BUSINESS AND COMMUNITY WASTE PLANNING

For the successful application of the ‘Reduce Reuse and Recycle’ principle, there needs to be more than a Waste Management Strategy suggesting how people should be behaving. The three principles need to be translated into practical action on the ground.

An ideal mechanism for achieving waste reduction is through developing individual waste management plans for Auroville’s business, service units and communities. The combined effect of multiple waste management plans adapted for individual circumstances will produce powerful waste minimisation outcomes.

One of the key roles of Eco-Service will be to facilitate this process. Appendix A outlines a waste management planning process for businesses. This paper was written by the Waste Management Authority of New South Wales, Australia, as a resource for industries who are looking to implement more sustainable waste management practices. This may be a useful format to adapt for use in Auroville.

The same waste planning process can be adapted for communities. Not only will this provide an upgrading of source separation procedures, it also acts as an educative strategy, focusing on waste minimisation within the home and the workplace. For those places that already have a system in place, Eco-Service can provide a review, and suggest improvements to the current system.

A further role for Eco Service is to develop and promote a uniform materials handling system. With colour coded bins or bags, as well as clear signage for the various categories of wastes, a business or community can set up source separation infrastructure at relatively low cost. The current system of separated versus unseparated will give way to a system where there will be commingled ‘recyclables’ versus ‘residual’ (unrecyclable). Eco-Service will introduce this system on a community wide basis through direct communication with individual business units, service units and communities.

In speaking to many community members, they have reported a major barrier to successful source separation is the inability of Ammas to separate the waste appropriately. However, on closer analysis there is often no attempt to assist this process by providing a clear and comprehensible system, or appropriate monitoring of its functioning. Eco-Service will promote waste management systems that are user friendly and effective. If training of staff is required, Eco-Service can work with Exnora and other agencies to deliver simple and effective training programs on a cost recovery basis.

With 165 business/service units and 95 residential communities, the task of developing individual waste plans is substantial. Allowing the staff an average

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1 Auroville Master Plan
of 4 hours per establishment, and the completion of 6 Waste Plans per week, the exercise would take approximately 10 months to complete.

This exercise has the greatest potential to deliver waste avoidance outcomes. This is particularly the case for when new business and service units are developed in Auroville. As a component of the development process, a waste management plan should be a pre-requisite. Assistance from Eco-Service will be available to develop sound waste management planning at the conceptual stage.

As an example, the relocation of Pour Tous to the central plaza provides an excellent opportunity to rethink waste minimisation for this particular business. The design will take a number of factors into account such as aesthetics, security, product display, and ease of cleaning. If waste minimisation is also one of the features of the design brief, the layout and materials handling of the retail outlet will change accordingly. The new store would allow for the purchase of bulk materials stored in appropriate air tight and vector proof containers. Customers would be encouraged to reuse their old containers and bags or purchase second hand jars or paper/cloth bags from the store. Under the present system, customers find it very difficult to avoid unrecyclable packaging and unnecessary waste production. Through the design team applying creative thinking and problem solving, Pour Tous could become a local model for sustainable food retailing.
APPENDIX A

Waste Planning for Industry: A Guide

Waste Management Authority of New South Wales
CHAPTER 6

Waste Management Research – Business and Community Waste Management Planning

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Summary

Today's challenge for industry is to provide creative managerial solutions to ensure the long-term protection of the environment.

The Waste Management Plan (WMP) is an essential step towards the minimisation of non-productive costs. It will also assist an organisation in meeting its environmental and social responsibilities.

Management commitment is essential for successful integration of the Plan into the day-to-day activities of a business. The establishment of a workplace committee with achievable goals will assist in its successful implementation. The committee should provide feedback to production and management staff and encourage their involvement during the various phases of the WMP.

The Waste Audit, which is divided into five stages, is the first task undertaken by the committee. Firstly, background information from company records detailing the production process, the waste streams, costs and other relevant data are summarised. A plant survey is then carried out to determine sources of wastes and their composition. This information is then cross-checked against the background information and a detailed material balance is completed. Quantitative information allows a business to identify priority waste streams.

