GUIDELINES ON CONSTRUCTION WASTE MANAGEMENT

All enquiries regarding this document should be forwarded to:

Chief Executive
Construction Industry Development Board Malaysia
7th Floor, Grand Seasons Avenue
72, Jalan Pahang
53000 Kuala Lumpur
Malaysia

Tel : 603-2617 0200
Fax : 603-4045 1808
Website: www.cidb.gov.my

CONTENTS

FOREWORD

As we move towards becoming an industrialised nation, Malaysians are beginning to realise that environment and development are the opposite sides of the same coin. Renewable resources are fast becoming depleted or rendered economically useless due to the unsustainable manner in which they have been exploited. The construction industry is one of the major sectors that has played and will keep on playing a very important role in driving Malaysia towards the achievement of *Vision 2020*. However, environmental degradation resulting from construction activities has been widely reported by the media. There is no denying that general practices in the construction industry pay very little attention to principles of sustainable development. To avoid irreversible damage to the environment, the Construction Industry Development Malaysia (CIDB) emphasises this issue in the Malaysia Construction Industry Master Plan (CIMP) 2006-2015. The plan identifies seven Strategic Thrusts to be included for the duration of this 10-years Master Plan. Strategic Thrust No.3 exhorts us to strive for the highest standard of quality, occupational safety and health, and environmental practices.

With respect to environmental degradation resulting from construction activities, one of the major concerns is the production of construction and demolition (C&D) wastes. Though there is no reliable record of the actual amount of C&D wastes generated and disposed off in Malaysia, estimates from researches, practitioners and regulators have led us to believe that the C&D wastes constitute more than 30 % of the total wastes generated in the country. This large amount of C&D wastes clearly indicates that the construction industry is not efficient and does not utilize resources in a sustainable manner. There is a need to review current practice in the construction industry in order to improve procedures, so that better and more efficient design, construction, operation and maintenance can be affected, thus resulting in less waste. This guideline has been prepared to assist stakeholders in the construction industry to understand the concepts of integrated waste management and waste minimisation; to assist stakeholders in identifying measures that can be adopted in their projects towards minimising waste and moving towards sustainable construction practices. The roles of major players namely, the Client, the Consultants and the Contractors in implementing waste minimisation in construction projects are outlined, and the importance of sharing a common view towards sustainability is highlighted. Various regulatory instruments related to the construction industry and waste disposal are also included. Finally, some descriptions of good practices found in Malaysia are documented in the guideline for the stakeholders' reference.

I sincerely believe that this guideline will be immense value to various stakeholders in the Malaysian construction industry, in our efforts to achieve a sustainable environment. I wish to extend my heartfelt gratitude to all members of the technical committee for their guidance and to the Working Group 6 (WG6) for their contributions.

Datuk Ir. Hamzah Hasan
Chief Executive
Construction Industry Development Board (CIDB) Malaysia

GUIDELINES ON CONSTRUCTION WASTE MANAGEMENT

SECTION 1: INTRODUCTION

1.0 Construction Waste

For the purposes of this guide, "Construction Waste" is defined as materials that are unwanted or being generated during construction or demolition activities, including improvement, preparatory, repair or alteration works. Many factors contribute to the generation of construction waste at a site. Waste may have one cause or a combination of causes. Gavilian and Bernold (1994) organised the causes of construction waste into six categories:

1. Design - e.g. Improper initial design can lead to wastage;

2. Procurement - e.g. Over-ordering of materials;

3. Handling of materials - e.g. Material damage on site, resulting from mishandling and/or careless delivery;

4. Operation - e.g. Lack of recording of material supplied and used on site;

5. Residual - e.g. Excess materials left on site after completion of job; and

6. Others - e.g. Vandalism.

Construction, demolition and land-clearing activities all produce construction waste, which may include, but not be limited to the following:

Acoustic ceiling tiles	Drywall	Wood
Asphalt	Fluorescent lights	Plastic from packaging
Asphalt shingles	Insulation	Window glass
Bricks	Cardboard	Land-clearing debris
Carpet and pad	Metals	Paint
Concrete	Dirt	Plaster
Glass containers	Stones	Steel
Earthworks		

Component	Road Work Materials	Excavated Soil	Demolition Waste	Site Clearance	Renovation Waste
Soil/ sand	23.0	73.8	21.5	33.0	19.4
Concrete/ Mortar	16.9	1.2	10.8	4.6	7.4
Rock/ Rubble	14.4	12.5	27.7	15	38.8
Reinforced Concrete	14.2	0.4	5.8	0.9	7.0
Bricks/ tiles	0.8	0.4	12.1	1.4	9.6
Slurry and mud	1.8	9.7	1.5	1.0	3.1
Asphalt	24.7	0	0	0.2	0
Cement Contaminated	1.7	0.4	3.2	15.6	3.3
Wood	0.6	0.9	10.5	13.3	7.1
Ferrous metals	0.5	0	0.6	1	1.3
Non-ferrous metals	0	0	0.7	0.2	0.1
Others (glass etc)	1.4	0.7	5.6	13.8	2.9
Total	100.0	100.0	100.0	100.0	100.0
% of total quantity of C & D waste landfilled	5.2	59.4	8.5	14.6	12.3

Table 1. Composition of construction and demolition waste disposed of at landfills in 1995 (Source EPD 1995)

1.1 Management of waste in construction

Management of construction waste entails reducing waste generation during the design and construction phases of a project.

Waste management, especially with respect to waste minimisation, can contribute towards significant efficiency and environmental savings. Savings in purchasing cost are another benefit derived from proper waste management, gained through reusing and recycling of construction waste. When proper waste management methodology is implemented, there are savings in transport costs and landfill charges, as well as revenue from the sale of recyclable construction waste. Other benefits encompass reduced legal liability due to environmental law issues and improved workplace safety. Furthermore, by practicing good waste management, there may be environmental benefits such as fewer chances of soil and ground water contamination.

1.2 Malaysian perspective

The breakdown of waste generation according to a study by Mohd Nasir in 1998 showed that on average, industrial and construction waste account for 28 % of total waste generation. Normally construction waste in Malaysia is finally disposed of in landfills.

1.3 Objectives of this guideline

In line with the Construction Industry Master Plan (CIMP) Strategic Thrust No. 3, which is to "Strive for the highest standard of quality, occupational safety and health and environmental

practices” the objectives, have been devised to mirror CIMP’s initiatives.

The main objective for developing this guideline for waste management is:

a) to establish proper construction waste management practice in Malaysia;

b) to identify roles and responsibilities of construction industry players;

c) to provide guidance on waste management plans; and

d) to list legislative requirements associated with waste management.

SECTION 2: ROLES AND RESPONSIBILITIES OF CONSTRUCTION INDUSTRY PLAYERS

2.0 Clients, Consultants and Contractors

The three main players in the construction industry supply chain are the “Client”, “Consultant” and the “Contractor”. Each of them plays an important role and has responsibilities in the management of waste in the construction industry.

2.1 Client

Clients, being the initiator of projects, should be pro-active and must give clear instructions that waste associated with their projects should be minimised and wherever possible such wastes are to be recycled on site or off site.

Waste management and minimisation will result in cost savings, construction of better quality, reduced duration of the projects and greater site safety. Waste management and minimisation must be planned meticulously from the inception stage. Such planning needs support and commitment from clients; their Environmental Policy should reflect the waste management initiatives. Details of construction waste management must be clearly included in the project brief given to consultants.

2.1.1 Design Stage

Clients should establish requirements for waste reduction and make it clear to consultants that they expect green designs. These intentions should be spelled out to the consultants in the project brief. Consultants should be selected from those who have sound environmental policies and/ or in-house best-practice documents.

Meetings with consultants during the pre-tender stage should focus on the specifications that ensure waste minimisation at construction sites.

2.1.2 Tender Stage

During the tender stage, clients, in collaboration with consultants, should hold technical briefing sessions where waste minimisation concepts and objectives are declared and clarified to the tenderers. Expectations of compliance need to be made clear to all parties.

Clients should ensure that tender documents address the need for waste minimisation. Technical specifications regarding materials to be used, technology to be adopted and methods of waste removal from sites must be clearly stated. Stipulations for manufacturers and material suppliers to remove packaging from sites should also be included. An example on technical aspects of construction waste specification can be found at Resource Venture’s Website. See note for details of the website.

Note: There is a standard template of technical specifications for construction waste management in Microsoft Word document format which can be downloaded (www.resourceventure.org). The document can be modified to suit individual projects.

2.1.3 Construction Stage

When the project is underway, clients in collaboration with consultants should establish a clear set of performance indicators to be used in monitoring and evaluating the effectiveness of the measures implemented to minimise construction waste. A system of rewards and/ or

penalties can be introduced to encourage contractors to meet the waste minimisation objectives set for the project. Clients should be represented by senior management personnel during site meetings. A walkabout session a few days before the site meeting will lead to more focused criticism that will help contractors to improve their performance.

Most importantly, clients should have no reservations in accepting the "apparent initial costs" associated with the provision of additional infrastructure on site. These apparent costs will eventually be paid off by the benefits gained through the minimisation of wastes-producing activities on site.

Clients' Roles and Tasks:

- Proactive
- Planning
- Establish EH & S requirements
- Set project brief
- Set criteria for selecting Consultants
- Monitoring, assessment and evaluation
- Rewards and Penalties

2.2 **Consultants** (Architects/Engineers)

A client's good intentions to reduce construction waste from sites will not materialise unless consultants provide professional services that will ensure the client's intentions are realised.

