Effective Management of Hazardous Materials, Hazardous Wastes and Contaminated Sites

Training Workshop

Samoa

February, 2001

[redacted]

SPREP

Golder Associates

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INTRODUCTION

BACKGROUND

Management of hazardous materials, hazardous wastes and contaminated sites has become an increasingly important issue for Pacific Island Countries (PICs). In 1997, AusAID, in conjunction with SPREP, implemented the Persistent Organic Pollutants in Pacific Island Countries project (POPs in PICs) to address this issue. As part of the POPs in PICs project, training workshops will be held in thirteen PICs to create awareness and understanding on how to effectively manage hazardous materials, hazardous wastes and contaminated sites.

The five day workshops will be delivered during late 2000 and early 2001, and will include interactive activities and exercises as well as practical field demonstrations. The workshops are designed and delivered by Golder Associates.

OBJECTIVES

The broad objectives of this training workshop are to :

- To upgrade regional capacity for the effective management of hazardous materials and hazardous waste;
- To upgrade regional capacity for effective management of contaminated sites;
- To encourage the development of country-specific strategies for managing hazardous materials; and
- To raise awareness in the PIC communities of issues associated with the generation and management of hazardous wastes.

PARTICIPANT EXPECTATIONS

/hat are your expectations for this workshop nd what do you hope to learn?

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

TRAINING OVERVIEW

The training workshop will commence at 10.00am each morning and conclude at 4.30pm each afternoon. Three to four workshop modules will be covered each day and the following program is expected:

Day One:

10.00 am – 12.00 noon Module 1
Training Program Introduction

12.00 noon – 1.00 pm Lunch

1.00 pm – 2.30 pm Module 2
Introduction to Hazardous Materials

2.30 – 3.00 pm Afternoon Tea

3.00 pm – 4.30 pm Module 3
POPs in PICs Country Profile

Day Two:

10.00 am – 12.00 noon Module 4
Safe Materials Storage and Handling

12.00 noon – 1.00 pm Lunch

Day Two: (con't)

1.00 pm – 2.30 pm Module 5
Hazardous Waste Management

2.30 – 3.00 pm Afternoon Tea

3.00 pm – 4.00 pm Module 6
Personal Safety

4.00 pm – 4.30 pm Module 7
Country Issues

Day Three:

10.00 am – 12.00 noon Module 8
Hazard Control Systems

12.00 noon – 1.00 pm Lunch

1.00 pm – 2.30 pm Module 9
Incident Management

2.30 – 3.00 pm Afternoon Tea

3.00 pm – 4.00 pm Module 10
Monitoring and Testing Procedures

4.00 pm – 4.30 pm Module 11
Country Issues

Day Four:

10.00 am – 12.00 noon Module 12
Field Program

12.00 noon – 1.00 pm Lunch

1.00 pm – 2.30 pm Module 12
Field Program

2.30 – 3.00 pm Afternoon Tea

3.00 pm – 4.00 pm Module 12
Field Program

4.00 pm – 4.30 pm Module 12
Field Program

Day Five:

10.00 am – 12.00 noon Module 13
Remediation of Contaminated Sites

12.00 noon – 1.00 pm Lunch

1.00 pm – 2.30 pm Module 14
Review Module

2.30 – 3.00 pm Afternoon Tea

3.00 pm – 4.30 pm Module 15
Draft Workshop Report

HOW TO USE THIS MANUAL

This manual was prepared by Golder Associates for use by workshop participants. The manual contains an outline of workshop modules as well as supplementary resource materials for each module. Specific resource material pertaining to your country is also provided in this manual.

In addition to supplying information about management of hazardous materials, hazardous wastes and contaminated sites, this manual should also be a record of workshop outcomes for each participant. ***Therefore, participants are encouraged to write their thoughts and ideas throughout this manual.***

LIST OF PARTICIPANTS

Please list the names and positions of the other participants at this workshop:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Your Facilitators

Allan Boase

Allan is a civil engineer with extensive experience in waste management, water supply and sanitation, environmental engineering process design and appropriate technology. He is a recognised leader in the waste management field in Australia.

Allan has been involved in many waste management projects in Pacific Island Countries and islands of the Asia-Pacific region, including Palau, Papua New Guinea, Tuvalu, Philippines, Solomon Islands, Bougainville, Kalimantan, Java, Sulawesi, Irian Jaya and Myanmar.

Paul Scells

Paul is a civil engineer with extensive experience in landfill design and management, contaminated land, effluent disposal and hazardous waste management.

Paul has worked extensively with the Aboriginal and Torres Strait Island communities of Australia and has also completed projects in Papua New Guinea, Tuvalu, Solomon Islands and the Philippines. Through experience gained in these countries, Paul is highly experienced in developing culturally and technologically appropriate waste management solutions.

Margaret Leonard

Margaret has extensive experience in the environmental field, particularly in the areas of solid waste management (landfills, waste management strategies) and liquid waste management (wastewater treatment and disposal to land and water). She is experienced in environmental auditing, contaminated site investigations and the preparation of management plans, including contingency plans. As a chemist, Margaret is very familiar with development of sampling programmes and sampling and analytical techniques. She has given lectures for tertiary courses on environmental legislation, environmental impact assessment and wastewater treatment.

Your Facilitators

David Hodge

David is an environmental scientist with extensive experience in waste management, environmental management, regulatory compliance, microbiology and chemistry as applied to industrial waste treatment processes, contaminated site assessment and remediation and due diligence assessments.

David has been involved in numerous site contamination assessments, remediation and bioremediation projects. As a qualified chemist, David has a strong understanding of the properties and characteristics of hazardous chemicals and is also familiar with the development and analysis of contaminated land sampling programs.

Ken Gilbert

Ken is an environmental scientist with extensive experience in contaminated site assessments, management and remediation and water quality investigation and modelling.

Ken has supervised and participated in contaminated land field assessments and is proficient in data compilation, analysis and reporting. Ken has extensive experience in fresh water and marine water quality assessments and modelling projects, including a recent project undertaken in Palau. He has also researched marine bacteriological water quality with regard to public health risks in the United Kingdom.

Katherine Yew Woon

Kathy Yew Woon is a hydrogeologist with extensive experience in contaminated lands, groundwater supply and due diligence assessments in Canada, the United States of America and Australia.

Kathy has coordinated field investigations for large contaminated sites including a military base in Canada. She has also performed contaminated site investigations for the oil and gas industry, the agricultural industry, the transportation industry and the Department of National Defence in Canada.

Kathy has been involved in several due diligence projects and portfolios relating to large property transactions for commercial and agricultural lands.

MODULE ONE
TRAINING PROGRAM INTRODUCTION

INTRODUCTION

The purpose of Module One is to provide the context for the training workshop by highlighting the major international initiatives and regional programs for management of hazardous materials, hazardous wastes and contaminated sites.

After discussing the broad environmental implications of hazardous materials, hazardous wastes and contaminated sites in the Pacific, participants will examine the objectives of the Management of Persistent Organic Pollutants in Pacific Island Countries project (POPs in PICs project).

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

1. Understand in general terms, the environmental and health impacts of hazardous materials, hazardous waste and contaminated sites;
2. Be aware of the international conventions that relate to management of hazardous materials and hazardous waste;
3. Be aware of the regional programs to implement our international obligations
4. Understand the objectives of the *POPs in PICs* project; and
5. Relate the *POPs in PICs* project to my country.

MODULE ONE
TRAINING PROGRAM INTRODUCTION

ENVIRONMENTAL AND HEALTH IMPACTS OF HAZARDOUS MATERIALS

The underlying principle of this workshop is to provide participants with a basic understanding of how to best manage hazardous materials, hazardous waste, and contaminated sites in their country.

Before we begin to explore this however, it is critical to understand why a knowledge of sound management techniques is useful:

- Why is it important to know how to store and handle hazardous wastes?
- Why do we need to know how to respond to an incident, such as a chemical spill?
- Do we really need to worry about wearing protective clothing when working around hazardous materials?
- What is the point of cleaning up sites that have been contaminated in the past?

The reasons we need to know all these thing, is because hazardous materials are potentially dangerous to human health (including both workers and the general public) and can also damage the natural environment and property. Inadequate management of hazardous materials will greatly increases the risk of harm occurring.

There are many environmental and health impacts associated with hazardous materials, hazardous wastes and contaminated sites. On the following page, list the ones you can think of and any others suggested by the group:

Activity: What is the "hazard" of Hazardous Materials (see page 3).

Activity: What is the "hazard" of hazardous materials ?

List below the environmental and health impacts of hazardous materials, hazardous wastes and contaminated sites:

- _____
- _____
- _____
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SPREP ACTION PLAN 2001-2004

Every four years, SPREP produces an "Action Plan" for Managing the Environment of the Pacific Islands Region. In October 2000, the Action Plan for the period 2001-2004, was acknowledged and adopted by SPREP members at the 11th SPREP Meeting held in Guam. The 2001-2004 Action Plan was developed through a highly participatory consultative process involving a wide range of stakeholders.

The Action Plan provides the regional agenda for managing the environment of the Pacific islands region. It is a planning document, that identifies board priorities and key results areas of the regional agenda and associated capacity building processes and interventions.

There are 4 Key Result Areas (KRAs) identified in the 2001-2004 Action Plan. These are:

1. Nature Conservation
1. **Pollution Prevention**
1. Climate Change and Variability
1. Economic Development

The objective of the Key Result Area **Pollution Prevention** is to *"increase the capability of SPREP members to manage and respond to marine pollution, hazardous waste, solid waste, sewerage and other land-based sources of pollution and to meet the requirements of relevant international and regional legal instruments".*

Activities that are hoped to be undertaken in meeting this objective include the development and implementation of Hazardous Wastes Management Plans in all SPREP member countries, provision of technical assistance in the development of waste treatment and disposal facilities; and encouragement of and assistance for SPREP member countries in moving towards ratification of the Basel and Waigani Conventions (these conventions are discussed in more detail in the following section).

The ownership of the Action Plan is shared by SPREP members and the Secretariat who work in partnership with NGO's, Inter-governmental organisations, local communities and the private sector. Implementation of the Action Plan is the It is the responsibility of all SPREP members.

INTERNATIONAL CONVENTIONS AND TREATIES

The impacts of hazardous materials on the environment and human health has been recognised world-wide for many years. Several international initiatives and regional programs have been developed in the last thirty years or so, which address the issue of hazardous materials management.

International conventions and treaties associated with the management of hazardous waste, hazardous materials, and contaminated sites include:

- Agenda 21 (1992) - United Nations Conference on Environment and Development (UNCED) - Chapters 17, 19, 20, 21 and 22.
- Basel Convention (1989) - Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal.
- London Convention (1972) and 1996 Protocol – Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.
- Rotterdam Convention (1998) – Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.
- South Pacific Nuclear Free Zone Treaty (1985) (Also known as the Treaty of Rarotonga).
- SPREP Convention (1986) – Convention for the Protection of the Natural Resources and Environment of the South Pacific Region. (Also known as the Noumea Convention).