The WMP is based on the following hierarchy:

- waste minimisation
- recycling or re-use
- waste treatment
- waste disposal by landfill

The prevention and reduction of waste is emphasised rather than treatment and disposal.

Waste minimisation can involve changes to the raw material input, the production process and/or the final product. It can often be achieved through simple procedural changes or may involve, and often justify, significant capital expenditure.

Recycling or re-use of materials can be carried out either on-site or off-site. The potential is greatest if materials are segregated early within the process as there are less contaminants to remove before re-use.

Waste treatment should only occur when source reduction, recycling and re-use options have been fully considered and evaluated on a cost-benefit basis. Where treatment achieves a reduction of toxicity or pollutant mobility, a greater range of disposal options may be available.

Disposal is the last option in the waste management hierarchy. Approval must be gained for the disposal of hazardous waste and conditions apply to the storage and transport of these wastes. Generators have absolute responsibility for ensuring that all wastes are disposed of in an approved manner.

All waste management options must be evaluated on the basis of both their technical and economic feasibility given program goals and constraints. The technical criteria used should first consider the waste reduction effectiveness. There are a number of economic benefits (e.g., reduced risks, reduction in workers compensation claims and insurance costs) which, although difficult to equate in dollar terms, must be included in the economic analysis.

Once the proposed options are selected an Implementation Plan is developed for each of the waste streams. Considerations include staff education, training, waste specific accounting and coordination of further investigations.

It is important to recognise that the WMP is a continual review process. Options that are not feasible at a given point in time may become feasible at some future stage. The dynamic nature of the Plan will allow firms to be pro-active in meeting their environmental responsibilities.

Waste Management Authority of NSW
During 1989, industrial waste quantities received by the Waste Management Authority of NSW increased dramatically in comparison to previous years. The current rate of waste generation is exceeding the capacity of treatment facilities and economic landfill resources are rapidly diminishing.

Consequently, the cost of disposal is expected to increase steeply in the short to medium term and disposal options for some wastes may be restricted. In the extreme, some businesses may risk closure due to an inability to dispose of certain wastes.

There are excellent opportunities to reduce waste generation in many businesses and industries. Better waste management can reduce costs, avoid negative impact on the environment and improve the public perception of industry.

This document is designed to assist all businesses in waste management and minimisation. It is compelling reading — indeed it is essential reading.

To ensure its continuing relevance, your comments on the document or on waste management in industry are invited. Contact the Waste Management Authority on (02) 412 1388.

Tim Moore MP
Minister for the Environment

Waste Management Authority of NSW
Introduction

Background and Objectives
One of the major issues of the 1990s will be protection of the environment, an important aspect of which is waste management.

Waste quantities handled by the Authority arising from the general community, industry and government have grown significantly over the past decade (Figures 1 & 2).

Waste management policies are now increasingly being viewed in terms of environmental objectives with the following hierarchy:

- waste minimisation
- recycling, or re-use
- waste treatment
- land disposal.

In keeping with the above objectives, these guidelines for waste management have been developed to assist companies in the total management of their wastes. Figure 3 outlines the steps involved.

The aim is to encourage the development and provision of alternatives to waste treatment and disposal through reduction of pollution at the source of generation. This will require creative managerial solutions to address a range of complex and often interrelated problems.

Application to Industry
The Waste Management Plan is applicable to any organisation, regardless of size, generating pollutants discharged to either the air, water or land environment. It is an essential step towards the minimisation of non-productive costs, and the avoidance of possible future liabilities.

The first step is to ensure compliance with all current Acts and Regulations governing waste management. As well as meeting current obligations, this minimises possible future liabilities associated with site clean-up costs. In a situation of non-compliance, the Waste Management Plan provides the structure for the costing of available options to achieve regulatory compliance and the priority of required actions.

Other benefits include reducing the cost of waste management and improv-
ing occupational health and safety standards by reducing the toxicity and quantity of waste streams. This can be achieved by source reduction of waste, recycling or re-use in production processes or by waste treatment. Relatively minor changes to the production process can often yield large cost savings in waste handling, treatment and disposal.