2.2.1 Design Stage

Architects and engineers must focus on green design concepts and identify opportunities for waste reduction. Consultants should consider a policy of standardised design as this helps to reduce waste. Specifying components in sizes that can be used without wastage produced by cutting will substantially reduce wastage and save costs. Standardisation will enable components to be pre-fabricated and later transported to sites for assembly.

The choice of materials should favour those that will cause less damage to the environment and results in longer service life of the project. Choosing more durable materials will result in lower maintenance costs, thus realising monetary benefits for Clients in the long run.

Consultants should also adopt a flexible type of design where the function of the facilities can be easily changed with minor renovations, thus preventing facilities from being demolished prematurely. Designs should also consider the most effective way of decommissioning facilities, should the need arise. Decommissioning procedures should facilitate removal of toxic and non-toxic components in such a way that non-toxic components can be easily separated and recycled.

For better quality control and less wastage, consultants may recommend a modular approach to construction, where components can be pre-fabricated and assembled on site.

Consultants should also consider using construction waste management specifications to ensure that efforts to reduce waste are successful.

2.2.2 Pre-Construction Stage

Consultants are to work closely with clients in guiding/coercing contractors into adopting practices that will contribute towards not only towards successful completion of the projects, but also towards minimising of wastes from construction activities. Consultants may need to mentor contractors and may also need to provide contractors with a directory of potential customers for recyclable waste.

Consultants should be opened to comments and ideas from contractors and sub- contractors on improvements in construction methods that will lead to further waste minimisation. It would

be to everybody's advantage that policies or work procedures to be used on sites are jointly drawn up and mutually agreed upon by Clients, Consultants and Contractors.

2.2.3 Construction Stage

Policies on waste management on site, including the monitoring and record keeping of wastes leaving the site, must be formulated and reviewed periodically in light of developments during construction.

Designated locations where wastes are sorted and dumped in separate compartments make recycling feasible, since less effort is required to separate wastes. Policies on packaging material can drastically reduced the amount of waste generated on site; for example, material suppliers can be required to remove such packaging for final disposal or for recycling.

Consultants need to consider:

- Green Design Concepts
- Standardisation
- Flexible and Adaptable Design
- Materials Specifications
- Design for decommissioning and/ or recycling
- Modularisation and Prefabrication
- Construction Waste Management Specifications

2.3 Contractors/ Sub-Contractors

The construction industry in Malaysia has been relying heavily on traditional construction methods. Such labour-intensive procedures inevitably caused inconsistencies in the quality of works produced. To contractors, time and money are the main factors in determining the construction method. Low priority is given to the organised disposal of construction waste, since dumping of such waste is relatively inexpensive.

2.3.1 Pre-Construction Stage

Contractors must study the tender documents carefully and formulate a waste management plan to identify potential waste. Contractors should seek clarifications from Clients and Consultants on matters related to the projects so that any additional costs caused by requirements for waste minimisation can be included in the overall cost.

Desk study to identify inert waste disposal sites/ landfill and lists of waste recyclers should be conducted to effectively manage and dispose of or cash in on site wastes. Ministry of Housing and Local Government has published a list of recyclers. A list of inert landfills can be obtained from the respective Local Authorities.

Contractor should also appoint an officer to be responsible for waste minimisation and management on site. Proper site planning together with a practical site layout is needed to ensure that construction activities and waste minimisation requirements are not in conflict. A location for on-site waste storage is needed, preferably with separate compartments for different types of materials that have sufficient volume and value for recycling. Figure 1 illustrates a well-planned construction site where the waste storage area allows for separation of waste before removal from the site.

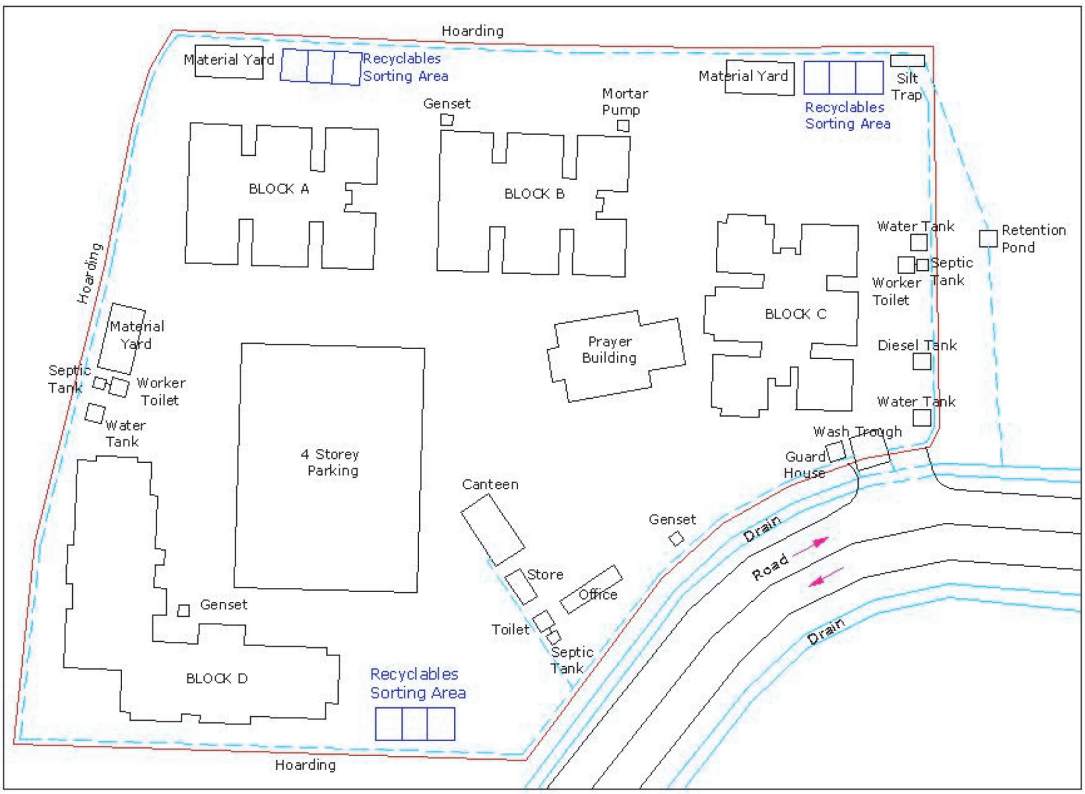


Figure 1. An example of a well-planned site layout

2.3.2 Construction Stage

Contractors should be encouraged to develop/ propose new construction methods in order to reduce the production of waste.

There should be regular meetings and reports regarding waste management and waste minimisation. These should be held weekly or monthly depending on whether they involve only the contractor, or the contractor and the consultant, or all parties involved in the project.

Training for workers and site supervisors should be systematically scheduled. Incentives or awards should be given to employees or sub-contractors who best achieve specified waste minimisation objectives. Concomitantly, if employees or sub-contractors fail to comply with waste minimisation policies, a penalty should be imposed.

2.4 Concluding remarks

Waste management has become a vital element in the construction industry in Malaysia. Clients, Consultants and Contractors play a very important role in ensuring sustainable development. Figure 2 summarises the roles of these key players in the waste management hierarchy through out the different phases of construction.