- UNCLOS (1982) – United Nations Convention on the Law of the Sea.

- Waigani Convention (1995) - Convention to Ban the Importation into Forum island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region.

A summary of the key features of each of the above Conventions and Treaties is provided in Table 1-1 on Page 8. The status of each PICs acceptance of each Convention and Treaty is summarised in Table 1-2, located on Page 10.

There are also negotiations currently underway for the development of an international, legally binding **treaty on the management of the following 12 specific POPs:**

- Aldrin – a pesticide;
- Chlordane – an insecticide;
- DDT – an insecticide;
- Dieldrin – an insecticide;
- Dioxin – a by-product from the production of other chemicals;
- Endrin – an insecticide and rodenticide;
- Furan - a by-product from the production of other chemicals;
- Heptachlor - an insecticide;
- Hexachlorobenzene – a fungicide and a by-product of the production of other chemicals;
- Mirex – an insecticide;
- Toxaphene - an insecticide; and
- Polychlorinated Biphenyls (PCBs) – a group of chemicals used in a number of industrial applications.

These negotiations are in response to a mandate (or instruction) issued by the United Nations Environment Programme (UNEP) in February, 1997. The mandate stems from growing world-wide recognition of the human health and environmental risks associated with persistent organic pollutants.

Table 1.1 – Overview of International Conventions and Treaties Dealing with the Management of Hazardous Materials

CONVENTION	OBJECTIVES	RELEVANT SECTIONS	PLACE AND YEAR OF ADOPTION	ENTRY INTO FORCE	SECRETARIAT	WEB-SITE ADDRESS
Agenda 21 UNCED	"To meet the needs of the present without sacrificing the ability of future generations to meet theirs". It is a comprehensive plan of action to be taken globally, nationally and locally by organisations of the United Nations System, in every area in which humans impact on the environment.	Chapters 17, 19, 20, 21 and 22 (see also UNCLOS Convention)	Rio de Janeiro, 1992	-	United Nations	http://www.un.org/esa/sustdev/agenda21.htm http://www.un.org/esa/sustdev/sids.htm
Basel Convention	"A global solution for managing hazardous wastes" ▪ To control and reduce transboundary movements of hazardous wastes; ▪ to minimise generation of hazardous wastes; ▪ to assist developing countries in the sound management of hazardous and other wastes.	-	Basel, 1989	May, 1992	United Nations	http://www.ngo.grida.no/ggvnet/agree/haz-sub/basel.htm http://www.unep.ch/basel http://www.unep.ch/basel/text/con-e.htm
London Convention	To prevent indiscriminate disposal at sea of wastes liable to create hazards to human health, to harm living resources and marine life, to damage amenities, or to interfere with other legitimate uses of the sea.	-	London, 1972	August, 1975	International Maritime Organization (IMO) c/ United Nations	http://www.ext.grida.no/ggvnet/agree/mar-env/london.htm http://www.imo.org http://www.londonconvention.org/LC72.htm

ONVENTION	OBJECTIVES	RELEVANT SECTIONS	PLACE AND YEAR OF ADOPTION	ENTRY INTO FORCE	SECRETARIAT	WEB-SITE ADDRESS
Rotterdam onvention	To promote shared responsibility and cooperative efforts among the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use.	-	Rotterdam, 1998	Not yet in force	Joint. Food & Agricultural Organisation (FAO) and UNEP	http://www.ext.grida.no/ggynet/agree/haz-sub/pic.htm http://www.fao.org/AG/AGP/AGPP/Pesticid/PIC/pichome.htm
uth Pacific uclear Free one Treaty	To establish a nuclear weapon free zone in the South Pacific, and includes the prohibition of dumping of radioactive wastes at sea within the nuclear free zone.	-	Rarotonga, 1985	December, 1986	The South Pacific Forum	http://www.nuclearfiles.org/docs/1985/850806-rarotonga-sum.html
SPREP onvention	To protect and manage the natural resources and environment of the South Pacific region.	-	Noumea, 1986	August, 1990	SPREP	http://www.ext.grida.no/ggynet/agree/mar-env/sprep.htm
UNCLOS onvention	To establish a legal framework to facilitate international communication and promote peaceful uses of the oceans and seas, equitable and efficient utilisation of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment.	-	Jamaica, 1982	November, 1994	United Nations	http://www.ext.grida.no/ggynet/agree/mar-env/unclos.htm
Waigani onvention	▪ To prohibit the importation of hazardous wastes (including radioactive wastes) into Pacific island developing Parties; ▪ To regulate and facilitate the sound management (including the transboundary movement) of hazardous wastes within the Pacific Island region	-	Waigani, 1995	Not yet in force (needs to be ratified by 4 more countries).	SPREP	http://www.ngo.grida.no/ggynet/agree/haz-sub/waigani.htm

Table 1-2: International Conventions and Treaties

Status of Acceptance

COUNTRY	CONVENTION or TREATY							
	Agenda 21 (SIDS) [1]	Basel Convention [2]	London Convention [3]	Rotterdam Convention [4]	South Pacific Nuclear Free Zone Treaty [5]	SPREP Convention [5]	UNCLOS Convention [5]	Waigani Convention [5]
Cook Islands	M	-	-	-	R	R	R	R
Fiji	M	-	-	-	R	R	R	R
Kiribati	M	-	A	-	R	-	-	S
Marshall Islands	M	-	-	-	-	R	A	-
FSM	M	A	-	-	-	R	A	R
Nauru	M	-	A	-	R	S	R	S
Niue	M *	-	-	-	-	-	S	S
Palau	M	-	-	-	-	S	A	S
Samoa	M	-	-	-	R	R	R	S
Solomon Islands	M	-	A	-	R	R	S	R
Tonga	M	-	A	-	-	-	-	S
Tuvalu	M	-	-	-	-	-	S	-
Vanuatu	M	-	A	-	-	-	S	S

A = Accepted R = Ratified S = Signatory X = Not Involved M = Member of the Alliance of Small Island States (AOSIS)

[1] As of 31 Aug 2000 [2] As of 1 Jan 97 [3] As of 31 Aug 2000 [4] As of 15 Sep 2000 [5] As of 15 Aug 2000

* Not a member of the United Nations

POPs IN PICs PROJECT

The Persistent Organic Pollutants (POPs) in Pacific Island Countries (PICs) Project, was established by SPREP (and AusAID) in 1997.

The objective of the project is to upgrade regional capacity in participating countries, for the effective management of common hazardous chemicals, in order to eliminate the threats posed by these towards the environment and human health.

The project has three phases as follows:

Phase 1: Conduct survey to identify chemical stockpiles and contaminated sites and review existing management systems in each country *(completed May, 2000)*. Train local personnel in basic chemical handling and disposal procedures *(in progress and includes this workshop)*.

Phase 2: Repack unwanted chemicals and provide appropriate temporary storage facilities *(Not started. Estimated to take up to three years to complete)*.

Phase 3: Safely dispose of chemicals and remediate contaminated sites. *(Not started. Estimated to take up to three years to complete)*.

With the exception of the training workshops, which have a wider awareness raising objective, the POPs in PICs project will primarily concentrate on assessing stockpiles of waste and obsolete chemicals and chemical contaminated sites only. It will not include assessments of pollution or contamination arising from current industrial or agricultural activities.

The training workshops will focus on management of all hazardous materials currently being used in PICs, and not just hazardous material stockpiles or contaminated sites. **By raising participants awareness on how to best manage hazardous materials, it is hoped that current usage of chemicals will not lead to further waste stockpiles or contamination of clean sites.**
The POPs in PICs project is currently in Phase 1, which is scheduled to be completed in March, 2001.

A summary of the POPs in PICs project is provided in Figure 1-1 on the following page.

Note: The specific definition of a Persistent Organic Pollutant (POP) is a chemical that:

- persists in the environment for a long time;
- bio-accumulates through the food-chain; and
- poses a risk of causing adverse effects to human health and the environment.

However, **under the POPs in PICs Project, the term POPs has been interpreted more broadly, to include all hazardous or potentially hazardous chemicals that are commonly used in the Pacific Region**, including pesticides, poly-chlorinated biphenyls (PCBs), general industrial chemicals, medical wastes, laboratory chemicals, oil, bitumen, timber treatment chemicals and fertilisers.

Figure 1-1: Overview of the POPs in PICs Project

POPs in PICs

A programme aimed at improving the management of chemicals in the South Pacific Region, in order to eliminate the threats posed by these towards the environment and human health.

WHAT IS A POP?

"Persistent Organic Pollutant" – under this project, a POP is a chemical substance that poses a risk of causing adverse effects to human health and the environment. Includes pesticides, fertilisers, oil, bitumen, medical wastes, and timber treatment chemicals.

WHAT IS A PIC?

"Pacific Island Country" – 14 PICs involved: Cook Islands, Fiji, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, Niue, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu (PNG will be included later for Phases II and III).

How did POPs in PICs start?

- AusAID recognized there was a need for improved waste management in the Pacific
- A was study undertaken in 1997 which identified management of waste chemicals as an issue that needed addressing.
- The POPs in PICs project was developed to address this issue.

WHO'S INVOLVED?

- SPREP (managing project) and AusAID (funding project)
- 14 Pacific Island Countries (PICs)
- Specialist Consultants

WHAT'S GOING TO HAPPEN UNDER THE PROJECT?

Phase I:

- Conduct survey of all wastes and obsolete chemical stockpiles and contaminated sites.
- **Provide training in basic chemical handling and disposal procedures.**

Phase II:

- Repack unwanted chemicals and provide appropriate temporary storage facilities.

Phase III:

- Clean-Up contaminated sites and safety dispose of chemical stockpiles.

(Project is targeting stockpiles of waste and obsolete chemicals and chemical contaminated sites only).

LIST OF RESOURCE MATERIALS *

- SPREP Action Plan for Managing the Environment of the Pacific Islands Region 2001-2004
- Selected web-pages for the following international conventions and treaties:
  - Agenda 21
  - Basel Convention
  - London Convention
  - Rotterdam (or PIC) Convention
  - South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga)
  - SPREP Convention
  - UNCLOS
  - Waigani Convention
  - United Nations Environment Program – Persistent Organic Pollutants
- Immediate International Action on Persistent Organic Pollutants (POPs) (article / web page)
- Persistent Organic Pollutants in Pacific island Countries (POPs in PICs) (article / web page)
- Report on the Management of Persistent Organic Pollutants in Pacific Island Countries - Waste and Obsolete Chemicals and Contaminated Sites - Executive Summary
- Toxic Waste Clean-up in the Pacific (Press Release)

* Resource Materials for each Module can be provided upon request.

MODULE TWO
INTRO TO HAZARDOUS MATERIALS

INTRODUCTION

Module 2 is intended to provide participants with an overview of the major sources and types of hazardous waste in the Pacific Region. The characteristics, nature, source and extent of particular hazardous materials and hazardous chemicals will be explored.