A conscientious approach to waste minimisation may also improve a company's image and relations with other local land users and the public. Widespread environmental concerns are often expressed over proposed developments and the production of a Waste Management Plan can be a critical step in the acceptance of a development application. An integrated strategy for waste management from generation through to disposal, will help to answer or minimise public concerns at an early stage.

The concept stage for a new facility is the most favourable time to consider alternative technologies, production processes and capital equipment available. Such considerations are an important aspect of the Waste Management Plan which encourages a company to achieve the preferred management option of prevention and source reduction of wastes.

Figure 3: The Waste Management Plan

![Diagram of the Waste Management Plan]

6 Waste Management Authority of NSW
**Management Commitment**

Waste generation is a management problem. In many cases managerial decisions are of greater importance than narrow technical solutions.

Management commitment is essential if employees are to be motivated to conduct and implement a successful Waste Management Plan. Corporate policies and objectives with a demonstrated commitment to environmental protection, and in particular the waste management hierarchy, are essential. Such commitment will provide both encouragement and direction to staff in the day-to-day and long-term management of waste.

**Goals**

Achievable goals need to be set which can be either qualitative or quantitative. The latter is preferable as it gives staff the opportunity to reach identifiable targets. For example, an annual 10% waste reduction goal. Goals should be reviewed periodically to take into account changing circumstances, such as consumer demand for products, government regulation, technology, work practices or management techniques.

**Workplace Committee**

Depending on the operational complexity at a site, either one or a number of personnel may form a workplace committee. They should be selected from major waste generating areas and be familiar with the various operations of the business. The committee will liaise with the various sectors affected by the Plan's implementation and draw upon the expertise found within these areas. Management backing, including time, authority and monetary support, if necessary, is essential.

The committee provides feedback to production and management staff and encourages their involvement during the various phases of developing the Waste Management Plan.
The waste audit is divided into five stages, which are discussed below.

**Pre-Audit Phase**

The aim of this phase is to compile all the background information available on the business. Much of the data can be obtained from company records, responsible personnel, and through discussions with staff to highlight perceived environmental problems. Preparation should include a review of the literature on the activities performed at the site and other relevant documents which relate to waste discharge. In general, the four main aspects are discussed below.

**Production Process Information**

The inputs to and outputs from the various processing areas need to be quantified to allow the origins and quantities of waste to be determined. Information can be broadly obtained from the measurement of raw materials, units of product and water usage.

Other information required to assist this analysis can include:

- design process flow diagrams
- heat and material balances
- equipment lists
- piping and instrument diagrams
- production schedules
- sewer layout
- number of process lines
- operational manuals, process descriptions
- operator data logs, batch sheets
- accounting reports.

**Waste Stream Information**

Information should be collated on the types, quantities, composition and sources of gas, solid and liquid streams. A standard recording form for all wastes will enable data to be analysed more easily. The location of all waste collection and storage points need to be identified, as well as operating data and diagrams of any on-site treatment plant, for example, wastewater or incineration units.

Other relevant information, depending on the type of business, may include:

- waste flow characteristics (quantity and rate)
- environmental monitoring reports
- physical properties of wastes, e.g. solid, liquid
- waste dockets
- waste analyses
- sewer discharge records
- transportation records
- current methods of disposal, control systems for dust, odours or first-flush systems
- hazard assessment (i.e., toxicity, flammability, etc.)
- spill incidences - quantities and composition.

It is particularly important to note whether the flow rates are continuous, batch or incidental (spills), as this will have an impact on storage requirements and treatment process design.

The waste generation rate, if possible, should be related back to the process

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Waste Management Authority of NSW
or business, e.g. kg/unit of product, kg/value added, kg/sales, etc.

Cost Information
To enable correct management decisions, waste treatment and disposal costs must be separately accounted for. Information required includes:

» Disposal costs (solid, liquid, packaged wastes, etc.)
» Transportation costs
» Water and sewer discharge costs
» Packaging costs
» Treatment costs (on-site/off-site)
» Storage costs
» Raw material costs.

These costs can be obtained from company accounts, the transporter, Water Board notices, or other sources including the Waste Management Authority and need to be reviewed regularly.

General Information
Currently source reduction and recycling practices need to be documented, as well as any previous correspondence with government departments or authorities.