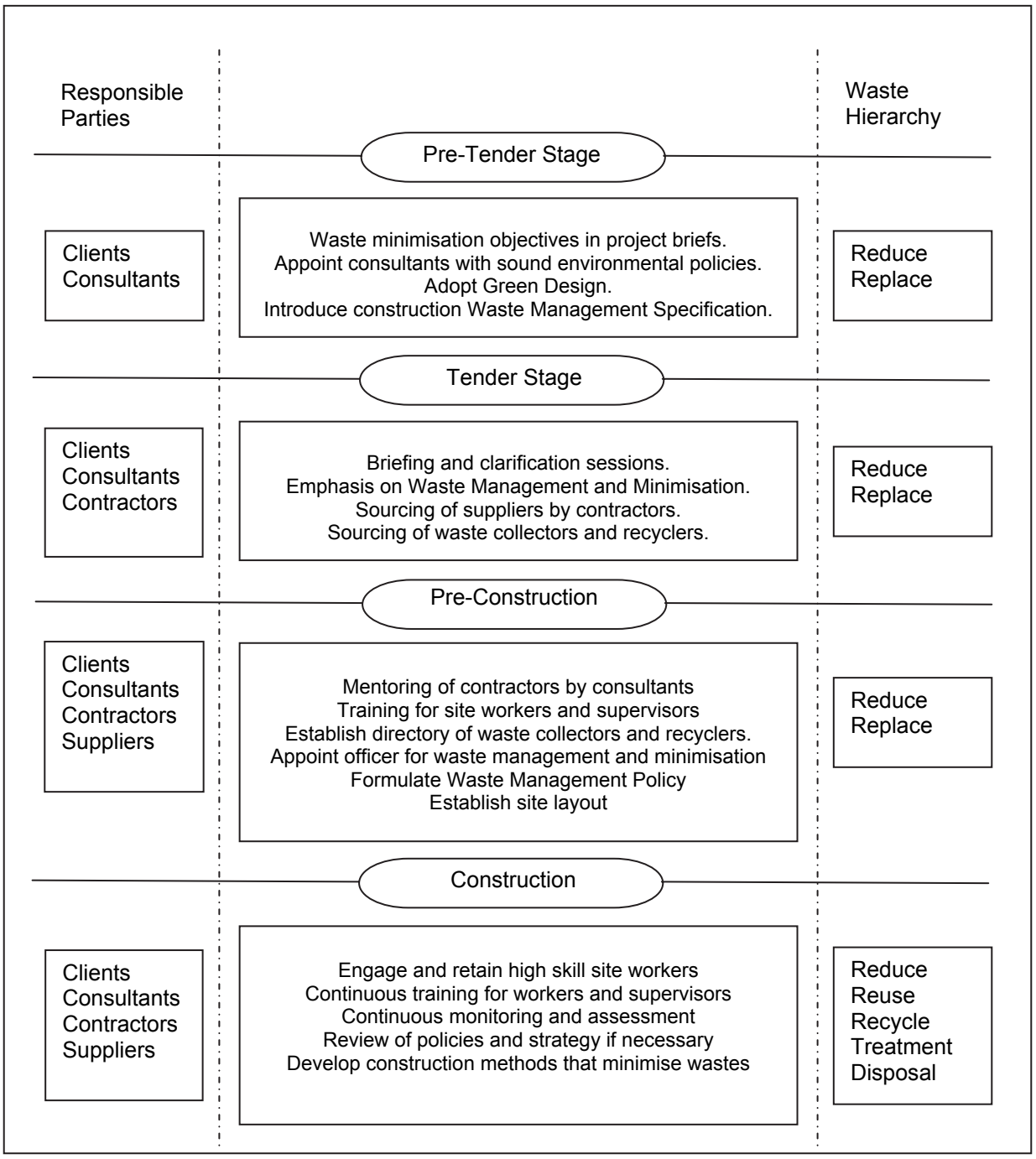


Figure 2. Roles of Client, Consultant and Contractor during different stage of construction.

SECTION 3: WASTE MANAGEMENT PLAN (WMP)

3.0 Introduction

The requirement for a WMP should be incorporated in the tender document and the WMP must be developed at a very early stage of a project i.e. before commencement of work. The WMP shall provide an overall framework for waste management and reduction. The WMP should:

1) Prepare Organization Chart which shows responsibilities for waste management.

2) Estimate the quantities and types of wastes generated.

3) Identify the waste destinations and transport modes.

4) Set a target and find ways to track resources.

5) Produce a layout showing the location of designated sorting and storage areas for new/ used materials.

6) Ensure that everyone on site is familiar with the objectives of the plan.

7) Carry out meetings, monitoring and auditing programmes.

From this WMP, specifications can be developed for the bid/ contractor document, outlining procedures for reduction, re-use and recycling. A comprehensive WMP must incorporate both concept and strategies and should be able to meet the objectives as stated below. Sample of WMP is shown in Annex 3.1.

3.1 Concept and Strategy

a) Priorities based on internationally accepted Solid Waste Management Hierarchy.

b) Cradle to Grave Concept.

c) Environmentally Friendly System.

d) To identify local waste contractors/recyclers in order to determine the types of waste that can be recycled and have market value.

3.2 Objectives

a) To minimise waste generation at construction sites, where possible.

b) To maximise recovery of recyclable materials from construction sites through segregation at site.

c) To minimise waste disposal and reduce disposal cost by disposing of only non-recyclable items at landfills.

d) To prevent illegal dumping activities.

e) To promote and create markets for recyclable construction materials.

3.3 Waste Management Hierarchy

The *Solid Waste Management Hierarchy* concept, as illustrated in Figure 3 is internationally accepted and places emphasis, in order of priority on waste prevention, reduction, reuse, recycling, waste treatment and disposal. The SWM Hierarchy places 'Waste Minimisation' and the 3R; 'Reduce', 'Reuse', 'Recycle', as the highest priority, followed with, 'Treatment' (including Composting and Thermal Treatment) and the least priority is given to 'Disposal' that includes land filling.

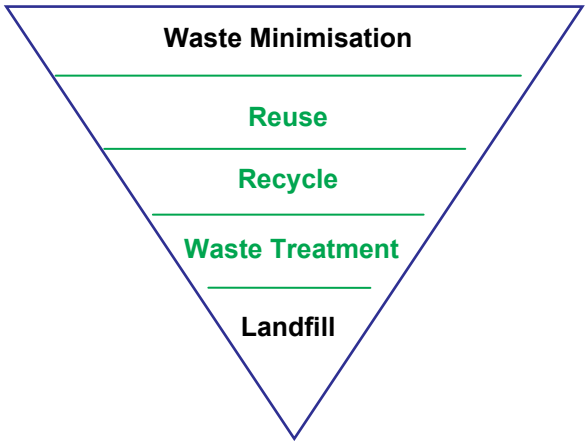


Figure 3. A Hierarchy of Waste Management

Though the concept of Waste Hierarchy is well accepted, recent thinking and understanding on Integrated Waste Management recommend that the Waste Hierarchy should not be used as a rigid guideline (DOE, 1995; UNEP, 1996; Brisson, 1997). The Waste Hierarchy on its own does not address the use of a combination of waste minimisation approaches, nor costs neither analysis of economic affordability nor the high variability of options due to various local conditions and the availability of treatment and disposal facilities.

In place of a hierarchy of preferred waste management options, as shown in Figure 3, there should be an integrated approach, which recognises that all options have a role in waste management towards a sustainable environment. The integrated approach shown in Figure 4, illustrates the inter-relationships of the various elements of the system. Each option needs to be assessed with the objective of optimising the effectiveness of the whole system, rather than its parts, to make it environmentally and economically sustainable and socially acceptable. Further information on the concept of integrated waste management can be found in Mc Dougall et al. (1999)

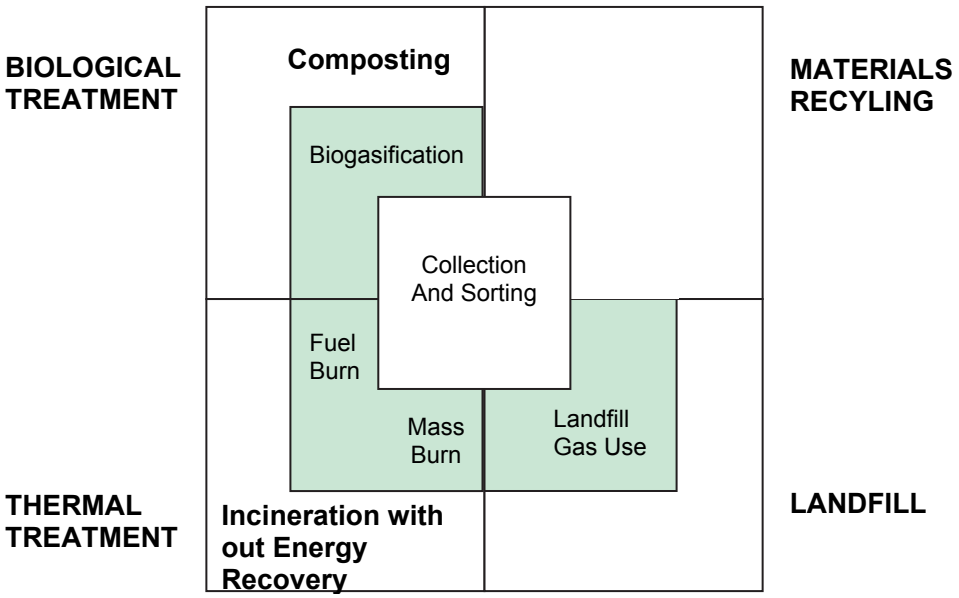


Figure 4. The elements of integrated Waste Management (Mc Dougall et al., 1999)

3.3.1 Waste Minimisation/ Reduction

Waste minimisation in construction makes good business sense and has additional environmental benefits. Waste reduction activities will reduce material expense and cut disposal costs. Environmental benefits of minimising construction waste include:

a) Less dependence on natural resources, such as trees, oil and minerals.

b) Less pollution from manufacturing and transportation related emissions.

c) Lower energy and water consumption.

d) Lower greenhouse gas emissions.

Waste Minimisation Activities

It is recommended that a holistic approach to waste minimisation/ reduction is adopted. There are three key project stages where waste minimisation activities should be introduced.

Stage 1: Contractual

Stage 2: Design Stage

Stage 3: Site Operation Stage

Tips that can help architects, contractors and developers to reduce resource waste and costs are:

1. Before designing.

a) Study the site - Understand the features and limitations of building site, record the microclimate, wind directions, sun angles, slopes, vegetation, neighbouring roads, buildings etc. Think what will change at different seasons.

b) Question the size of the building in 10, 20 or even 50 years time – Build a flexi home with durable materials so that you will not face unnecessary costs for future repairs and alteration to suit future family needs.

c) Consult the project team – Involve the entire team and discuss how to tune the design to minimise waste and evaluate whether the things you want are practical. Communication is the key to successful implementation.

d) Research – Find out about new practices and materials which may reduce wastage by talking to many people, reading books and searching the internet.