Participants will discuss the types of environmental problems associated with the generation, storage and disposal of hazardous materials. Furthermore, participants will discuss the human-health issues associated with common hazardous materials. Finally, participants will examine the practices currently available for managing hazardous materials.

WORKSHOP OUTCOMES

At the end of this workshop module, you will:

- Appreciate the broad environmental impacts associated with hazardous wastes and hazardous chemicals;
- Be familiar with the types of hazardous materials prominent in the region;
- Describe the types of industries and activities that generate hazardous materials;
- Understand the health implications of human exposure to hazardous materials and chemicals; and
- Be familiar with the Codes of Practice governing the management of hazardous materials.

MODULE TWO
INTRO TO HAZARDOUS MATERIALS

HAZARDOUS MATERIALS IN THE PACIFIC

Hazardous materials include a variety of substances that can cause adverse impacts on the environment and human health.

Hazardous materials can be in the form of a gas, solid, liquid, sludge or an organism. They can be

Table 2.1: Properties of Hazardous Materials Commonly occurring in the Pacific Region

Chemical	Description	Source	Human Health Effects	Environmental Effects
Polychlorinated Biphenyls (PCB's)	A group of man-made chemicals developed for their insulating and nonflammable properties. PCBs are either colourless to light yellow oily liquids or solids.	Old capacitors, old transformers, old fluorescent lighting fixtures, some hydraulic fluids, old refrigerators	PCBs are carcinogenic (causes cancer), can cause liver and kidney damage, and skin damage.	Build up in fish and marine mammals.
Organochlorine Pesticides (OCP's)	OCP's are a family of chemicals including DDT, chlordane, dieldrin and aldrin. These chemicals remain persistent in the environment for many years.	Pesticide spraying Eating contaminated fish, beef, birds or plants.	Lowers immune system. Reproductive damage and birth defects. Pesticides build up in the fatty tissue of humans.	OCP's are very toxic to fish. OCP's can bio-accumulate in fish, birds and humans.
Timber Treatment Chemicals	Timber treatment chemicals include boron salts, pentachlorophenol (PCP), copper/chrome/arsenic (CCA). Boron, copper chrome and arsenic are all naturally occurring heavy metals. Pentachlorophenol is produced by the chlorination of phenol. In pure form, it exists as colorless crystals and has a characteristic odor when hot.	Timber treatment sites	*Boron salts:* skin irritations, vomiting *PCP:* skin irritations, headaches, kidney and liver damage, carcinogen. *CCA:* carcinogenic, vomiting, gangrene, central nervous system dysfunction.	PCP: Highly toxic to aquatic life, bio-accumulates. CCA: toxic to plant life, toxic to aquatic organisms.

Chemical	Description	Source	Human Health Effects	Environmental Effects
Polyaromatic Hydrocarbons (PAH's)	A group of chemicals formed during the incomplete burning of oil, coal, petrol, or other organic substances. PAH's exist as colourless, white or pale yellow-green solids.	Ash, asphalt, tar, charcoal, smoke, vehicle exhaust emissions.	PAH's are carcinogenic, and can cause birth defects.	Toxic to aquatic life, birds. Bio-accumulates
Bitumen	Bitumen is the black viscous substance used in road construction which contains PAH's.	Road construction, leftover drums	Carcinogenic, birth defects	Molten bitumen traps birds, contaminate groundwater and surface water
Waste Oil	Brown to black oily liquid used as a lubricant in engines. Waste oil contains a number of chemicals that formed during its operational use including PAH's.	Oil spills, motor vehicles, power stations, fishing vessels	Carcinogenic (PAH's), headaches, nausea, kidney damage, depression of central nervous system	Smothering effect on plants and benthic environment, coating fish and birds leading to death, vegetation die-back
Petroleum Hydrocarbons (fuel)	Yellowish to light brown liquid mixtures that originate from crude oil. This fuel includes diesel and petrol used in motor vehicles.	Petrol stations, drums, motor vehicles	Skin irritations, nausea, depression of the central nervous system.	Build up in plants and animals, poison water bodies.

TABLE 2.2: Examples of activities that require the use of hazardous materials

Activity	Examples of Hazardous Materials Used
Crop growing	Organochlorine Pesticides, Copper, Arsenic, Pentachlorophenol
Power Generation	Polychlorinated Biphenyls, Waste Oil, Polyaromatic Hydrocarbons, Sulphuric Acid, Lead
Road Building	Polyaromatic Hydrocarbons, Waste Bitumen
Timber Treatment	Boron Salts, Pentachlorophenol, Copper, Chrome, Arsenic.
Laboratories	Mercury, Acids, Alkalis, Chlorinated Hydrocarbons
Hospitals / Clinics	Pharmaceuticals, Clinical Waste, X-ray Fixing Chemicals, Sharps
Fuel Depot / Distribution	Petroleum Hydrocarbons, Benzene, Tolulene, Ethyl-benzene, Xylene, Lead
Vehicle Maintenance Workshops	Heavy Metals, Volatile Organic Compounds, TPH/BTEX, PAH's
Household Cleaning	Caustic Soda, Ammonia, Chlorine Salts, Bleach
Pest Control	Arsenic, Organochlorine Pesticides, Copper, Pentachlorophenol
Weed Control	Phenoxy Acid Herbicides, Copper, Arsenic, Pentachlorophenol
Landfills	Hydrogen Sulphide, Methane, Heavy Metals, Waste Oil, PCB's, PAH's.
Sewerage Treatment Plants & Water Treatment Plants	Chlorine Compounds, Aluminium Sulphate, Silver Nitrate
Boat Repairs	Tributyltin, Solvents, Pentachlorophenol, Lead(red), Bilge water

MODULE TWO
INTRO TO HAZARDOUS MATERIALS

Activity: Match the Substance to the Hazard

Your facilitator will describe a number of different hazardous materials. Participants will then be asked to match each substance to a particular hazard (eg: radiation, toxic, chemical, etc). As each substance is matched with its particular hazard, record it in the table below, as well as any specific environmental and/or health impacts associated with that substance.

zardous Substance	Type of Hazard	Impacts on Human Health and/or the Environment
Treated Timber	Chemical	Fixed in timber, toxic in smoke i.e. firewood or smoking fish

STANDARDS AND CODES OF PRACTICE

There are a number of international regulations, standards and codes of practice for the transport, storage, handling and use of hazardous chemicals.

These include:

Australian Standards

- ***AS 2507-1998***, Storage and handling of agricultural and veterinary chemicals.
- ***AS 2508.8.010-1990***, Safe storage and handling information cards for hazardous materials – Sulfuric acid.
- ***AS 2714-1993***, Storage and handling of hazardous materials – Class 5.2 substances.
- ***AS 3765.1-1990***, Clothing for the protection against hazardous chemicals.
- ***AS 1940-1993***, Storage and handling of flammable and combustible liquids.

The Australian standards can be purchased on-line from the Standards Australia web site at, **www.standards.com.au**

New Zealand Standards

- ***NZS 5418.1:1983***, Transportation containers for hazardous substances.
- ***NZS 5417:1986***, Specification for transportation labels for hazardous materials.
- ***NZS 4403:1976***, Code of practice for the storage and handling of explosives.
- ***NZS 3816:1998***, Management of clinical and related wastes.
- ***NZS 1596:1997***, Storage and handling of liquefied petroleum gas.
- ***AS/NZS 4452:1997***, Storage and handling of toxic substances.

The Australian standards can be purchased on-line from the Standards New Zealand web site at, **www.standards.co.nz**

United States of America Standards

- ***ASTM E1566-93***, Standard guide for handling hazardous biological materials in liquid nitrogen.
- ***ASTM F1127-88 (R1996)***, Standard guide for containment by emergency response personnel of hazardous material spills.
- ***FED DOT-E-8059***, Hazardous materials regulations.
- ***FED FED-STD-313D***, Material safety data, transportation data and disposal data for hazardous materials furnished to government activities.
- ***NAS 854***, Hazardous material packaging and safety data sheet preparation.

The United States of America Standards can be purchase on-line from the American Society for Testing and Materials web site, **www.astm.org**

The storage and handling of hazardous materials will be discussed in more detail in Module 4.

LIST OF RESOURCE MATERIALS

- Brief Notes on Different Types of Hazards (Identifying and Controlling Hazards – A Workbook)
- National Pollutant Inventory Database (web-sites) for 25 commonly occurring hazardous substances
- NCAP Publications: Pesticides and Alternative Factsheets (selected web pages)
- IOMC, POPs Assessment Report (1995) Chapter 6 – Substance Profiles for the POPs
- Useful Web-sites

www.environment.gov.au/epg/chemcials.html

www.environment.gov.au/epg/npi/index.html

www.environment.gov.au/cig-bin/epg/npi/database/

http://irptc.unep.ch/pops/indxhtms/asses6.html

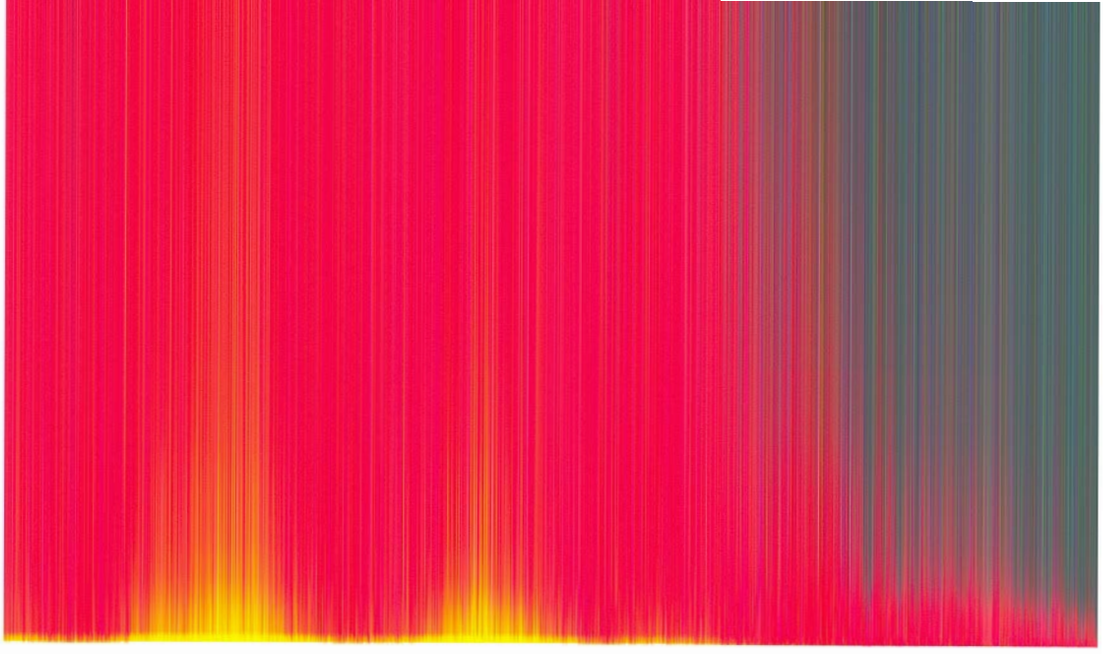
preparation of a **country report** for each country in the Pacific. Reports included,

- an overview of chemical stockpiles;
- an overview of contaminated sites; and
- the existence of regulations pertaining to management of hazardous materials and country-specific issues.