When the background information is obtained a general flow diagram or material balance can be developed. This is simply a diagram relating inputs to outputs. If possible, the diagram should clearly identify the source, type, quantity and concentration of each identified waste stream.

This information can be used to develop and organise the plant survey and help identify gaps in data, problem areas and information conflicts.

Plant Survey
The plant survey provides the opportunity to compare the actual conditions at the site with the background data collected in the pre-audit assessment. Information gaps and additional waste streams which may not have been evident initially can be identified.

Sources of Waste
All steps in the operation of a business, from the reception area to the product storage areas are examined. The main elements are:

» Prepare an agenda in advance
» Schedule inspections to coincide with the operation of the areas of interest
» Monitor operation at different times
» Interview staff in the areas of concern
» Note housekeeping practices and general appearance of the site
» Photograph observations for later reference.
In most cases the survey should follow the process flow from start to finish. Notes on housekeeping practices such as rinsing operations, sources of odour, sumps, smoke plumes, waste segregation, and product use should be made. Simple things should not be overlooked, for example, rinse hoses not turned off after use; equipment clean-up frequency; spent containers; dust and sweepings. Product storage areas can also be useful indicators of potential problems such as evidence of expired raw materials or materials no longer in use.

It is particularly important to examine waste storage areas, sewer discharge points and emission points. Floor drains can show if anything was discharged incorrectly, for example, odours or visible signs of grease and oil. Areas which can generate hazardous materials such as solvents, oil and paints should also be looked at, for example, maintenance or workshop areas.

The plant survey could also commence at the waste storage or treatment areas and work back to the point of generation. However, in doing so less obvious wastes could be accidentally overlooked and could increase on-site hazards.

**Waste Sampling**

Information on both the quantity and composition of waste is required. If this cannot be calculated then it will be necessary to undertake a sampling program with points identified prior to the commencement of the survey. Identification can be as simple as observing physical characteristics. Additional points may be added as new sources of wastes are discovered during the audit.

Things to take into account are:

- production scheduling
- fluctuations in production, e.g. seasonal variations.

Composite samples can be taken for constant wastewater flows whereas batch tanks should be spot sampled.
Data Completion Check

Once the data has been gathered it is important to correct and adjust the waste flow diagram. For each waste stream the following details should be documented:

- point of origin
- physical/chemical characteristics
- quantity
- waste handling/treatment/disposal
- rate of generation (e.g. kg/unit of product)
- variations in generation rate
- costs to manage and dispose of waste
- potential for contamination or upset.

Priority Waste Streams

To assist in resource allocation, waste stream priorities can be made according to criteria such as:

- regulatory compliance
- toxicity and other hazard risks
- quantity
- costs – treatment, storage, disposal
- perceived problem areas

Regulatory Compliance

With all of the quantitative information summarised, reference must be made to the regulatory requirements relevant to the identified waste streams. For instance, air emission standards, sewer discharge standards, waste disposal requirements, etc. In addition, the various costs associated with meeting those regulations under current practices must be identified. This should be cross-checked with the expense ledger.
Waste Management Hierarchy

The preferred path in the management of wastes lies within an integrated waste management hierarchy. The hierarchy acknowledges that no single approach will solve all the problems presented by the range of wastes.

The waste management plan considers waste from its point of generation through a variety of reduction, treatment and recovery options to its ultimate disposal. This can be viewed appropriately as a hierarchy of alternatives as shown in Figure 4.

There are basically three general options:

- In-plant options should be used to prevent or reduce the generation of wastes.
- Wastes that are generated should be converted to less hazardous forms or useable products.
- The remaining residues and wastes should be stored, treated and disposed of in a manner that minimises risks to both the environment and the community.

The prevention and reduction of waste is emphasised rather than treatment and storage. The goal is the reduction of risk to the environment and community. The hierarchy must be viewed as an order of priorities with prevention given the greatest emphasis – it is not a bottom-up approach.

It is within this framework that the guide has been prepared.

Waste Minimisation

The minimisation of waste at the source of generation is well recognised as the most desirable waste management option. To maximise efficiencies and avoid future environmental degradation, a fundamental change is necessary from pollution treatment and control, to anticipation and prevention.