2. During the design.

a) Design buildings in harmony with their surroundings – Reduce the clearing of vegetation, earthworks, driveway length and paved surfaces. Consider using piles or poles, especially on sloping sites, to avoid excessive excavation.

b) Consider module sizes in the design – Design room-sizes to coordinate with the size of floor, roof and external cladding panels. The overall cost of a building can be reduced significantly if fewer panels need to be cut.

c) Service Efficiency – Grouping wet areas, such as kitchens, laundries and bathrooms close together will result in major savings due to reduced pipe work lengths and sharing of gully traps. Also work out efficient circuits for electrical and telephone cabling.

d) Use pre-fabricated and pre-cut components – Wall framing and roof trusses can be pre-cut, pre-nailed, and delivered as a correctly sized unit ready to be installed. Construction is faster, and no waste is generated on site. Resource use is more efficient at the factory than at a building site, where off-cuts are often dumped and burnt.

e) Less is more – Design for simplicity and user-friendliness. Find low technology and simple solutions because simple solutions are far less likely to breakdown or require maintenance. They also cost less and use fewer resources.

f) Use fewer finishes by choosing materials which do not need applied finishes, such as wood ceilings, bricks and tiles, pigmented concrete or plaster, or roofing steel with the colour baked on at the mill. Fewer materials are used, labour costs are lower and there is no maintenance later. Reducing the use of paints and varnishes, which are often quite toxic, means fewer health and environmental risks.

g) Consult and plan well – Take all the time you need to plan the project carefully. Talk the design through with your project team and ask them to find ways that use fewer materials and produce less waste. Have an intensive brainstorming session with all parties involved. Time invested in the planning stage will be paid back during the construction and lifetime of the building. Making changes during construction or after can be very costly.

h) Document your design – Keep records of all details of the design, to ease future repairs and maintenance and ensure that less waste is created trying to locate leaking pipes or faulty cables. The “house-book” should stay with the house when ownership changes.

i) Design for the future – Use durable and low maintenance materials. Design houses to make alterations and repairs easy. Choose materials and components that can be reused and install them in a way that allows disassembly use screws instead of nails.

j) Design for green living – Design homes in a way that will make ‘green’ living easy. Allow room for storage of recyclables and provide space for a compost pile.

3. Dealing with contractors

a) Finding the right people - Negotiate waste minimisation issues before contracts are signed to avoid re-negotiation which later may result in additional costs. One session to brief all interested bidders can save time and ensure that all parties have understood the issues. Contractors should submit a WMP prior to commencement of work.

b) Get advice about building maintenance from the contractors; this information should be included in the “house-book”. Their advice will help to increase the life-span of the building.

c) Cost out waste minimisation options to gain maximum benefit from your efforts. Issues concerning costs and benefits should be sorted out before contracts are signed.

4. The building site

a) Make sure the building site is kept tidy. Provide a suitable area to store material and this should be covered, if possible. Waste should be separated and recycled if it can’t be reused. Ask suppliers to take back packaging materials. A tidy site will reduce loss and damage of materials and increase safety because workers are less likely to trip over things.

b) Materials should be cut and their off-cuts stored at a central location. It is much easier to re-use off-cuts if you don’t have to hunt for them all over the site. This technique has reduced waste by 15 %.

c) Reuse temporary works such as scaffolding and formwork for concrete. This is particularly useful when building several identical houses. Select more durable materials, such as metal, to avoid waste. Reusable crates are better than plastic or cardboard wrapping.

d) Estimate materials correctly and arrange for them to arrive just in time to avoid materials being damaged during storage.

e) Contractors should segregate and sort waste materials at designated location or use a company that sorts waste after collection and sells recyclable and re-usable materials.

f) It is important that work is documented ‘as built’ in the ‘house-book’, with special markings for those details changed from the original plans. Attach photos, if possible.

g) Learn from experience – Visit the building site and conduct a waste audit. Analyse the savings obtained by reducing waste.

3.3.2 Reuse

Materials that can be reused on site include, but are not limited to, the following:

▪ Doors, patio and French door sets ▪ Electrical and HVAC supplies ▪ Faucets and plumbing fixtures ▪ Fencing ▪ Flooring – carpet and vinyl (new) ▪ Flooring – wood ▪ OSB and masonite ▪ Plywood and chipboard ▪ Shelving and racking ▪ Siding and shutters ▪ Mirrors and mirror tiles ▪ Kitchen cabinet sets ▪ Kitchen fixtures ▪ Gutters ▪ Hinges and other hardware ▪ Insulation, new or gently used ▪ Windows – wood and vinyl, especially newer energy – efficient windows ▪ Stained glass	▪ Bathtubs (mainly white or neutral colour) ▪ Sinks – kitchen/bath (no chips), utility/lab ▪ Lumber (clean, denailed, min. 4 ft. long) ▪ Glass, sheet and plexiglass (min. 4 sq. ft.) ▪ Claw-foot or antique tubs ▪ Columns, pillars, and posts ▪ Concrete blocks and products ▪ Countertops, straight, neutral colours ▪ Displays and display fixtures ▪ Doors, especially solid wood door ▪ Tile (most types and quantities) ▪ Toilets (low flow, pre-40's, no cracks) ▪ Tubs (mainly white or neutral colour) ▪ Store fixtures	▪ Brick and paving stones ▪ Cabinetry – wood ▪ Corbels ▪ Trim and mouldings ▪ Tile board ▪ Wood beams ▪ Architectural features ▪ Bath vanities ▪ Banisters ▪ Bath fixtures ▪ Bookcases, files, library shelves ▪ Lighting fixtures ▪ Lockers ▪ Radiators and registers ▪ Roof tiles ▪ Sandstone ▪ Slate, granite and marble

Materials which are not acceptable for re-use are as follows:

▪ Appliances older than 5 years ▪ Ceiling fans ▪ Commercial 200 volt electric equipment ▪ Commercial bath fixtures ▪ Commercial ducting and vent covers	▪ Commercial flashing ▪ Commercial shelving missing parts ▪ Countertops – L-shaped or dated colours ▪ Doors – damaged, commercial or hollow	▪ Fireplace doors ▪ Fluorescent light fixtures, bulbs ▪ Gutters: leaking, rotted ▪ Mini-blinds ▪ Electric baseboard heaters ▪ Used carpet ▪ Windows – aluminium	▪ Open bags of cement, mortar, drywall mud ▪ Room dividers missing parts ▪ Shower doors, except high-end ▪ Sinks – wall hung, cultured marble, dated	▪ Tile with heavy grout ▪ Wood: shorter than 4', rotten/bug-damaged, contaminated or nailed ▪ Wood-burning equipment, unless antique

How to reuse?

- Insulation materials can be placed in attic space.
- Larger rigid insulation scraps can be used under concrete floors.
- Cosmetically damaged finished products can go to non-profit organisations and taken as a tax-exempt charitable donation.

3.3.3 Recycle

Recycling construction materials saves money by cutting disposal costs. It reduces waste going to the landfill, facilitates a cleaner and safer construction site. There are two methods of recycling waste:

1) Source separation: Recyclable materials are collected in separate containers as they are generated; and

2) Co-mingled recycling: Recyclable materials are collected in one container as they are generated.

The following strategies should be adopted:

1) Set a goal that establishes a minimum level of performance required.

2) Select a contractor with proven recycling experience, determine if they have track record of past performance by looking at the WMP and documentation verifying the recycling rate on past projects.

3) Use a Construction Waste Management Specification – refer Annex 3.2 (sample taken from 'Resource Venture').

4) Monitor the waste reduction program by imposing a requirement on the contractor to submit a waste management report with the application for progress payment. To include waste reduction program in the project meetings.

Some recyclable materials found at construction site and how to recycle them are described briefly below:

? What can be recycled onsite?

Most residential construction waste is recyclable including wood (solid sawn and engineered products), drywall, corrugated cardboard, metal and some plastics.

? How to recycle?

Wood – can be used for mulch in composting operations, animal bedding, and landfill cover, as an industrial fuel source.

Drywall – can be used for some type of animal bedding or applied as a soil amendment. Waste drywall can be cut and stack into uninsulated wall cavities.

Cardboard – can be sold to local recyclers

Siding – vinyl and metal siding cut-off waste can be sold to local recyclers or sent to central collection area such as a siding or building supply distributor.

3.4 Waste Minimisation Plan

Waste minimisation is about a change of attitude and common sense, rather than new technologies. Often waste minimisation options cost nothing to implement and give benefits straight away with little or no effort.

3.4.1 Identifying and Exploration of Waste Minimisation Opportunities

The process flow in identifying waste minimisation opportunities can be summarised as follows:

1) Identify waste composition on site during construction and alteration. For example see table below.

Identification of Waste	
Bricks	reusable
Concrete	recyclable
Plaster Boards	recyclable
Packaging	used for landscaping purposes
Insulation material	nil
Paint	reused
Timber	recyclable/ reusable
Pipe work	recyclable

2) Identify the end users/ recyclers for recyclable waste materials

3.4.2 Implementation of the Waste Management Plan

a) Separate recyclable materials by type from waste materials to the maximum extent possible.

b) Provide containers, clearly labelled by type for recyclable materials. The containers should not contain more than 10 % of non-recyclable material, by volume. Provide other storage methods for managing recyclable materials until they are removed from the project site if this 10 % is exceeded.

c) Separate inert from non-inert materials for reclamation and site formation use.

d) Higher grade use e.g. a road sub-base of inert waste is also feasible, provided that the relevant specifications are met.

3.4.3 Disposal Facilities/Recyclers

Contractors have to ensure that their wastes are being disposed of at sites approved by the Local Authorities. List of approved sites for disposal of construction waste shall be referred to the Local Authorities nearest to the project site.