WORKSHOP OUTCOMI

At the end of this workshop module, I will:

- Be familiar with the hazardous materials and



IN-COUNTRY EXPERTISE

List the expertise of your fellow participants in managing hazardous materials, waste and contaminated sites:

Name: _____

Organisation:

_____

Expertise in the following issues:

_____

_____

Name: _____

Organisation:

_____

Expertise in the following issues:

_____

_____

Name: _____

Organisation:

_____

Expertise in the following issues:

_____

_____

Name: _____

Organisation:

_____

Expertise in the following issues:

_____

_____

POP'S in PIC's SURVEY – Samoa

COUNTRY VISITS

A survey of Samoa was conducted by Dr. Bruce Graham with the assistance of Mr. Lavaasa Malua, Senior Environmental Planning Officer, Division of Environment and Conservation, Department of Lands, Surveys and Environment.

The survey was carried out in May and June, 1998.

MAJOR SITES

Major sites visited during the survey included:

- Timber Treatment Site, Vaitele
- Timber Treatment Site, Asau
- Ministry of Agriculture, Forests, Fisheries and Meteorology (MAFFM), Nu'u
- MAFFM Forestry Offices
- MAFFM Store, Vaitele
- Electric Power Corporation (EPC), Viatele
- EPC Power Stations
- S C Percival Ltd., Apia
- Laboratories

Overview of Significant Stockpiles and Contaminated Sites

Ministry of Agriculture, Forests, Fisheries and Meteorology (MAFFM), Nu'u

- Waste Pesticides 2.5 tonnes

Electric Power Corporation (EPC)

- PCP Contaminated Transformer oil 9000 litres

Timber Treatment Site, Vaitele

- Timber Treatment Chemicals 10 000 litres

Electric Power Corporation (EPC), Viatele, Savaii

- Oil contamination

SAMOA: CHEMICAL INVENTORIES

Refer Tables 3.1 and 3.2 (pages 4 & 5) for a detailed list of chemical inventories obtained during the in-country survey.

Table 3.1 – POPs in PICs Survey Results

Waste and Obsolete Chemicals and Chemical Contaminated Sites

(POPs in PICs Report, Annex B: Chemical Inventories – Country/Site)

Site No.	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Sam01	Viatele	Bluebird Transport Ltd.	Ex timber treatment site	✗	✓
Sam02	Nu'u	Ministry of Agriculture	Agriculture research and extension	✓	✓
Sam03	Savalalo, Apia	S C Percival Ltd	Pest control chemicals	✓	✗
Sam04	Apia	Department of Health	National Hospital	✓	✗
Sam05	Vailima	Ministry of Agriculture	Livestock development	✓	✗
Sam06	Apia	Education Department (CDU)	Curriculum Development	✓	✗
Sam07	Viatele	Electric Power Corporation	Maintenance Base	✓	✓
Sam08	Vailima	Electric Power Corporation	Power Station	✗	✓
Sam09	Tafaigata	Department of Environment & Conservation	Apia Landfill	✗	✓
Sam10	Apia	Agriculture Stores Corporation	Agriculture chemical & other retail	✗	✓
Sam11	Viatele	Agriculture Store Corporation	Agriculture chemical & other	✗	✓
Sam12	Asau	Ministry of Agriculture/Forestry Division	Forestry office	✓	✗
Sam13	Asau	Ministry of Agriculture/Forestry Division	Forestry nursery	✓	✗
Sam14	Maota	Ministry of Agriculture/Forestry Division	Forestry office	✓	✗
Sam15	Asau	Samoa Forest Corporation	Timber Mill	✓	✓

Site No.	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Sam16	Salelologa	Electric Power Corporation	Power Station	✓	✓
Sam17	Savaii (2)	Electric Power Corporation	Power Station	✓	✓

Table 3.2 – POPs in PICs Survey Results
Chemicals Identified in the survey
(POPs in PICs Report, Annex B2, B3 and B4)

LOCATION	TYPE OF CHEMICALS	QUANTITY	CONDITION	DISPOSAL OPTIONS
Pesticides				
Sam02	Mancozeb	62.0 kg	Poor	Off-island disposal
Sam02	Maneb	10.0 kg	Poor	Off-island disposal
Sam02	Dimethoate	5.0 litres	Ok	Off island disposal
Sam02	Acephate	0.5 kg	Ok	Off island disposal
Sam03	Pyrethroid	150.0 litres	Ok	Local Use
Sam12	Iprodione	5.0 litres	Ok	Off-island disposal
Sam12	Etridiazole	2.0 kg	Ok	Off-island disposal
Sam12	Deltamethryn	1.0 litres	Ok	Off-island disposal
Sam12	Permethrin	3.0 litres	Ok	Off-island disposal
Sam12	Formaldehyde	5.0 litres	Ok	Local Use
Sam13	Carbofuran	4.0 kg	Ok	Off-island disposal
Sam13	Acephate	7.5 kg	Ok	Off-island disposal
Sam13	Iprodione	5.0 litres	Ok	Off-island disposal
Sam13	Dalapon	2.0 litres	Ok	Off-island disposal
Sam13	Formaldehyde	85.0 litres	Ok	Off-island disposal
Sam14	Fosetyl (aluminum)	1.0 kg	Ok	Off-island disposal
Sam14	Etridiazole	4.0 kg	Ok	Off-island disposal
Sam14	Deltamethryn	1.0 litres	Ok	Off-island disposal
Sam14	Iprodione	10.0 litres	Ok	Off-island disposal
Sam14	Amitrole	5.0 litres	Ok	Off-island disposal
Sam14	Mancozeb	7.5 kg	Ok	Off-island disposal
Sam14	4-indol-3-ylbutyric	1.0 kg	Ok	Off-island disposal
Hydrocarbons and PCB's				
Sam07	PCB's	50 transformers	Empty	Off-island disposal
Sam15	PCB's	250 litres	Ok	Off-island disposal

Sam16	PCB's	1000 litres	Ok	Off-island disposal
Miscellaneous Chemicals				
Sam01	Copper Chrome Arsenic	10000 litres	-	Off-island disposal
Sam04	Lab. chemicals	200 kg	Ok	Local use or disposal
Sam05	Lab. chemicals	100 kg	Ok	Local use or disposal
Sam06	Lab. chemicals	50 kg	Ok	Local use or disposal

RISK RATINGS OF CONTAMINATED SITES

The following information is taken from the *SPREP POP's in PIC's Report* (Refer Annex B.5, B.6 & B.7)

Contaminated sites identified during the in-country survey were assessed using the ***Rapid Hazard Assessment Scheme*, (New Zealand Ministry for the Environment, 1993).**

Under this system, risk ratings were based on:

1. Extent of contamination
2. Toxicity and mobility of contaminants
3. Contamination potential (food/water)
4. Ease of public access

Individual ratings for each of these four factors were combined to give an overall hazard rating for the site, ranging from 0 (non-hazardous) to 100 (extremely hazardous).

Outcomes:

Pesticide Contaminate Sites

Sam02 – Ag. Research Station
Rating **60** / Priority 13
Excavate contaminated soil, off-island disposal

Sam11 – Pest control chemicals
Rating 32 / Priority 16
Collect spillages & decontaminate, off-island disposal

Hydrocarbon Contaminated Sites

Sam07 – Transformer Maintenance
Rating **64** / Priority 10
Excavate contaminated soil, off-island disposal

Sam16 – Power Station
Rating **32** / Priority 31
Excavate contaminated soil for off-island disposal

Sam17 – Power Station
Rating **32** / Priority 32
Landfarming and oil management programme

SITES NOT LISTED

Are there areas that contain hazardous materials, hazardous wastes or contaminated sites that you are aware of that have not been discussed above? If so, please list these sites below.

_____

_____

_____

_____

_____

_____

_____

ON JOB TRAINING NEEDS

Training needs identified in the POPs in PICs report included:

- Chemical identification
- Safe chemical handling and disposal
- Sample Collection
- Clean-up of contaminated sites
- Disposal of chemical stockpiles

SAMOA: RECOMMENDATIONS

OP's in PIC's Report Phase One recommended hat Samoa may be included in the following ossible SPREP programmes:

- Regional programme for the removal of PCB contaminated transformer oil;
- regional programme to remediate pesticide contaminated sites including buried pesticides at the Nu'u research farm;
- Regional programme to dispose of hazardous materials in off-island treatment facilities including waste CCA identified at the abandoned timber treatment facility in Vaitele;
- Regional programme for the disposal of less hazardous materials including waste chemicals identified in the inspections;
- Regional programme for the remediation of CCA contaminated sites including the abandoned timber treatment facility in Vaitele. In the interest of public safety access to this site should be restricted immediately until such time as a comprehensive site evaluation be undertaken and any necessary remediation be undertaken. In particular the current industrial development at this site should be immediately curtailed;
- NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- International chemical management programs of UNEP, WHO, and FAO;
- Regional programme for the environmentally appropriate management of waste oil;
- Regional programme for the remediation of oil and diesel contaminated sites;
- Regional program to upgrade management of school laboratory chemicals;
- Regional program to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites; and
- WHO regional medical wastes and chemicals program.

Further, it was suggested that Samoa consider involvement in the following:

- Ratification of the Basel and Waigani Convention
- Development of a National Chemicals Profile
- Negotiations for a legally binding instrument for certain persistent organic pollutants .

LEGISLATION

A significant body of environmental law is already in legal effect or in draft form in Samoa. Various Governement Departments are mandated with administrative environmental responsibility. No single Samoa Government Department has final responsibility or authority or the full range of necessary initiatives.

To remedy this situation, the legislature passed the 1989 Land and Environment Act establishing a Division of Environment and Conservation within the Department of Lands, Surveys and Environment.

A number of existing pieces of legislation require some amendment in one form or another to take into consideration the environmental problems and concerns facing Samoa.

There are also other international conventions under the same auspices of the Internatinal Maritime Organisation relating to the protection of the marine environment, which Samoa is presently considering implementing as part of its domestic legislation.

The national statutes relevant to waste management are as follows:

- Health Ordinance 1959
- Water Act 1965
- Petroleum Act 1984
- Agriculture, Forests and Fisheries Amendment Act (1989)

- Ports Authority Bill 1989
- Lands and Environmental Act 1989
- EIA Regulations

Workshop Exercise:

Local regulations to control hazardous substances, hazardous waste and management of contaminated sites could be improved by:

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

SITE VISITS

If time permits, participants will visit a number of sites discussed in the POPs in PICs Country Report.

LIST OF RESOURCE MATERIALS

- POP's in PIC's Country Report for Samoa

DAY ONE
WORKSHOP EVALUATION

Your name: ..... (optional)

Organisation: .....