While the treatment of a waste stream can reduce the disposal charges involved, reduction of the waste at source will eliminate the raw material losses and all other costs associated...
with the waste. Raw material and labour costs will generally far exceed the more obvious cost of waste disposal.

Source reduction of waste can involve changes to the raw material input, the production process and/or the final product. It can often be achieved through simple procedural changes or may involve, and often justify, significant capital expenditure.

**Raw Material Changes**

The use of less hazardous raw materials can result in a less hazardous waste stream, or facilitate greater recycling or treatment of waste.

Raw material substitution has been widely adopted in recent years in the coatings and printing industries. The widespread change from solvent-based products to water-based, has reduced the generation of hazardous waste and made in-house treatment of waste easier. Reduced emissions of volatile organic compounds have also improved health and safety standards. Similarly, the use of lead-based pigments in paint has been phased out with the use of less hazardous alternatives.

With waste disposal charges being increasingly related to priority pollutants which present difficulty in treatment or disposal, substitution of raw materials will become increasingly desirable. Chlorinated degreasing solvents and phenolic paint strippers, for example, will increasingly be substituted by less hazardous alternatives as disposal charges and acceptance standards become prohibitive.

Companies generating hazardous waste will need to critically examine all inputs to the production process and, through research and development activities, appraise all possible alternatives.

It is through raw material substitution that changes to the waste stream are most readily effected and therefore production efficiencies most readily achieved.

**Production Changes**

Changes to production may involve either simple changes to operational procedures and work practices, or the employment of alternative or additional equipment.

**Procedural Changes**

Significant waste reduction can often be achieved by changes to work practices or procedures. A detailed examination of these aspects should be made to determine where improvements are possible.

Large volumes of washwater are commonly generated, for example, from the cleaning of small spills with high pressure hoses, where a small brush or absorbent cloth would be adequate. Inefficient work practices are identified, staff will require re-training. Some form of recognition or reward for improved process operations will give greater success. Similarly, improved plant maintenance can increase process efficiency by reducing leaks or spills from hoses, valves, pumps, etc., and reducing material losses upon plant start-up or shutdown.

**Equipment Upgrading**

With the increasing cost of waste generation and disposal, upgrading to new, more efficient production equipment can often be justified by a short pay-back period. If a particular equipment change is not justified at a given point in time, it is important to recognise that the Waste Management Plan is a continual review process. At some future time the upgrading, or an aspect of it, may be feasible.
Many good industry examples exist of changed process operations, resulting directly in decreased waste generation and financial benefit. Often changes are implemented primarily to improve production. The computerisation of production equipment may be introduced for raw material and labour efficiencies, but can result in significant waste reduction. The reverse may also be true. The development of powder coating and electrostatic painting technologies greatly reduced the generation of hazardous waste. It also provided technical and economic benefits for the wide range of applications in which it is used.

**Product Changes** Major product changes most frequently occur as a result of major changes in community concern, government regulation or consumer demand. With the banning or phasing out of products such as DDT, leaded petrol and more recently CFCs, alternatives have been readily developed and accepted without significant evidence of the severe economic dislocation predicted by some groups. For some products, current disposal options may not be available in the future.

The manufacturer of a raw material may change the product formulation in response to a customer’s changing requirements. For example, during the manufacture of contact moulded products such as bath tubs and boat hulls from polyester resins, toxic styrene monomer is released into the air. A styrene suppressed resin has been developed and is now used by many manufacturers. The development of the product was in response to the end users’ pollution problem and proved a significant advantage over competitors (Campbell, 1982). Innovative research and development into alternative production technologies and products, will undoubtedly continue to see some companies gaining a competitive advantage over others and in the long term see improved technologies widely introduced.

**Recycling or Re-use**

Recycling may be done either on-site or off-site, with advantages and disadvantages for both. Factors affecting the decision will include the costs, quality of the waste and recycled material, and the final use for the material.

**On-Site Recycling**

On-site, recycling may be direct or indirect. Direct recycling involves the return of the material to the process that generated it; for instance, scrap metal may be put back into the furnace and re-melted. Indirect recycling is returning the product to another process within the same site, where input quality is of lesser consideration, such as using coloured plastic scrap to produce a dark coloured product.