For recyclable materials, the contractors can sell to local recyclers. For a list of recyclers, refer to web site Ministry of Housing and Local Government, www.kitarsemula.com or Direktori Kitar Semula 2006/ 2007.

3.4.4 Monitoring and Modifying the plan

Monitoring can be carried out by conducting an environmental site review at regular intervals. The plan has to be modified after changes have been proposed during the monitoring.

3.5 Overall Implementation

An organisational chart with responsibilities shall be prepared. A designated on-site waste manager (or the Safety, Health and Environment Manager or a site manager) shall be appointed. His responsibilities are as follows:

1) Overseeing the management of building wastes.

2) Managing waste reduction initiatives.

3) Coordinating the activities of other employees.

4) Carrying out various programs include staff awareness programs, training programs, safety and health activities.

3.5.1 Staff Awareness Programs

The key factor for successful implementation is the acceptance of change by the employees. Therefore it is very important to make them aware of all activities to be implemented on site so their commitment can be obtained. Awareness and communication programs shall involve staff of all levels.

3.5.2 Training Programs

It is recommended to use a training module prepared by CIDB which comprises legal aspects, impacts of construction on the environment, construction waste management and also good practices on site. The training programs shall be conducted for the entire workforce.

3.5.3 Safety and Health

All staff shall be briefed on the safety and health aspects of all construction activities, especially those activities related to waste management. Procedures on handling, segregating and transporting construction wastes shall incorporate safety and health measures.

3.5.4 Contractual Obligations

Clients, consultants and contractors can play an important role at the contractual stage of the project to minimise waste. The following points are recommended:

a) Agree upon the type of contract.

b) Identify the type of materials used.

c) Identify the team and workforce for the project.

d) Identify construction methods and techniques.

e) Identify potential source of waste.

3.6 Onsite Monitoring and Auditing

Material and waste audits should be carried out in order to identify areas that can be improved in subsequent projects. The procedure for carrying out a material and waste audit is as follows (*source: C.S. Poon, T.W.Yu and L.H. Ng, Research Centre for Urban Environmental Technology and Management, Department of Civil and Structural Engineering, The Hong Kong Polytechnic University*) :

? Record the quantities of materials employed on construction sites

? Record the storage for the materials periodically,

? Record the quantities of work done using each material periodically,

? With the data available, monitor the material wastage level periodically by comparing the quantities of materials used with the corresponding quantities of work done,

? Investigate the causes of material wastage,

? Evaluate the effectiveness of corrective measures,

? Compare with the company material wastage level standard,

? Recommend preventative measures to reduce material wastage levels,

? Recommend methods to reduce construction waste, and

? Set up a computerised data collection system for material and waste audit purposes.

3.7 Transportation and Disposal System

3.7.1 Transportation

Transportation of construction waste shall use suitable and appropriate containers and trucks as specified by the local authorities. The waste collector shall ensure there is no spillage and waste should be covered at all times during transport to the approved disposal site.

3.7.2 Disposal System

The waste shall be disposed of at approved sites. List of approved sites can be obtained from nearby Local Authorities or Ministry of Housing and local Government.

SECTION 4: LEGISLATIVE AND ADMINISTRATIVE REQUIREMENTS

4.0 Introduction

The construction industry embraces every aspect of the natural and built environment from the procurement of raw materials to the operation of buildings or structures. This wide range of activities has significant environmental implications at every stage of the construction life cycle. In order to ensure that the negative impacts on the environment arising from the development activities are mitigated, our government has introduced a number of legislative and regulatory environmental management control mechanisms, and provided legislation through government agencies such as Department of Environment, Ministry of Housing and Local Government, Local Authority and Land Office as well as legal requirements by other related agencies. Some laws are specifically targeted at protecting the environment e.g. the Environmental Quality Act 1974, whilst others incorporate environmental legislation as part of a wider range of laws involving areas such as health and safety, building control and planning. The industry in turn, is affected by increasing environmental legislation. Owing to the nature of operational activities within the construction industry, the main concerns regarding environmental legislation relate to waste management and pollution prevention.

4.1 Legal Requirements by related Agencies

4.1.1 Department of Environment (DOE)

i) Environmental Quality Act 127, 1974 and Subsidiary Legislations, (EQA)

EQA is an Act relating to the prevention, abatement and control of pollution and enhancement of the environment, and for purposes connected therewith. It was enacted in 1974 and applies to whole of Malaysia.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 22**	**Restrictions on pollution of the atmosphere** Emission or discharge of any environmentally hazardous substances, pollutants or wastes into the atmosphere.	A fine of RM100 000.00 or 5 years jail or to both. A further fine RM1 000.00 for each day the offence is continued after a notice requiring compliance has been served.
2	**Section 24**	**Restrictions on pollution of the soil** Polluting soil or land surface by: a) depositing any matter, whether liquid, solid or gaseous in or on soil, or place where it may gain excess to soil; b) establishing on land a refuse dump, garbage dump, soil/ rock disposal site, sludge deposit etc.	A fine of RM100 000.00 or 5 years jail or both A further fine RM1 000.00 for each day the offence is continued after a notice requiring compliance has been served
3	**Section 25**	**Restrictions on pollution of inland waters** Emission, discharge or deposit of wastes into inland waters: a) placing wastes in or on waters or place where they may gain access to waters; b) Placing wastes in positions where they may fall into waters.	A fine of RM100 000.00 or 5 years jail or both A further fine of RM1 000.00 for each day the offence is continued after a notice requiring compliance has been served.
4	**Section 29**	**Prohibition of discharge of wastes into Malaysian waters** Discharge of environmentally hazardous substances, pollutants or wastes into Malaysian waters	A fine of RM500 000.00 or 5 years jail or both
5	**Section 29A**	**Prohibition on open burning** No person shall allow or cause open burning on any premises	Compound of RM2 000.00 A fine of RM500 000.00 or 5 years jail or both

No.	Section	Sub Title and Description	Legal Impact
6	**Section 29B**	**Owner or occupier of premises liable for open burning** Owner or occupier of premises where open burning occurs shall be deemed to have contravened Section 29A	Compound of RM2000.00 Fine RM500 000.00 or 5 years jail or both
7	**Section 34B**	**Prohibition against placing, depositing, etc. of scheduled wastes** No person shall: a) place, deposit or dispose of, or cause or permit to place, deposit or dispose of, except at prescribed premises, any scheduled wastes on land or into Malaysian waters b) receive or send any scheduled wastes in or out of Malaysia c) transit or cause or permit the transit of scheduled wastes	A fine RM500 000.00 or 5 years jail or both

4.1.2 Department of National Solid Waste Management

i) Solid Waste and Public Cleansing Management Act 2007 (Act 672)

This Act provides for and regulates the management of controlled solid waste and public cleansing for the purpose of maintaining proper sanitation. The Act allows the Federal Government to have executive authority with respect to all matters relating to the management of solid waste and public cleansing. Under this Act, controlled solid waste is variously categorised as commercial solid waste, construction solid waste, household solid waste, industrial solid waste, institutional solid waste, imported solid waste and public solid waste. This Act applies throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 8**	**Construction or alteration of prescribed solid waste management facilities.** No person shall construct or undertake any alteration of any prescribed solid waste management facilities unless the relevant plans or specifications which require the approval of the Director General have first been approved in writing by the Director General. Failure to comply with the court's order to alter the prescribed solid waste management facilities so as to comply with the approved plans and specifications.	A fine RM100 000.00 or 5 years jail or both. A further fine RM5 000.00 for every day or a part of a day in which the offence continues after conviction.
2	**Section 12**	**Application to close any prescribed solid waste management facilities** Any owner or occupier who intends to close any prescribed solid waste management facilities may apply to the Director General by submitting a written application and a proposed closure plan to the Corporation.	A fine of RM100 000.00/ 5 years jail or both.
3	**Section 14**	**Requirement for licence** Subject to Section 16, no person shall: (a) undertake or provide any solid waste management services; or (b) manage or operate any solid waste management facilities, unless he holds a license granted under this Act.	A fine of RM50 000.00/ 5 years jail or both. A further fine RM5 000.00 for every day or a part of a day which the offence continues after conviction.
4	**Section 20**	**Compliance with license conditions** A licensee shall comply with the conditions imposed by the Director General on the license.	Fine RM25 000.00/ 2 years jail or both. Further fine RM2 500.00 for every day or a part of a day which the offence continues after conviction.