Country: .....

Date of Workshop: .....

MODULE 1

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

3. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

MODULE 2

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

3. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

Please circle the correct words:

MODULE 3

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

4. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

Please make any further comments about the training workshop:

OTHER COMMENTS

_____

_____

_____

_____

_____

Thank you for taking the time to provide feedback on the training workshop.
Please hand this form to your workshop facilitator.

MODULE FOUR
SAFE MATERIALS STORAGE & HANDLING

INTRODUCTION

The purpose of Module 4 is to provide participants with an overview of the different types of hazards that may be encountered when dealing with hazardous materials. Following on from this, participants will explore a range of practical storage and handling techniques that can be used to minimise the risk of harm occurring from such hazards.

WORKSHOP OUTCOMES

At the end of this workshop module, you will:

- Understand the different types of hazards associated with hazardous materials;
- Know what a Material Safety Data Sheet and how to use it;
- Be familiar with strategies to store, handle and transport hazardous materials; and
- Be aware of international techniques used for labelling hazardous materials.

BIOLOGICAL HAZARDS

Biological hazards are living agents capable of causing infection or disease in exposed individuals. Biological hazards include viruses, bacteria, fungi, and parasites.

Most biological agents require a host to complete their lifecycles. For example, dogs carry certain viruses (ie. rabies) which can then infect humans.

RADIATION HAZARDS

Radioactive materials can emit alpha particles, beta particles or gamma waves that cause cell dysfunction or even death.

Radiation can not be detected by the body through odour, irritation or taste. Preventing radioactive material from entering the body or protecting against external radiation is the best protection.

EXPLOSISIVE HAZARDS

A gas or vapour explosion is a rapid and violent release of energy, releasing heat and gaseous products.

Similar to flammable materials, explosive materials have lower and upper explosive limits. The most dangerous flammable substances require little oxygen to support combustion and have low LFL / LEL and a wide flammable / explosive range.

FLAMMABLE HAZARDS

Flammable materials (liquid, gas, or solid) are highly combustible (readily ignited). Fuel, oxygen and heat are the three elements required to ignite and maintain combustion.

Materials have a lower and upper flammability limit depending on the air and fuel ratio. The term too 'lean' refers to fuel that is less than the lower flammable limit where there is too little fuel to result in combustion. The term too 'rich' refers to too much fuel and too little oxygen for the fuel to combust.

MODULE FOUR
SAFE MATERIALS STORAGE & HANDLING

TOXIC HAZARDS

Toxic hazards cause adverse effects in an organism. These effects can include various types of poisoning, asphyxiation (oxygen depriving), irritation, mutations and cancer. Toxic hazards can be in the form of gases, liquids, sludges, and solids.

CHEMICAL HAZARDS

Chemical substances can occur as either solids, liquids or gases. They can enter the unprotected body through inhalation (breathing), absorption through the skin, ingestion (eating), or through a cut or wound.

Exposure to high concentrations of one or more chemical substances can harm a person in a relatively short period of time (this is known as an acute response). Conversely, exposure to low concentrations of chemical substance may not cause any noticeable harm in the short term, but can cause damage over a longer period of time (this is known as a chronic response).

Some chemicals may cause obvious symptons such as burning, coughing, nausea or rashes. Exposure to other chemicals (such as those that cause cancer or respiratory disease) may not be accompanied by such warning signs.

CORROSIVE HAZARDS

Corrosive substances erode other materials through a chemical reaction. Acids, bases and halogens are examples of corrosive substances.

Corrosive substances can cause severe skin burns and irritations.

MATERIAL SAFETY DATA SHEETS

A Material Safety Data Sheet is a one or two page information sheet that provides important information about a particular hazardous substance.

An MSDS provides information on the:

- Name of the substance (including product name, generic name and chemical name); (*For example: methane (a gas) is also known as methyl hydride, marsh gas and CH_4);*
- Active ingredients that make up the substance
- Chemical and physical properties of the substance;
- Health hazards (symptoms of exposure, etc);
- Safe use, handling and storage techniques;
- Recommended first-aid treatment instructions; and
- Manufacturers or importers name and contact details.

The MSDS is prepared by the manufacturer or supplier of the hazardous substance.

Material Safety Data Sheets are a useful way of informing workers about the health and safety risks of substances that they may be working with.

Activity: "Knowing your way around an MSDS".

MODULE FOUR
SAFE MATERIALS STORAGE & HANDLING

SAFE STORAGE

The safe storage of hazardous materials needs to incorporate several universal principles to minimise the potential of a hazard occurring. These include:

- Adequate bunding around the storage area
- Chemicals are stored within airtight containers
- Readily accessible storage areas
- Storage area should be a cool, dry, waterproof area
- Chemicals are not stored with other chemicals
- Equipped with fire fighting devices
- Equipped with a hand wash and emergency shower

The Material Safety Data Sheet (MSDS) should be referred for safe storage requirements for each hazardous chemical or product. For example, the safe storage specifications for Organochlorine Pesticides include:

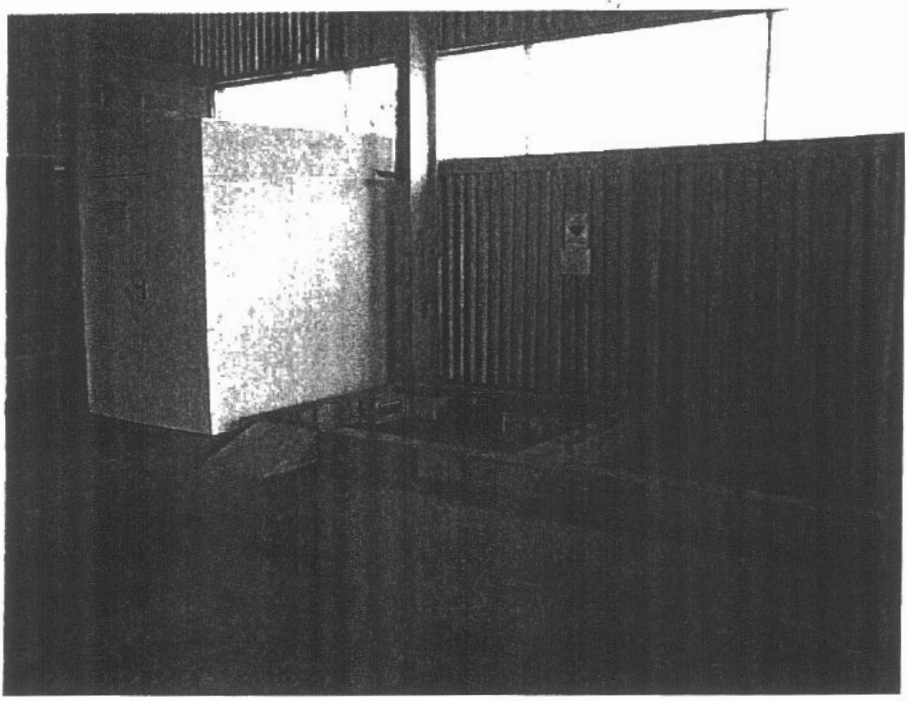
- Keep OCP's separate from other chemicals
- Keep in a locked, cool, waterproof shed out of direct sunlight. The shed must have an impervious floor.
- Keep OCP's away from watercourses or open storm-water drains.
- Keep pesticides stored in original containers.

SAFE STORAGE DESIGN

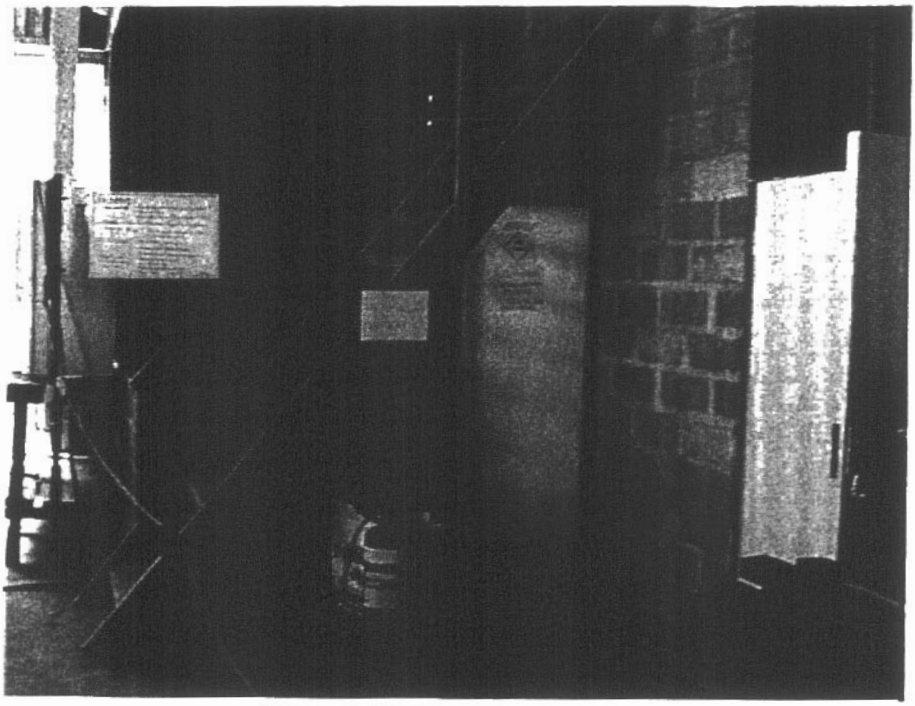
Safe storage design needs to incorporate the safe storage principles listed above.

Typical safe storage designs are shown in Figure 4.1a and 4.1b (pages 6 and 7).