By recycling on-site the generator is able to have greater control over the characteristics of the material. The potential is greatest if the materials are segregated early within the process as there are less contaminants to remove before re-use.

The use of washwaters in countercurrent flow or re-use of the water has also
resulted in major reductions in wastewater for many industries and should be investigated wherever technically feasible. In some cases it may involve treatment of the wastewater prior to re-use.

**Off-Site Recycling**

A recovered waste stream may be sent off-site for recycling and either returned to the generator or sold to someone else for re-use. For example, used oil may be sent to an oil refiner where it may be refined for use as a boiler fuel.

Off-site recycling has several advantages. It avoids the installation of equipment to treat the material, thus minimising capital expenditure and operating costs. There may also be savings on disposal costs. A disadvantage is the additional costs and risks of handling, transport and re-processing.

Often there are limitations on the characteristics of the waste, for example, water content. The user of the recycled material will have certain specifications that need to be met. The recycler must be reliable and able to supply material that meets these specifications.

**Industrial Waste Exchange**

Industrial waste exchanges are a means of putting companies in contact with each other, where the waste produced by one may be useful to another. They generally include a description of the material, the quantity requested or available and how frequently it is generated.

Waste exchanges are aimed at keeping potentially useful industrial by-products out of the waste stream. In doing so they can help industry find raw materials at significantly reduced costs. At the same time disposal costs are minimised.

The Waste Management Authority operates an *Industrial Waste Exchange* in Sydney (Phone (02) 412 1388). Information on waste exchanges in other States may be obtained from the relevant environmental agencies.

**Waste Treatment**

Consideration for waste treatment should only occur when source reduction, recycling and re-use options have been fully considered and evaluated on a cost-benefit basis. However, a commitment to waste prevention does not assume that all waste streams will be eliminated and treatment options may need to be investigated.

The principal aims of waste treatment include a reduction of toxicity, mobility in the environment and/or volume. Where technically feasible, treatment can involve the recovery of material able to be re-used or recycled. For example, conventional waste treatment in the plating industry involves the production of large volumes of metal hydroxide sludge with no recovery of raw material. Metal recovery technology, now firmly established in some companies, can recover up to 99% of metal and reduce sludge generation to zero. The recovered metal is of sufficient purity to be re-used as raw material and substantial economic and environmental benefits are achieved (Campbell, 1982).

**Off-site versus On-site**

On-site or in-house treatment of waste minimises the potential hazards and associated liabilities of off-site handling and transport. In the assessment of alternative treatment options, such potential liabilities must be carefully considered.
Segregation of Waste Streams

It has often been considered cost-effective to combine all waste streams to one point for collection or disposal. While this may be beneficial in some instances, to adjust pH levels for example, it may also result in a hazardous waste stream mixing with non-hazardous wastes and rendering the total hazardous. For example at regional landfill depots in the Sydney region, fine dusty wastes such as sawdust or activated carbon require additional care in handling during disposal. They are therefore charged at a higher rate. The mixing of such waste with non-hazardous trade or domestic wastes requires the combined load to be treated as hazardous and therefore charged at the higher rate.

Simple segregation of waste streams not only has the potential to reduce hazardous waste volume, but may often facilitate treatment, either in-house or off-site. It may also allow the recovery of an uncontaminated raw material where technically feasible.

Hazard and Volume Reduction

Where treatment achieves a reduction of toxicity or pollutant mobility, a greater range of disposal options may be available. The relative costs of these alternatives may provide an incentive for companies to render waste non-hazardous.

Many inorganic sludges are currently being disposed of in a secure landfill at a higher cost as they do not meet the required leaching criteria. Further treatment of these wastes to immobilise the pollutant load would allow disposal to a non-hazardous facility at a considerably lower price. Similarly, many organic sludges are currently disposed of in secure landfill because of their high liquid content and odour.

Dewatering and minimal chemical treatment would allow disposal of these wastes into ordinary landfills.

While technically feasible solutions exist, industry will be increasingly required to treat waste prior to disposal to reduce the demand on hazardous waste disposal facilities.