No.	Section	Sub Title and Description	Legal Impact
5	**Section 71**	**Prohibition against unauthorized depositing, treatment, etc., of controlled solid waste.** No person shall deposit, separate, store, keep, collect, transfer, transport, treat or dispose of any controlled solid waste, or cause such controlled solid waste to be or permit to be deposited, separated, stored, kept, collected, transferred, transported, treated or disposed of otherwise than in accordance with this Act.	Fine RM10 000.00/ 6 months jail or both.
6	**Section 72**	**Prohibition against unauthorized escape of any controlled solid waste** Any person who has in his possession any controlled solid waste shall take all reasonable measures to prevent the escape of such controlled solid waste.	Fine RM10 000.00/ 5 years jail or both.
7	**Section 76**	**Power to direct removal of unlawful depositing or disposing of controlled solid waste** If any controlled solid waste is deposited or disposed of in contravention of this Act, the Director General may, by notice in writing served on – a) the owner or occupier of the premises; b) the person who deposited or disposed the controlled solid waste; or c) the solid waste generator, direct him to remove the controlled solid waste from the premises within a period of not more than date of the service of the notice.	Fine RM10 000.00/ 6 months jail or both

No.	Section	Sub Title and Description	Legal Impact
8	**Section 108**	**Regulations** Regulations may be made for prescribing the standards and specifications for the design, construction, operation and maintenance of any prescribed solid waste management facilities.	Fine RM10 000.00/ 6 months jail or both

4.1.3 Local Authority

i) Street, Drainage and Building Act 133, 1974

Street, Drainage and Building Act is an act to amend and consolidate the laws relating to street, drainage and building in local authority areas in West Malaysia. Its purpose is to ensure uniformity of law and policy with regard to local government matters relating to streets, drainage and buildings. It was enacted in 1974 and applies only to West Malaysia.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 42**	**Materials not to be deposited without permission.** No person shall deposit any building materials or make a hole in any street or back-lane without prior written permission of the local authority.	A fine of RM1 000.00 A further fine of RM100.00 for every day the offence is continued after 24 hours notice from the local authority has been given, or The defaulting persons shall bear the expenses incurred by local authority.
2	**Section 44**	**Duty of owner or occupier to keep street clean.** Owner or occupier of premises shall clean such portion of the street as abuts his premises up to the centre of the street.	A fine of RM100.00 each day the non-compliance continues; or The defaulting persons shall bear the expenses incurred by local authority
3	**Section 47(2)**	**Depositing dirt on streets, etc.** Any person who, during construction or erection, alteration or demolition of building a) deposits any building materials onto public place; or b) fails to take precautions to prevent danger to life, health etc.	Offender may be arrest without warrant by police or officer of a local authority and shall be liable to: A fine of RM1 000.00; and A fine RM2 000.00 for second or subsequent conviction.

ii) Local Government Act 171, 1976

Local Government Act is purposely for ensuring uniformity of law with respect to local government. It was enacted in 1976 and shall apply only to West Malaysia.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 69**	**Committing nuisance in streams, etc.** Any person who commits a nuisance or deposits any filth in or upon the bank of any stream, etc. within the local authority area. shall be liable to	A fine of RM2 000.00/ 1 year jail or both. A further fine of RM500.00 for each day the offence is continued. The defaulting persons shall bear the expenses incurred by local authority
2	**Section 70**	**Pollution of streams with trade refuses, etc.** Within or outside limits of local authority area, a) pollute waters etc., b) solid or liquid sewage, and c) laundry trade,	A fine of RM5 000.00/ 2 years jail or both. A further fined RM500.00 each day the offence is continued The defaulting persons shall bear the expenses incurred by local authority

iii) Uniform Building By-laws 1984

Uniform Building By-laws are made in exercise of powers conferred by Section 133 of the Street, Drainage and Building Act 133, 1974. These By-laws came into force in 1984 and shall apply only to West Malaysia.

No.	By-law	Sub title and description	Legal Impact
1	**By-law 21**	**Materials not to be deposited in a street without permission.** No person shall deposit any building materials in any street without a temporary permit.	A fine of RM2 000.00. A further fine of RM100.00 for every day the offence is continued after conviction.

iv) Putrajaya Management Guide

The Environmental Department, Putrajaya Corporation has produced the Environmental Management Guide (EMG) 1998 for the purpose of mitigating environmental impacts from development activities. Since it is only a guideline and no enforcement shall be made to ensure compliance, Putrajaya Corporation through its Department of Town Planning has incorporated conditions to comply with EMG as one of its Development Order (D.O) conditions for developers in Putrajaya and thus, has made the EMG come into force.

No.	Chapter	Sub title and description
1	**5.0** **Item 5.4.4.2 (a)**	**Earthwork** No excess earth from earthworks is to be disposed of outside Putrajaya. No open burning of vegetation is allowed. Cut vegetation is to be collected for composting at the Putrajaya Bio-Mass Centre.
2	**5.0** **Item 5.4.4.7 (f)**	**Solid Waste** 1) No open burning. Sort solid waste into two types, that which can be recycled and that which is to be disposed off. 2) Dispose of non-scheduled waste at Local Authority approved disposal sites. Keep records and documents for audit. 3) Include 'Detailed Solid Waste Management Plan' in Environmental Management Compliance Plan (EMCP) consisting of this a) to f) list: a) Identify type of solid waste to be generated. b) Classify into recyclable and non-recyclable. c) For each identified solid waste, define its handling process in a flow chart, from the time it is generated at source to the time of disposal. d) Details of recycling and disposal contractors. e) Details of responsible project staff. f) Details of administrative procedures, documents and forms to be completed for audit purposes.

4.1.4 State Regulatory Bodies

4.1.4.1 Land Office

i) Water Act 418, 1920

No.	Section	Sub title and description	Legal Impact
1	**Section 7A**	**Prohibition of pollution of rivers** No person shall cause to enter or discharge into any water source: a) any poisonous matter etc.; b) any matter which by virtue of its temperature etc.; c) any matter which by virtue of its physical nature etc.; d) oil of any nature etc.	A fine of RM1 000.00

4.1.4.2 Selangor Water Management Authority (LUAS)

i) LUAS Enactment 1999 and Subsidiary Legislations

No.	Section	Sub title and description	Legal Impact
1	**Section 79**	**Prohibition of pollution of a water source** No person shall cause to enter or discharge into any water source: a) any poisonous matter etc., b) any matter which by virtue of its temperature etc., c) any matter which by virtue of its physical nature etc., d) oil of any nature etc.	A compound of RM25 000.00 A fine of RM100 000.00 or 3 years jail or both A further fine of RM5 000.00 for each day the offence is continued after a notice requiring compliance has been served

SECTION 5: GOOD MANAGEMENT PRACTICES

5.0 Introduction

At present, few contractors/ developers in Malaysia have implemented good waste management systems, which explain the rampant illegal dumping of construction wastes. Some large developers/ contractors, in their attempt to manage/ minimise the environmental impact of their activities, have attempted to ensure compliance with legal requirements in terms of waste disposal. It is also noted that the Industrialised Building System (IBS) has slowly become a common option for high rise building projects.

5.1 Waste Management System in Putrajaya

Putrajaya Holdings Sdn Bhd is the developer entrusted by the government to construct the Federal Government Administration Capital of Putrajaya. An environmental management unit was set up to manage and monitor all matters related to environmental management in construction. Waste management was one of the issues to be addressed by this unit.

Putrajaya Holdings Sdn Bhd implements a waste management system starting at the planning stage and covering the planning approval and tender briefing stage. The need to plan an effective waste management system was conveyed to all contractors through its project kick off meeting and the Environmental Management Compliance reports. A waste tracking system is also implemented via project audit and monitoring, enforcement and surveillance.

The current waste management practices in Putrajaya emphasise two major issues: i.e.

? ensuring legal disposal at approved dumpsites; and

? ensuring no open burning of construction wastes at site.

The monitoring mechanisms adopted by Putrajaya Holdings Sdn Bhd were:

? scheduled site audits and day to day site monitoring and surveillance;

? tracking records and documentation;

? enforcement; and

? awareness promotion and training.

5.2 Good Practices by Contractors in Putrajaya

Amongst other good practices carried out by PHSB are:

1. Management of concrete wastes and water at its batching plants

Excess concrete was used to produce concrete barriers, concrete blocks used for piling load tests. Waste water from drums and plants washing was reused (for road wetting etc.), in order to maintain zero discharge compliance. These batching plants have also attempted to start initiatives to charge environmental disposal fee for excess concrete return, which will reduce the amount of excess concrete returned to the plants.

2. Introduction of the IBS to minimise the wood waste generated via usage of formworks

A substantial numbers of high rise apartment's construction projects in Putrajaya have adopted the IBS. In addition to more rapid project completion, this method has reduced significantly the quantity of wood wastes generated at construction sites.

3. Reselling of scrap metal

As scrap metal is actually a commodity of high commercial value, there are high demands for this waste. Putrajaya contractors do practise segregation and selling of the scrap metals.

4. Implementing proper handling of waste oil and used diesel.

PHSB has set requirements for its contractors to abide by rules for proper storage and disposal of used oil/ diesel. Training and awareness promotion to educate the contractors were emphasised. Nevertheless, compliance is at a low level due to difficulty in disposing of small volumes of oil.

As one of its efforts to promote good environmental practices in the construction industry, CIDB has recorded these good practices in a publication entitled "Construction Industry Good Practices Series – Construction Waste Management". Users of this guide are recommended to refer to it for further details.

ANNEX A
(Informative)

SAMPLE WASTE MANAGEMENT PLAN

Company :
Project :
Designated Recycling Coordinator :

Waste Management Goals:

- This project will recycle or salvage for reuse xx % [e.g. 75 %] by weight of the waste generated on-site.

Communication Plan:

- Waste prevention and recycling activities will be discussed at each safety meeting.
- As each new subcontractor comes on-site, the recycling coordinator will present him/her with a copy of the Waste Management Plan and provide a tour of the recycling area.
- The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- All recycling containers will be clearly labelled.
- Lists of acceptable/unacceptable materials will be posted throughout the site.

Expected Project Waste, Disposal and Handling

The following charts identify waste materials expected on this project, their disposal method and handling procedures.

