more blocks, or be coupled with other deterrence activities.

When utilising concrete blocks it is important to consider the following:

- Ensure blocks are appropriately spaced and secured to each other and / or the ground (cabling cemented into anchor points).
- Ongoing monitoring of the site should occur to quickly rectify any vandalism or access issues.

Earth mounds

Earth mounds are, if installed to the specification included in Attachment 2, large, unmovable barriers to accessing sites, thereby effectively eliminating access to these tracks. Earth mounds are more aesthetically pleasing than concrete blocks, and have the ability to be planted, making it possible for them to be assimilated into the surrounding environment.

When installing earth mounds it is important to consider the following:

- Ensure the mounds are constructed with a solid core (concrete blocks or similar) to create a steep shape and solid core for the mound.
- Use layers and compacted clay over the core, to assist with the mounds keeping shape, and creating a steep face the 4WD are unable to drive over.
- Ensure appropriate drainage is included in the installation specifications, being mindful of not directing surface waters into nearby trees or shrubs in a way that will waterlog the grounds and kill off the vegetation.
- Do not place the mounds too close to nearby tree root systems which may lead to the trees dying off.
- Install additional measures, such as concrete block, bush rock or bollards at the edge of mounds, to prevent 'drive arounds'.

Revegetation

Revegetation can be an important long-term measure to restrict access to dumping sites. The planting and establishment of a natural barrier will not only prevent access, but may be more appropriate in ecologically sensitive areas or where the maintenance of natural amenity is appropriate. Revegetation alone is insufficient, as newly planted tube stock are easily destroyed, so revegetation must, in the first instance, be coupled with another deterrence barrier which enables the plants to establish and grow into a natural barrier.

In the trial, revegetation and log barriers were sufficient to deter access to dumping hot-spots.

When implementing revegetation consider the following:

- Use locally relevant native species.
- Ensure an active monitoring and maintenance system is implemented.

Surveillance cameras

Surveillance cameras, when used in conjunction with signage advertising their presence, appeared to reduce the amount of illegal dumping activity in the trial areas. Results on the use of the cameras indicate the placement and monitoring of the camera performance is necessary to ensure clear and useful images are captured (i.e. placing the camera close to the ground, in the direction of vehicle travel and with clear view to give the greatest chance of capturing a clear image of licence plates).

The use of cameras and signs do not pose a physical barrier as blocks and gates do, therefore access to sites remains possible, and dumping may still occur. Cameras could also be used in conjunction with physical barriers (gates, mounds, etc) as they could capture images of offenders as they attempt to access the old dumping sites, and potentially dump in front of the barrier (as occurred at a number of the trial sites).

The relatively cheap cost of the cameras and signs, coupled with evidence of decreased dumping incidents, however, does make cameras a viable option as a dumping deterrent.

Signage and community engagement

Signage alone, without any clean up activity of council of existing dumped waste, does not appear to reduce dumping activity. However, signed sites with the addition of camera surveillance installed did experience a decrease in dumping activity.

The less effective signs used the phrase “*this area is being monitored for illegal dumping*” where signage associated with cameras stated “*This area is under camera surveillance to detect illegal dumping*”. The signs indicating active monitoring and the potential photographic evidence appeared to have a greater impact on the behaviour of dumpers (due to the perceived likelihood of being caught) than those that did not reference any ‘active’ surveillance activities.

When designing and installing signage, consider the following:

- Location of signs (access points)
- Size of signs (reasonable to assume the signs were visible by all persons entering the site).
- Ensure the signs are graffiti proof for easy cleaning of any spray painting.

5.3 Outcomes from Stage 1 illegal dumping deterrence project

Stage 1 of the Illegal Dumping Deterrence Project has identified some key activities that can assist Councils with deterring illegal dumping in their LGAs.

The information (provided by councils participating in the trial) on each trial site was necessary to assist with determining appropriate measures to install. To facilitate the information gathering stage, a “Dumping Incident Reporting Form” was developed, which enables councils to capture information on both the site, and the nature of the waste dumped, in a consistent form so that it can be entered into the regional illegal dumping database.

The regional database is able to house data on dumping incidents from throughout the region, and plot them through councils GIS systems, enabling councils to gain a geographical picture of dumping activities and trends in their region. The regional nature of the database also assist in identifying adjacent areas in neighbouring councils experiencing similar issues and identifying when it may be appropriate for councils to work together on deterrence and enforcement activities.

The intelligence gathered through the use of the incident reporting forms and the regional database can be used by councils to manage future enforcement activities,

through targeted monitoring of areas on days when incidents are reported to typically occur. The information can also be used to identify which areas could benefit from either access closure or surveillance activities.

The sharing of information between councils on the impact and efficacy of different deterrence measures provides significant value to the region, as councils will not need to install all measures themselves (at some cost) to gain an understanding of their efficacy in different situations. The pooling of council resources, and sharing of findings from trials such as this, adds significant value to the region and assists councils in applying the limited budgets to those actions that provide the greatest outcomes.