Incineration achieves a reduction of volume, toxicity and pollutant mobility and for a number of wastes is currently recognised as the best available treatment technology. With an incinerator having recently commenced operation in Sydney for the destruction of hospital wastes, landfill disposal of such waste is now being phased out.

While all technically feasible treatment options should be considered during the evaluation of alternatives, it should again be stressed that the real, long-term benefit to industry and society is in the reduction of waste at source.

Disposal

Disposal is the last alternative in the waste management hierarchy. As legal requirements for proper waste disposal become tighter it is becoming increasingly difficult to dispose of many wastes without treatment. Tradeable licences and quotas have been proposed as possible future options.

Approvals

For disposal of liquid and sludge wastes approval must be obtained from the relevant authorities. In Sydney the Waste Management Authority issues all hazardous wastes with approval numbers to enable tracking from the gener-
Storage

Storage is not a desirable long-term option for waste materials. If waste is to be stored then it must be managed in a manner that minimizes the hazards created for the workforce, the environment and the general public. Dangerous goods should be stored in accordance with the Dangerous Goods Act in bunded areas and in well maintained and labelled containers.

At present long-term storage is used for intractable wastes, for example, PCBs and HCB, for which there is no acceptable method of disposal within Australia. Intractable wastes must be stored in an approved storage facility, which is isolated, bunded, out of the weather and regularly monitored. Records must be kept of what is in the store as well as what enters or leaves the store. The Waste Management Authority and State Pollution Control Commission must be notified if any intractable wastes are to be transported.

Acceptance Standards / Conditions

Acceptance of waste for disposal is dependent upon the characteristics of the waste. These standards are determined partly by the chemical and physical nature of the substance and by the disposal method to be used. For example, metal hydroxide slurges must meet the leach test criteria set down in the SPCC document “Guidelines for Landfill Disposal of Industrial Wastes in NSW, Environmental Guide WD-3”. Other acceptance standards will be based on odour, amount of liquid and the reactivity of the material. All waste discharged to sewer must meet the Water Board standards under its trade waste policy.

Transport

All wastes transported into, out of or within the Sydney Region must be transported by contractors licensed by the Waste Management Authority. Vehicles carrying bulk liquids must also comply with the NSW Dangerous Goods Regulations, 1978. It is the generator’s responsibility that the bona fides of a transporter are correct for the type of waste generated. Vehicles are likely to be refused use of an Authority facility if they do not comply with the licensing conditions.

Final Disposal

There will always be a need for landfill as most treatment methods generate a residue of some kind. Within the Sydney Region, wastes can be landfilled at regional depots and at a secure landfill, depending on the type of waste. Outside this region advice may be obtained from the State Pollution Control Commission. Generators have absolute responsibility for ensuring that all wastes are disposed of in an approved manner.
Feasibility Assessment

CHAPTER 6

The options of source reduction, recycling, treatment or disposal identified in the preceding sections must be evaluated on the basis of both their technical and economic feasibility given program goals and constraints.

Technical Evaluation

The technical criteria used should firstly consider the waste reduction effectiveness, i.e. does it reduce toxicity and quantity? In addition, reliability, effect on product quality and plant operations, should be factored into the evaluation process.

The techniques or technology under review must at least meet current regulatory requirements. Environmental standards are likely to become increasingly stringent with time and therefore, when selecting new processes, consideration should be given to likely new standards.

Other evaluation criteria include:

• reduction in occupational health and safety hazards
• reduction in inputs such as energy, water and raw materials
• waste minimisation rates achieved, i.e. kg/unit of product or total waste reduction
• wastes recovered for recycling
• other environmental problems that may arise from the proposed options
• reduction in liability – source reduction highest, disposal the lowest.

Other benefits can also accrue. Innovative technology developed to solve a particular problem may lead to a diversification in the product line of a business and, as a result, increased profit.

Economic Evaluation

Standard discounted cash flow techniques can be used, such as Net Present Value or Internal Rate of Return, to determine the cost-effectiveness of a proposal. The pay-back period for each of the options will need to be stated.