Figure 4.1a:
Typical Designs for Hazardous Materials Storage Facilities



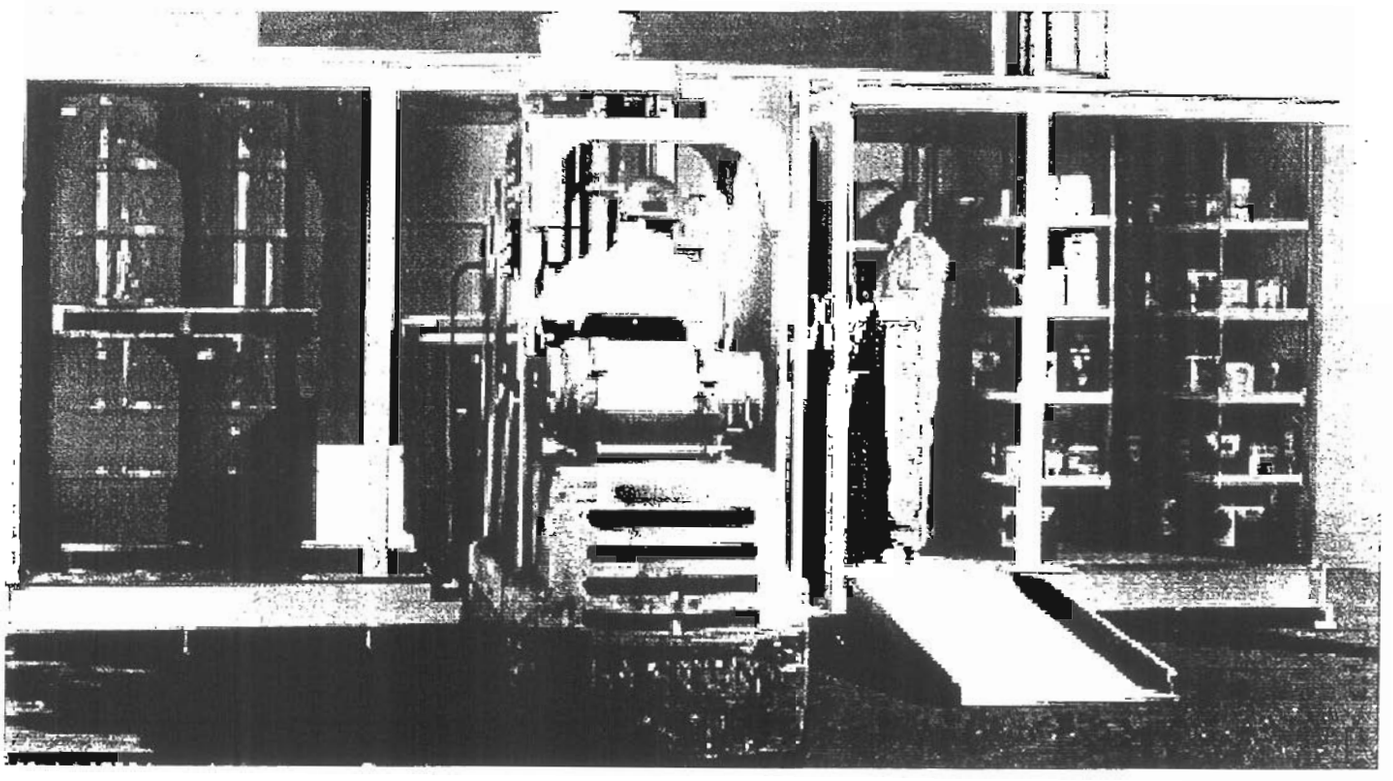
Example of a **sealed and bunded storage area**, which can be used for the storage of hazardous materials or hazardous wastes.



Example of a **sealed, bunded and lockable storage area,** which can be used for the storage of hazardous materials or hazardous wastes.

Figure 4.1b

Typical storage unit designs



This storage unit features:

- Separation of chemicals;
- Fire resistant, insulated walls;
- Adjustable shelving; and
- Secondary containment.

Images obtained from the,
WIC + Ideal Group web site, www.wicideal.com and
Chem-store web site, www.chem-store.com

STANDARD LABELLING

The United Nations has developed a system of classification and labelling for hazardous goods. This system is widely used by most countries throughout the world.

The classification system divides dangerous goods into nine different classes. These are:

Class 1 – Explosives
Class 2 – Gases

Class 3 – Flammable Liquids
Class 4 – Flammable Solids
Class 5 – Oxidising Substances
Class 6 – Poisonous and Infectious Substances
Class 7 – Radioactive Substances
Class 8 – Corrosives
Class 9 – Miscellaneous Dangerous Goods

Each Class Number has sub-classes to differentiate the varying types of hazardous materials within each class. For example, Class 2 (Gases) is further characterised into Class 2.1 (flammable gases), Class 2.2 (non-flammable gases, Class 2.3 (poisonous gases).

The hazardous goods are labelled with a coloured coded diamond that contains the above Class number codes. Refer to Figure 4.2 (page 11).

The United Nations has also devised a universal substance identification system. This is called the UN number. For example, UN 1075 = LP gas. This UN number is contained on the labelling.

Hazardous goods labelling will also contain a HAZCHEM code that provides information for emergency response action. The HAZCHEM code defines the appropriate means to contain, combat, or diffuse an emergency situation. For example, HAZCHEM code 3SE indicates that foam and full personal protective equipment must be worn, and evacuation should be considered. Refer to Figure 4.3 (page 12).

SEGREGATION REQUIREMENTS

Segregation of hazardous substances means keeping incompatible substances apart from one another when being stored or transported together. Incompatible substances are those that will react if they can come into contact. Typical reactions may include explosions, fire, or the generation of toxic gases.

Figure 4.4 (page 13) provides information that will assist you in determining the appropriate segregation requirements for different types of hazardous substances.

Figure 4.2

Hazardous Goods Labels

(also known as Hazardous Goods Class Diamonds)

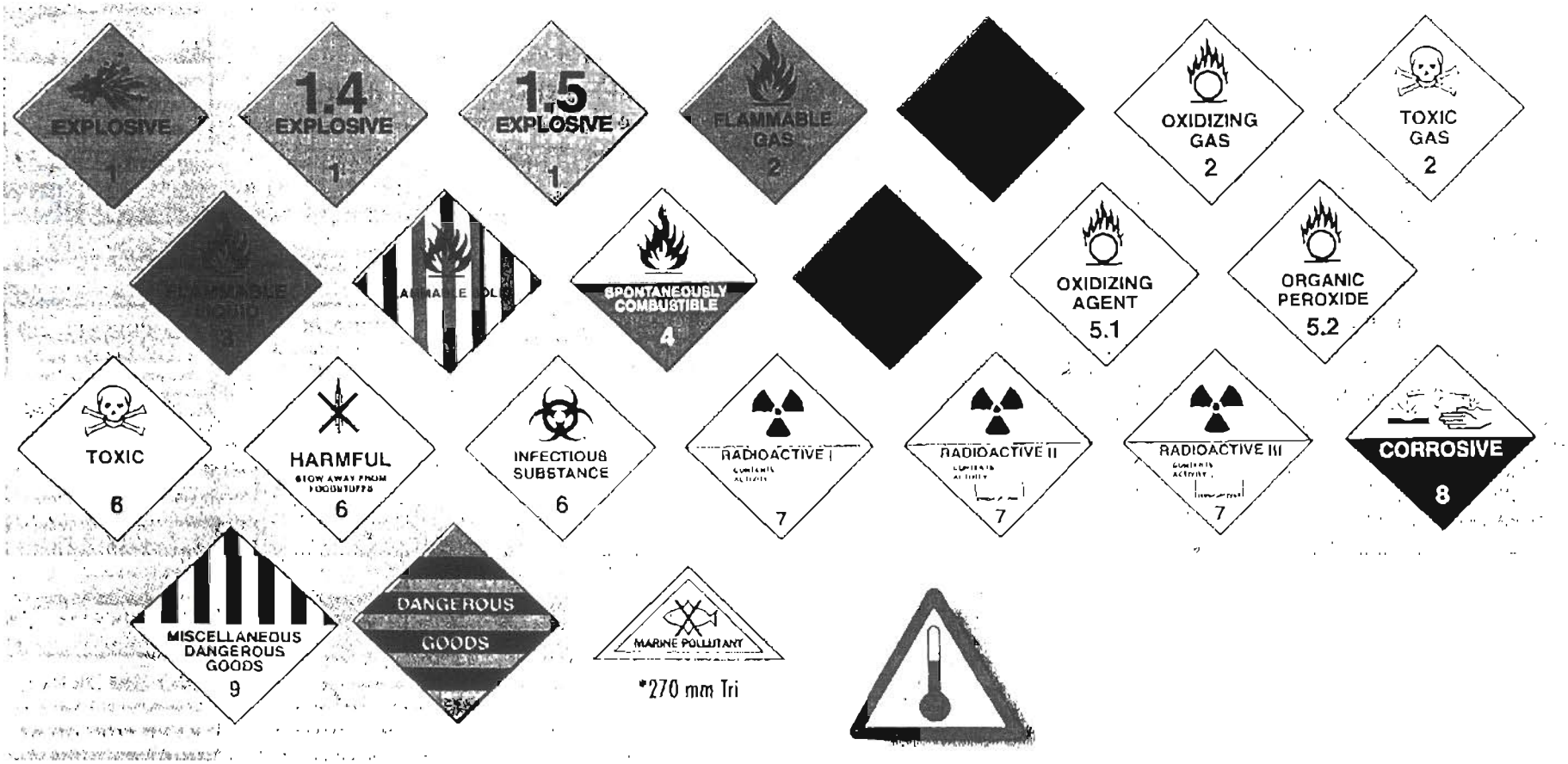


Figure 4.3

The HAZCHEM Code

Source: CSIRO Minerals Occupational Health, Safety and Environment Web-Site (http://www.minerals.csiro.au/safety/dangood.htm)

The HAZCHEM Emergency Action Code For Fire or Spillage:

1 WATER JETS 2 FOG 3 FOAM 4 DRY AGENT

P	V	FULL	
R			
S	V	BA	
S		BA for FIRE only	DILUTE
T		BA	
T		BA for FIRE only	
W	V	FULL	
X			
Y	V	BA	CONTAIN
Y		BA for FIRE only	
Z		BA	
Z		BA for FIRE only	

E	CONSIDER EVACUATION

Notes For Guidance:

The HAZCHEM Code provides advisory to personnel who are responding to an incident involving hazardous substances, to assist them in taking appropriate action to combat that incident.

Key For HAZCHEM Code:

V – risk of violent reaction or explosion.

BA – use breathing apparatus plus protective gloves.

FULL – use full body protective clothing with breathing apparatus.

DILUTE – may be washed away with large quantities of water. and where practicable contain and prevent from entering drains and watercourses.

CONTAIN – prevent spillage from escaping into drains and watercourses (such as streams, rivers, oceans, or stormwater channels).

WATER FOG – in the absence of fog equipment, a fine spray may be used.

Figure 4.4

Hazardous Substances - Storage Segregation Requirements

		2.1	2.2	3.1	4.1	5.1	6.1	8
								
2.1				FS	FS	PR	FS	FS
2.2				SG	SG	FS	SG	SG
3.1		FS	SG		FS	PR	FS	SG
4.1		FS	SG	FS		PR	FS	FS
5.1		PR	FS	PR	PR		FS	FS
6.1		FS	SG	FS	FS	FS		SG
8		FS	SG	SG	FS	FS	SG	

KEY

PR	Chemical classes are prohibited in the same or adjacent storage areas Must be stored in separate areas at least 10m apart
FS	Chemical classes must be fire seperated
SG	Chemicals must be seperated from each other by a distance of at least 3m
	Segregation is not applicable and chemical classes can be stored in the same area.

Note: Refer to www.minerals.csiro.au/safety/dangood.htm for full details of segregation required for other classes not shown.

LIST OF RESOURCE MATERIALS

uide for the Storage and Handling of dangerous Goods – University of Wollongong, Occupational Health and Safety Division.

The Land Transport of Dangerous Goods in Australia – Commonwealth Department of Transport and Regional Services (Land Transport).