The trial found, that although not a complete deterrent to illegal dumping, the use of surveillance cameras and associated notification signage, appeared to cause an immediate decrease in the incidents of illegal dumping. As such, surveillance cameras and associated signage are seen as an appropriate tool (considering ease of use, cost of cameras, and portability) for councils to invest in to deter dumping activities in areas where permanent closure of access points is not possible.

Hard engineering methods (bollards, fencing, blocks and mounds) were successful in eliminating vehicular access through the points they were installed. Gates also proved effective, but require councils to have an active key register and restrict access to keys – and ensure the gates are locked after use. This trial did not determine if dumping locations ‘moved’ but noted the success of these methods at restricting site access.

The trial has provided useful information on the effectiveness of different strategies in stopping people accessing sites for the purpose of illegal dumping. However, it has not provided any detail about whether installing deterrence measures has reduced the incidences of illegal dumping in the longer term, or whether they have just caused the problem to be moved from the known hot spot areas to new dumping locations.

An ongoing campaign by councils to restrict access, clean up and monitor dumping sites and inform the community of councils activities will provide constant pressure on illegal dumpers and may eventually reduce the availability of land to which they will continue ‘confidently’ dump waste illegally.

5.4 Continued trials of illegal dumping deterrence measures

Lake Macquarie City Council has implemented further deterrence measures during the trial period. Measures trialled included: signage without surveillance cameras; different surveillance camera models; different techniques for placement of surveillance cameras; engagement of community groups to manage opening / closing of gates and mounds; and revegetation and neighbourhood notification of the works.

The observations of the effectiveness of these measures mirrored that of the HCCREMS trial, key observations were:

- Signs alone (without any other deterrence measure) are not successful in reducing dumping incidents or volumes.
- Completely blocking access points can be effective, but may cause damage to nearby vegetation if people are determined to access the site (i.e. 4WD drive through vegetation to create a new access point).
- Passive surveillance (high passing traffic) may reduce the risk of dumping occurring.

Based on the outcomes of the HCCREMS trials and the further trials by Lake Macquarie City Council, it is suggested that further trials be undertaken to continue to build intelligence on the effectiveness of different measures in different site situations, and to trial the complimentary nature of deterrence measures. Possible trial activities could include:

- Closing access points (hard engineering) and placing surveillance cameras at this location to capture offenders dumping at the closure point;
- Closing access points to large vehicles, but enabling pedestrian and bike access, to reduce risk of nearby vegetation damage as new paths get cut;
- Successful engagement of user groups or neighbours to increase the passive surveillance at a site, noting such on signage and increasing patrols.
- Continued provision of dumping incident forms to HCCREMS for inclusion in the regional illegal dumping database.
- Consider use of multiple deterrence measures (fences, bollards, blocks, etc) placed at all likely “new access points” installed at the same time as access closure, to reduce the opportunity for new access points to be created when access is closed.

To assist with councils continuing to install deterrence measures and provide information into the region on the effectiveness of different measures HCCREMS will provide seed funding for councils to participate in Stage 2 of the deterrence trial project.

6. Conclusion

The HCCREMS Illegal Dumping Deterrence Stage 1 Project has increased regional knowledge and information resources regarding deterrence measures: their costs; design, installation requirements, and suitability and efficacy when used in certain site situations. This information can be used by councils to inform future strategies and selection of measures to deter dumping at hotspots.

Council's ongoing involvement in the illegal dumping deterrence project through continued installation of measures, monitoring of outcomes and reporting through to the regional illegal dumping database, will enable HCCREMS to continue to collate, analyse and report back on the activities achieving success in the region and provide this valuable information to all councils to assist with the planning, management and implementation of illegal dumping deterrence activities.

7. References

DECC (2008), *Crackdown on Illegal Dumping: Handbook for Local Government*, DECC, Sydney Australia.

DECC (2008), *Illegal Dumping Prevention and Clean Up: Handbook for Aboriginal Communities*, DECC, Sydney Australia.

United States Environment Protection Agency (1998) *Illegal Dumping Prevention Guidebook*, US, EPA, EPA905-B-97-001, Illinois, United States.

8. Attachments

The following documents are attached for reference and use in planning and implementing illegal dumping deterrence activities.

Attachment 1	Illegal Dumping Deterrence Trial Site Reports (for all sites included in the Stage 1 Trial)
Attachment 2	Earth mound design considerations
Attachment 3	Dumping incident report forms <ul style="list-style-type: none">• Dumping incident report• Photograph monitoring report• Dumping incident report (summary report format)
Attachment 4	Guide to Photograph monitoring activities (and use of report)
Attachment 5	Illegal dumping deterrence trial project management checklist
Attachment 6	Comparison of the three motion sensor surveillance cameras used in the Trial.
Attachment 7	Guidance on selecting appropriate deterrence measures when considering site characteristics. Guidance on site characteristics suitable for different deterrence measures.