The overall costs and benefits should include:

• liability and insurance costs
• capital costs
• operating costs
• savings in inputs
• savings in treatment/disposal costs

There are also a number of economic benefits which, although difficult to equate in dollar terms, must be included in the economic analysis. Too frequently, however, companies assess only short-term accounting costs without consideration for these benefits which include:

• reduced risks, e.g. reduction in workers compensation claims, insurance costs
• compliance with environmental regulations avoids plant shutdown or criminal penalties for a company if violations occur
• waste reduction reduces the need for staff to be deployed on environmental problems
• resources can be re-directed into production
» improved community relations
» delays in the siting of new facilities can be avoided
» waste prevention avoids the need for costly development applications and procedures which are required for on-site treatment or significant plant modifications.

Other Considerations
Once the costs and savings for each of the options have been identified, a comparison can be undertaken either in-house or externally. This can be based on either costs alone, or cost per unit of waste or waste constituent(s) reduced. This is shown in Figure 5 - where the on-site options are compared to the costs of treatment or disposal off-site. In the situation illustrated, options A,B,C,F would be selected over options D,E,G,H. Note that some options are actually profitable (Overcash, 1988).

The options selected can then be broken into three broad groups, according to their likely time frame for implementation, namely:

» Low cost options – waste segregation, stock control procedures, raw material control, housekeeping methods, simple equipment or process changes.
» Intermediate cost options – raw material substitution requiring either product or market testing or both.
» High cost options – those requiring capital outlays for new equipment or replacement of plant.

Low cost options can be implemented as soon as cost savings have been identified. However, higher cost options such as the need for new equipment or the replacement of old plant will entail a longer time frame. Feasibility will depend on the availability of capital within the overall business plan, pay-back periods and the age and economic life of current plant.

Depending on the size and complexity of a site, there may only be one or two technically and economically feasible alternatives. In other situations, a number of options may be used together to effectively reduce the waste stream.

Once options are selected, the waste management team must consult with staff in the affected areas regarding the proposed changes. Without their support and commitment, successful implementation of the program is unlikely to proceed smoothly or even reach the implementation stage.

Figure 5: Economic Assessment Of Alternatives

![Economic Assessment Of Alternatives Graph](image-url)
Waste Specific Plans
Once the proposed options are selected an implementation plan can be developed for each of the waste streams. Information should include:

- management requirements - organisational structure and lines of responsibility
- implementation schedule
- equipment needs - add on or future replacement of plant
- capital and operating cost estimates
- staff training
- frequency of review
- monitoring of performance.

Waste Specific Accounting
It is important that waste management costs are separately accounted for and are costed back to each production area. Regularly reporting back to the production area will create an awareness of the quantity and cost of waste treatment and disposal.

This will involve some type of tracking and recording system for each waste stream. Information should include a description of the waste type, quantity and generation source. Storage, transport, treatment and disposal information should also be maintained.

Co-ordination of Further Investigations
Given changes in production, development of new techniques or technologies and rising disposal costs, a regular review of the Waste Management Plan is required. Monitoring the performance of introduced waste management methods will also identify any weaknesses in the Plan and provide guidance for any future improvement. The dynamic nature of the Plan will allow firms to be pro-active in meeting their environmental responsibilities.

Education and Training
All staff need to be aware of good housekeeping practices such as waste segregation or rinsing practices. Methods selected must be easy to follow, such as proper labelling of drums or storage bins for recyclable materials.

Clear guidelines need to be circulated on the procedures to be followed for incident reporting (spills), storage, handling and disposal for each waste stream. The need for off-site treatment or disposal documentation to be completed accurately must be stressed.
CHAPTER 6

Conclusion

THE Waste Management Plan provides a structural outline for improved waste management at the corporate level. Beyond the obvious economic and environmental benefits identified in this guide, other important factors include improved community relations and a reduction in liability and risk. To provide maximum benefits to business and the community, prevention and source reduction must be given the highest consideration.

If all that is achieved in the coming years is a shift in focus from disposal to treatment and disposal, the public perception will be that industry has failed in its environmental and social responsibilities.

It is therefore critical that industry demonstrates its ability to effectively manage its waste by undertaking and implementing a Waste Management Plan that minimises waste generation and ensures long-term protection of the environment.