Demolition Phase

Material	Quantity	Disposal Method	Handling Procedure
Asphalt from parking lot	100 tons	Ground on-site, reuse as fill	
Wood Framing	6 tons	Recycle – Wood Recycling Northwest	Separate ‘clean wood’ in clean wood bin.
Decorative Wood Beams	300 bd. Ft.	Salvage – Timber Frame Salvaging	Remove by hand, store on-site, palletize for pickup
Remaining Materials	8 tons	Landfill – Sound Disposal	Dispose in trash dumpster

Construction Phase

Material	Quantity	Disposal Method	Handling Procedure
Concrete	2 tons	Recycle – Pacific Concrete	Rebar OK
Forming Boards		Reuse as many times as possible then recycle – Wood Recycling NW	Stack next to supply of new form boards for reuse. Recycle clean unusable forms in wood recycling bin.
Clean Wood Scrap	12 tons	Scraps reused for formwork, fire breaks, etc. Remaining recycled – Wood Recycling NW	Stack reusable pieces next to saw for reuse. Place unusable clean wood in wood recycling container
Scrap Metal	5 tons	Recycle – Seattle Metals	Deposit all metals in metal container
Drywall	10 tons	Subcontractor will recycle and submit receipt	Either provide container or collect in vehicle for recycling
All other wastes	14 tons	Landfill – Sound Disposal	Dispose of in trash dumpster

ANNEX B
(Informative)

MASTER
SECTION 017419 [01524]
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodelling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.

B. Salvage: Recovery of materials for on-site reuse or donation to a third party.

C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.

D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.

E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.

F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

G. Approved Recycling Facility: Any of the following:

a. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.

b. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials. Take co-mingled containers to **<insert name of approved Material Recovery Facility(s) from the King County Solid Waste Division Report of Co-mingled Recycling Facilities at www.metrokc.gov/dnrp/swd/construction-recycling/comingled.asp#rates>**

1.3 SUBMITTALS

A. Waste Management Plan: Submit [**3**] <**Insert number**> copies of plan within [**7**] **[14]** [**30**] <**Insert number**> days of date established for [**commencement of the Work**] [**the Notice to Proceed**] [**the Notice of Award**].

B. Waste Management Report: Concurrent with each Application for Payment, submit [**3**] <**Insert number**> copies of report. [**Include separate reports for demolition and construction waste.**]

1.4 PERFORMANCE REQUIREMENTS

A. General: Divert a minimum of **[50 %] [75 %] <insert number>** CDL waste, by weight, from the landfill by one, or a combination of the following activities:

1. Salvage
2. Reuse
3. Source-Separated CDL Recycling
4. Co-mingled CDL Recycling

B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:

1. Acoustical ceiling tiles
2. Asphalt
3. Asphalt shingles
4. Cardboard packaging
5. Carpet and carpet pad
6. Concrete
7. Drywall
8. Fluorescent lights and ballasts
9. Land-clearing debris (vegetation, stumpage, dirt)
10. Metals
11. Paint (through hazardous waste outlets)
12. Wood
13. Plastic film (sheeting, shrink wrap, packaging)
14. Window glass
15. Wood
16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Conduct construction waste management activities in accordance with State of Washington RCW 39.04.13, Seattle Municipal Code Chapter 21.36 and all other applicable laws and ordinances.

B. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.

1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.
    a. Owner.
    b. Architect.
    c. Contractor's superintendent.
    d. Major subcontractors.
    e. **<Insert the appropriate municipality representative. For projects in King County, outside the city of Seattle insert [**King County Construction Recycling and Green Building program representative (206) 296-4466**]. For projects within the City of Seattle insert [**Resource Venture representative (206) 389-7304**].>**
    f. Other concerned parties.

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:
    a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
    b. Review requirements for documenting quantities of each type of waste and its disposition.
    c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
    d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
    e. Review waste management requirements for each trade.
    f. Review and distribution of the following publications and programs (request copies by calling the King County Solid Waste Division at (206)296-4466):
        1) Construction Recycling Directory for Seattle/King County.
        2) Contractors Guide: Save money and resources through job-site recycling and waste prevention
        3) Construction Works program for Seattle/King County.
        4) King County Solid Waste Division Report of Co-mingled Recycling Facilities (available at www.metrokc.gov/dnrp/swd/construction-recycling/comingled.asp#rates).
    3. Minutes: Record discussion. Distribute meeting minutes to all participants within 3 days.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste types, quantity by weight, methods of disposal, handling and transportation procedures. Include separate sections in plan for demolition and construction waste.

B. Organize the waste management plan in accordance with the sample plan included at end of Part 3, including the following information:

1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.
2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:
    a. Contracting with a deconstruction specialist to salvage materials generated,
    b. Selective salvage as part of demolition contractor's work,
    c. Reuse of materials on-site or sale or donation to a third party.
3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:
    a. Requiring subcontractors to take their CDL waste to a recycling facility,
    b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility,
    c. Processing and reusing materials on-site
    d. Self-hauling to a recycling or material recovery facility.
4. Name of recycling or material recovery facility receiving the CDL wastes.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labelling, and designated location on Project site where materials separation will be located.

1.7 WASTE MANAGEMENT REPORT

A. Waste Management Report: Submit a cumulative waste management report on the form included at end of Part 3 with each Application for Payment with the following attachments:

1. A record of the type and quantity, by weight, of each material salvaged, reused, recycled or disposed.
2. Total quantity of waste recycled as a percentage of total waste.
3. Disposal Receipts: Copy of receipts issued by a disposal facility for CDL waste that is disposed in a landfill.
4. Recycling Receipts: Copy of receipts issued by an approved recycling facility.
   a. For co-mingled materials, include weight tickets from the recycling hauler or material recovery facility and verification of the recycling rate for co-mingled loads at the facility.
5. Salvaged Materials Documentation: Types and quantities, by weight, for materials salvaged for reuse on site, sold or donated to a third party.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

A. Provide containers for CDL waste that is to be recycled clearly labelled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.
B. The collection containers for recyclable CDL waste must contain no more than 10 % non-recyclable materials, by volume.
C. Provide containers for CDL waste that is disposed in a landfill clearly labelled as such.
D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.
E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.
F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

A. General: Separate recyclable materials from CDL waste to the maximum extent possible. Separate recyclable materials by type.
1. Provide containers, clearly labelled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

3.4 REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

END OF SECTION

WASTE MANAGEMENT PROGRESS REPORT				
	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	**DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE**		
MATERIAL CATEGORY		Recycled	Salvaged	Reused
1. Asphalt (cu yds)				
2. Concrete (cu yds)				
3. Porcelain Plumbing Fixtures (lbs)				
4. Ferrous Metals (lbs)				
5. Non-Ferrous Metals (lbs)				
6. Wood (lbs)				
7. Glass (lbs)				
8. Clay Brick (lbs)				
9. Bond Paper (lbs)				
10. Newsprint (lbs)				
11. Cardboard (lbs)				
12. Plastic (lbs)				
13. Gypsum (lbs)				
14. Paint (gal)				
15. Insulation (lbs)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL THE ABOVE VALUES - IN WEIGHT)		
	Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)		

SAMPLE WASTE MANAGEMENT PLAN

Company:
Project:

Designated Recycling Coordinator:

Waste Management Goals:

- ❑ This project will recycle or salvage for reuse xx % [e.g. 75 %] by weight of the waste generated on-site.

Communication Plan:

- ❑ Waste prevention and recycling activities will be discussed at the beginning of each safety meeting.
- ❑ As each new subcontractor comes on-site, the recycling coordinator will present him/her with a copy of the Waste Management Plan and provide a tour of the recycling areas.
- ❑ The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- ❑ All recycling containers will be clearly labelled.
- ❑ Lists of acceptable/unacceptable materials will be posted throughout the site.

Expected Project Waste, Disposal, and Handling:

The following charts identify waste materials expected on this project, their disposal method, and handling procedures.