- *Classification of Dangerous Goods* – Work Cover NSW (Chemical Safety Unit).
- Selected factsheets (8) on chemicals management - Minerals and Energy Western Australia (Goods Division).
- *Safe handling of organochlorine pesticides on farms* – Environment Australia (Scheduled Wastes Management Group).
- *The Hazchem Code* - Queensland Government.
- *Material Safety Data Sheets and Labels* – Department of Training and Industrial Relations (Workplace Health and Safety) Brochure 037.
- *Workers and Hazardous Substances* – Department of Training and Industrial Relations (Workplace Health and Safety) Brochure 024 (page 1).
- Selected Material Safety Data Sheets (48).
- Web Sites:

www.environment.gov.au/epg/swm/

www.ruralfire.qld.gov.au/Level2/M12/

www.minerals.csiro.au/safety/dangood.htm

www.dme.wa.gov.au/prodserv/pub/

www.uow.edu.au/admin/personnel/ohs/

www.dotrs.gov.au/land/vehicle/danger/dgoodsum.htm

www.jtbaker.com/msds/

http://msds.pdc.cornell.edu/msdssrch.asp

www.vetmed.ucdavis.edu/msds/

www.epa.gov/epaoswer/osw/tsd.htm

MATERIAL SAFETY DATA SHEET FORMAT

Section Headings on sheet ← The advice you can find in each section
Date of issue ← Check if it is up to date (not more that 5 years old)

MANUFACTURER'S OR SUPPLIER'S DETAILS

Company ← This tells you how to contact the supplier
Address
Telephone number
Emergency telephone number

IDENTIFICATION SECTION

Product names
Other names
Manufacturer's product code ← This is where you can check identification against the label (make sure you have the right MSDS).

UN number
Dangerous Goods class
and subsidiary risk ← UN numbers apply to substances classified as dangerous goods. Some hazardous substances may also be dangerous goods and/or scheduled poisons.

Hazchem code
Poisons schedule number
Packaging group ← The Hazchem code is for fire fighting.

USE

Here you find the uses recommended or intended by the manufacturer and methods of application. These should be followed to ensure safe use.

PHYSICAL DESCRIPTION AND PROPERTIES

This covers a wide range of technical information on properties such as melting and boiling points, flash point and flammability.
You can also find information on reactivity with other common substances, which is very important when considering safe use and storage.

INGREDIENTS

Chemical name
CAS number ← This gives you the chemical identity of each hazardous ingredient. The CAS number also identifies each ingredient. In some cases generic names and a range of concentrations (e.g. 30 - 60%) are used.

Proportions

HEALTH HAZARD INFORMATION

Health effects:
- acute ← Here you find the short-term effects of exposure to the product by the relevant routes of exposure (if any).
  - swallowed
  - eye
  - skin
  - inhaled
- chronic ← These are the long-term effects (if any).

MODULE FIVE
HAZARDOUS WASTE MANAGEMENT

INTRODUCTION

Module Five is intended to provide participants with practical strategies for safely disposing of hazardous waste. Country-specific hazardous waste streams will be examined and disposal options and associated disposal costs will be discussed. Furthermore, the status of hazardous waste management infrastructure in individual PIC's will be explored.

This module is also designed to raise participant awareness of **ways to prevent the generation of hazardous waste in the first place.**

WORKSHOP OUTCOMES

At the end of this workshop module, you will:

- Understand options and costs for the disposal of a variety of hazardous waste streams;
- Be aware of a range of hazardous waste treatment methods; and
- Be able to identify strategies for preventing the generation of hazardous waste.

HAZARDOUS WASTE STREAMS

The major hazardous waste streams for Pacific Island Countries include:

- Polychlorinated biphenyls (PCB's)
- Pesticides
- Timber treatment chemicals
- Polyaromatic Hydrocarbons (PAH's)
- Bitumen
- Waste Oil
- Petroleum Hydrocarbons / BTEX

HAZARDOUS WASTE MANAGEMENT OPTIONS

The hierarchy of management options includes reduce; re-use, recycle or recover; and treatment and disposal.

Waste reduction aims to prevent the generation of hazardous waste at the source rather then disposing or treating the waste after it has been generated.

Activity: List some ways how you can reduce waste:

1. _____

2. _____

3. _____

Re-use, recycle or recover strategies also aim to **reduce waste generation**. For example, waste oil from automobiles could be used as a secondary fuel for a burner or incinerator.

Activity: List below, some how some can be re-used, recycled or recovered.

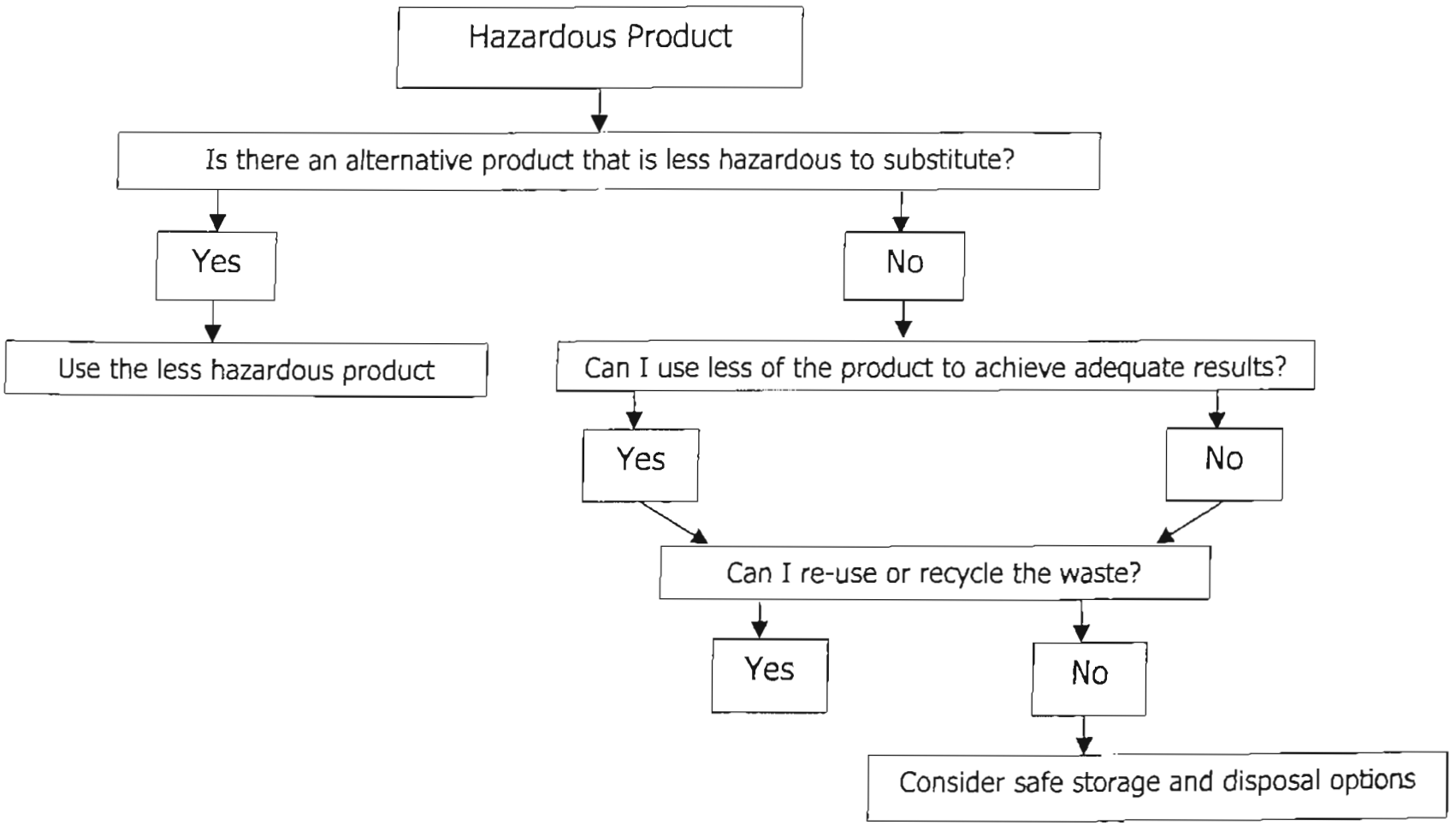
1. _____

2. _____

3. _____

Refer to Figure 5.1 for a waste management decision-making activity.

Figure 5.1: Waste Management Decision-making Process



MODULE FIVE
HAZARDOUS WASTE MANAGEMENT

HAZARDOUS WASTE TREATMENT METHODS

There are a number of different treatment technologies available to process hazardous waste. These include incineration at high temperatures, encapsulation, cementation, ball milling, plasma arc, enzyme treatment, bioremediation, and dechlorination techniques.

The treatment technology used to treat hazardous waste will depend on the type of waste. For example, organic waste (ie. pesticides, petroleum hydrocarbons), and PCB's can be incinerated to remove the toxic substances, however heavy metal waste cannot be removed by incineration. Leachable heavy metal waste may require fixation or encapsulation before burial at a landfill.

Some waste may require **off-island disposal** where facilities are inadequate to treat or dispose of certain hazardous waste. **Such disposal will need to be in accordance with the Basel and Waigani Conventions.**

Refer to Table 5.1 for a list of treatment technologies for various hazardous wastes.

Table 5.1: Hazardous Waste Treatment Technologies

HAZARDOUS WASTE	TREATMENT METHOD	TREATMENT PROCESS DESCRIPTION
Polychlorinated Biphenyls (PCB's)	High Temperature Incineration	Cement kilns are used to burn hazardous waste. A cement kiln comprises a long inclined cylinder (50m to 150m) which is rotated. Waste material passes down the kiln and fired at very high temperatures. The waste molecules reform into non-hazardous clinkers which are used to make cement.
	Plasma Arc	A thermal plasma field is created by directing an electrical current through a low pressure gas stream. Plasma arc fields reach very high temperatures (up to 15,000 °C). The high temperatures dissociate the waste into its atomic elements.
	Chemical / Physical Treatment	There are a number of chemical treatment processes including cement fixation, dechlorination of PCB's.
Pesticide Wastes	Disposal to Local Landfill	Pesticides can be mixed with limed and buried at depth.
	Off-Island Disposal	Incineration Thermal Desorption
Timber Treatment Chemicals	Disposal to Local Landfill	Cement Solidification: Copper, chromium and arsenic wastes can be mixed with lime and cement to render the chemical immobile and inert.
	Off-Island Disposal	Encapsulation and burial
Polyaromatic Hydrocarbons (PAH's)	Disposal to Local landfill	Burial
	Off-Island Disposal	Incineration Enzyme treatment technologies: aerobic degradation process using a mixture of enzymes.
Waste Oil	Recycle	A number of different treatment process are available including filtration, thermal cracking, dehydration, chemical treatment and distillation (these typically require access to specialised equipment and facilities).
Petroleum Hydrocarbons (Fuel)	Bioremediation	Contaminated soil can be bioremediated. This process encourages naturally occurring bacteria within the soil to break down the hydrocarbon molecules. The soil is usually prepared with fertiliser and water to obtain optimum conditions.
Heavy Metals	Disposal to Landfill	Fixation / Cementation: contaminated soil is mixed with cement to prevent heavy metals from leaching out into the groundwater.