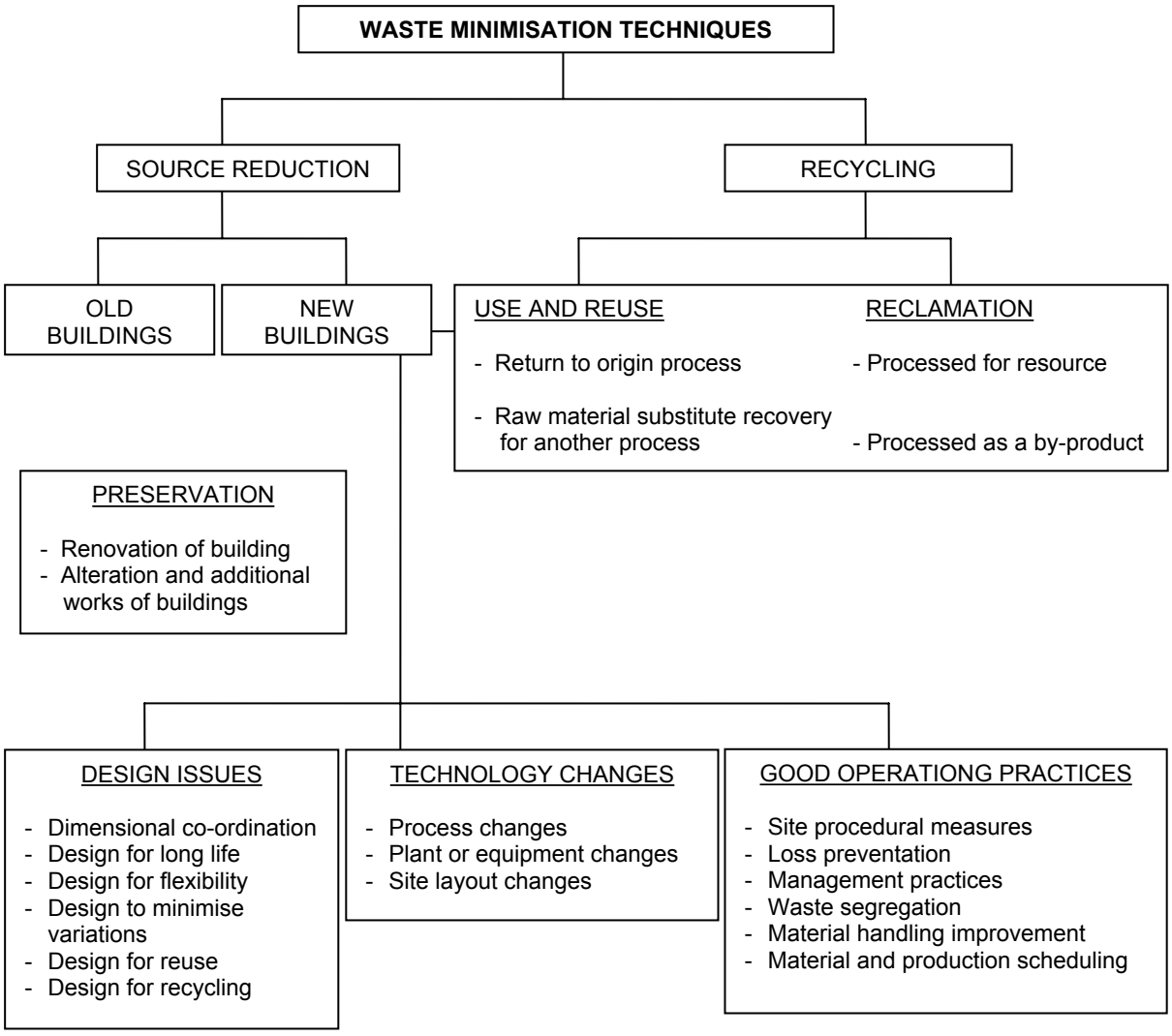
Demolition Phase

Material	Quantity	Disposal Method	Handling Procedure
Asphalt from parking lot	100 tons	Ground on-site, reused as fill	
Wood Framing	6 tons	Recycled - Wood Recycling Northwest	Separate "clean wood" in clean wood bin
Decorative Wood Beams	300 bd. ft.	Salvaged - Timber Frame Salvaging	Remove by hand, store on-site, load on pallets for pickup
Remaining Materials	8 tons	Landfill - Sound Disposal	Dispose in "trash" dumpster

Construction Phase

Material	Quantity	Disposal Method	Handling Procedure
Concrete	2 tons	Recycle - Puget Sound Concrete	Break up any wastes or mistakes and put in concrete bin. Rebar OK
Forming Boards		Reuse as many times as possible then recycle - Wood Recycling NW	Stack next to supply of new form boards for reuse. Recycle clean unusable forms in wood recycling bin
Clean Wood Scrap	12 tons	Scraps reused for formwork, fire breaks, etc. Remaining recycled - Wood Recycling NW	Stack reusable pieces next to saw for reuse. Place unusable clean wood in wood recycling dumpster
Scrap Metal	5 tons	Recycle - Seattle Metals	Deposit all metals in metal dumpster
Drywall	10 tons	Subcontractor will recycle and submit reports to recycling coordinator	Either provide container or collect in vehicle for recycling

WASTE MINIMISATION TECHNIQUES IN CONSTRUCTION
(Modified from Ciambrone, 1996)



Source: C.S. Poon, “A Guide for managing and minimizing building and demolition waste”, The Hong Kong Polytechnic University

BIBLIOGRAPHY

Borger J, Carrasquillo R and Fowler D. Use of recycled wash water and returned plastic concrete in the production of fresh concrete. Advanced Cement Based Materials, 1, 1994. pp 267-274

Brisson, I.E. (1997). *Assessing the Waste Hierarchy – a Social Cost–Benefit Analysis of Municipal Solid Waste Management in the European Union*. AKF, Institute of Local Government Studies, Denmark. Available at www.akf.dk/eng

Department of the Environment. Sustainable Development: The UK Strategy. HMSO, London, 1994.

Department of the Environment. Making Waste Work: a Strategy for Sustainable Waste Management in England and Wales. HMSO, London, 1995.

Department of the Environment, Transport and the Regions. Waste Strategy 2000 for England and Wales. HMSO, London, 2000.

HM Customs and Excise. Notice LFT1: A General Guide to the Landfill Tax. HM Customs and Excise, 2000.

McDougall, F., White, P., Franke, M., Hindle, P. (1999), *Integrated Solid Waste Management: a Life Cycle Inventory*, Blackwell Publishing, UK.

Newman J. Reducing concrete waste. 21st Annual Convention of the Institute of Concrete Technology, Coventry, April 1993.

Okawa Y, Yamamiya H and Nishibayashi S. Study on the reuse of returned concrete. Magazine of Concrete Research, 52, No.2, April 2000. pp 109-115

Poon, C.S., Yu A.T.W & Ng, L.H. 2001. A Guide for Managing and Minimizing Building and Demolition Waste. The Hong Kong Polytechnic University, Hong Kong

Rubina Greenwood. 2003. Construction Waste Minimisation: Good Practice Guide. Cardiff University. United Kingdom

UNEP (1996). *International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management*. International Environmental Technology Centre Technical Publication Series (6). United Nations Environmental Programme.

Wilkins T and Hodkingson L. Washout elimination from ready mixed concrete plants. CANMET Conference, Cement Industry Solutions to Waste Management, Calgary, Canada, October 8 1992.

ACKNOWLEDGEMENTS

This Guideline on Construction Waste Management was developed with the effort of the following representatives:

TECHNICAL COMMITTEE ON GOOD PRACTICES IN ENVIRONMENT (TC 9)

Prof Madya Dr Joy Jacqueline Pereira (Chairman)	Institut Alam Sekitar dan Pembangunan (LESTARI) Universiti Kebangsaan Malaysia
Puan Nor Hamiza Bt Zahar (Secretary)	Construction Industry Development Board
Encik Hari Sundar Hari Dass (Secretary)	Construction Industry Development Board
Ar Steven Thang Boon Ann	Persatuan Arkitek Malaysia
Datin B S Mc Coy	Persatuan Perlindungan Alam Sekitar Malaysia
Dr Saim Suratman	Jabatan Mineral dan Geosains Malaysia
Encik Abdul Aziz Long	SIRIM QAS International Sdn Bhd
Encik David Yap/ Dr Ahyar Idris	Association of Environmental Consultants and Companies of Malaysia
Encik Patrick Tan Hock Chuan/ Encik Charanpal Singh	Jabatan Alam Sekitar
Ir Ahmad Fuad Embi/ Cik Anita Ainon	Jabatan Pengairan dan Saliran
Puan Geetha P Kumaran	Persatuan Pengurusan dan Penyelidikan Alam Sekitar Malaysia
Puan Tan Choo Lan	Jabatan Kerajaan Tempatan
Ir Abu Harith Shamsuddin	Jabatan Kerja Raya
Ir Prof Dr Ruslan Hassan	The Institution of Engineers Malaysia
Ir Tan Gee Hoi/ Encik Lim Len Wei	Persatuan Pemborong Binaan Malaysia
Encik Tiah Oon Ling	Persatuan Pemaju Hartanah dan Perumahan Malaysia
Puan Winnie Ng Guat Poh	Association of Consulting Engineers Malaysia
Puan Norliza Hashim	Malaysia Institute of Planners
Puan Chui Yuet Yue	Putrajaya Holdings Sdn Bhd
Ir Dr Zuhairi Abd Hamid	Construction Research Institute of Malaysia

WORKING GROUP ON GUIDELINE ON CONSTRUCTION WASTE MANAGEMENT (WG 6)

Puan Chui Yuet Yue (Chairman)	Putrajaya Holdings Sdn Bhd
Cik Siti Khadijah Bt Satari (Secretary)	Institut Alam Sekitar dan Pembangunan (LESTARI) Universiti Kebangsaan Malaysia
Encik Hari Sundar R Hari Dass (Secretary)	Construction Industry Development Board
Puan Nor Hamiza Zahar	Construction Industry Development Board
Ar Voon Wan Lin	Pertubuhan Arkitek Malaysia

Ir Prof Dr Suhaimi Abdul Talib	The Institution of Engineers Malaysia
Puan Sharifah Yaacob	Alam Flora Sdn Bhd
Cik Raihani Che Mamat/ Encik Muhamad Zaini Bin Hasnan	Jabatan Kerajaan Tempatan
Puan Azrida Abdul Manab	Lembaga Urus Air Selangor
Encik Patrick Tan Hock Chuan	Jabatan Alam Sekitar
Encik Alias Mohd Zain	Jabatan Perumahan Negara
Encik Tiah Oon Ling	Persatuan Pemaju Hartanah dan Perumahan Malaysia
Encik Lim Len Wei	Persatuan Pemborong Binaan Malaysia