MODULE FIVE
HAZARDOUS WASTE MANAGEMENT

LIST OF RESOURCE MATERIALS

- *Hazardous Waste: Pretreatment Technologies* – CMPS&F and Environment Australia
- *Treatment Technologies for Destruction or Management of Arsenic Waste* – Environment Australia (Environment Protection Group)
- Treatment Technologies Screening Matrix
- *Strategy for Hazardous Waste Minimization and Combustion* – RCRA/UST, Superfund and EPCRA
- Model Code of Practice: Timber Preservation Plants – Management of Persistent organic Pollutants in Pacific island Countries (Annex C.6)
- *Introduction to Hazardous Waste Incinerators* – RCRA, Superfund & EPCRA
- *Geosynthetic Clay Liners Used in Municipal Solid Waste Landfills* – USE EPA (Solid Waste and Emergency Response Division)
- Useful Web sites:

www.environment.gov.au/epg/swm/swtt/technologies.html

www.epa.gov/epaoswer/osw/treatech/htm

www.frtr.gov/matrix2/section3/matrix.html

www.environment.gov.au/epg/hwa/index.html

MODULE SIX
PERSONAL SAFETY

INTRODUCTION

The purpose of Module 6 is to familiarise participants with the different types of **Personal Protective Equipment (PPE)**, that can be used to protect the worker from hazards associated with the use, handling and storage of hazardous substances.

Participants will discuss the general types of PPE available as well as learn about the different levels of protection required for different types of hazards.

Module six will also explore issues relating to the decontamination (cleaning) of Personal Protective Equipment and other equipment used at sites containing hazardous materials.

Throughout the module, participants will be asked to **consider the limitations faced regarding availability of the different types of PPE** discussed, and what alternative approaches can be used to can overcome these.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

1. Be familiar with the different types of PPE available;
2. Know how to select the appropriate protective equipment for use at a site containing hazardous materials;
3. Understand the different levels of personal protection required for exposure to different hazardous episodes; and
4. Be able to apply decontamination procedures for PPE and other equipment used at a site containing hazardous materials.

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) is worn by a person to protect them against the harmful effects hazardous materials can have on the body.

Different types of PPE protect different parts of the body, including the respiratory system (lungs and breath), skin, the eyes, face, hands, feet, head, body (and ears).

Examples of PPE, include:

Overalls, boots and gloves (for skin and body protection)

Breathing apparatus and dusk masks for respiratory protection

Glasses for eye protection

Hard hats for head protection

LEVELS OF PROTECTION

he type of PPE required at a site will depend on several factors including

- physical **form of hazardous materials** (ie: is it a gas, solid or liquid?);
- **toxicity** of material (what effect will material have if a worker comes into contact with it?);
- **amount** of material present; and
- **potential for exposure** whilst work is being conducted.

Other important things to consider are the **cost and availability** of PPE and its suitability in the given situation (see "Question and Answer" example at the end of this section).

In Pacific Island Countries a critical factor in deciding what sort of PPE should be worn is availability. There is no point in specifying somebody wear a special breathing apparatus or a chemical resistant suit, if they don't have access to one in the first place. In cases like this, you will often have to make do with what is available – you might be surprised however items sold in your local supermarket or hardware store, that can be used as basic PPE.

Activity: Basic PPE requirements.

The table provided on page 5, lists six things that PPE can provide protection against (that is: respiratory system, skin, hands, feet, eyes. and head). The rest of the table has been left blank. As a group, discuss each column and fill in each space as you go along. When completed, the table will provide you with a list of basic PPE items, information on the limitations of these items and where you might be able to purchase them.

ACTIVITY: BASIC PPE REQUIREMENTS

Basic PPE Requirements	Examples of PPE	Provides protection against	Limitations	Possible suppliers
Hand Protection				
Head protection				
Eye Protection				

Basic PPE Requirements	Examples of PPE	Provides protection against	Limitations	Possible suppliers
Skin Protection				
Foot Protection				
Respiratory Protection				
Other Items				

It is important to note that **some work situations may require the use of higher levels of protection that is not commonly available** in your country.

Such situations may include:

- release of a toxic gas that requires use of specialised breathing equipment to stop you from inhaling the gas; or
- release of carcinogenic (cancer causing) substance that requires use of a specially designed body suit to protect the skin against exposure.

In the event that such a situation occurs, list below some of the things you could do:

1. _____

2. _____

3. _____

4. _____

5. _____

Question: What would be one problem associated with the use of PPE such as chemical resistant suits and overalls in a Pacific Island Country?

Answer:

_____

_____

_____

_____

_____

Note: **PPE should be purchased in advance** and keep in a central location so that it is available for use when required. Nominate someone to regularly check what PPE is available on site, to see whether new items need to be ordered in.

In many nations, where access to specially designed PPE is readily available (and often required by law), there are four basic **levels of protection** that can be used at a site. These range from "Level A" which provides the maximum amount of protection in the most hazardous situations, through to "Level D" which is used at a site with only little or no hazards present.

Further information on types of PPE required for each of the four levels is provided in Figure 6-1, on page 8. A summary of the key factors that should be considered when deciding on what level of protection is required at a site containing hazardous materials, is provided in Table 6-1, on Page 9. (This information is provided for your general interest only - the majority of equipment listed will probably not be available in most Pacific Island Countries at present).

Remember: PPE is only one way of ensuring the safety of workers and it may even be relatively ineffective if used on its own. For example: there is no point in providing staff with overalls and safety glasses if they are then going to smoke cigarettes on a site that contains unsealed drums of fuel.

To adequately protect the health and safety of people working at a site containing hazardous materials, other safe work practices such as the preparation of site safety plans, emergency response procedures and personal induction must also be undertaken.

IF IN DOUBT – STAY OUT and always ensure:

1. Everyone understands the hazards involved;
2. Everyone is properly protected
3. There are at least two people on site so one person can go and get help if required.

Figure 6-1: The Four Different Levels of Personnel Protection

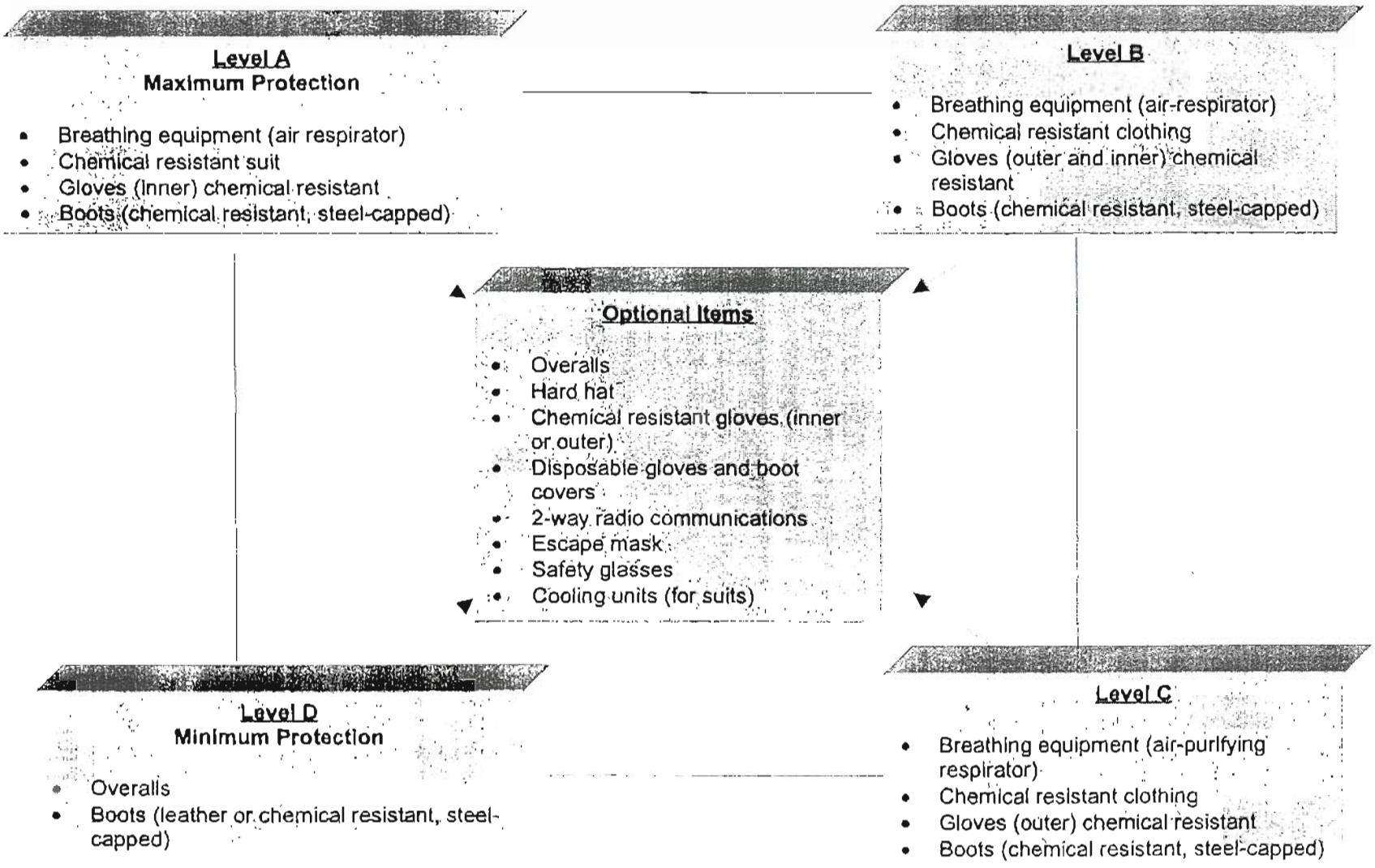


Table 6.1 – Levels of Protection
Criteria for Selection

Level A	Level B	Level C	Level D
Maximum protection	High level of respiratory protection but less skin (and eye) protection than Level A	Medium level of respiratory protection, same level of skin protection as Level B	No respiratory protection, minimum level of skin protection
▪ Chemical substance(s) has been identified and based on its high concentration and/or high potential for exposure, the highest level of protection for skin, eyes and the respiratory system is required; or ▪ substances with a high degree of hazard to the skin are known or are suspected to be present and skin contact is possible; or ▪ operations to be conducted in confined, poorly ventilated areas and it is not known if highly hazardous chemicals are present ▪ high levels of unidentified vapours and gases have been recorded.	▪ Chemical substance has been identified and based on its atmospheric concentration, a high level of respiratory protection is required. (Less skin protection than Level A is required due to concentration and nature of substrate representing less of a skin hazard, and operations not resulting in high potential for exposure); or ▪ unidentified vapours or gases have been recorded to occur at the site, however levels of these substances are not thought to contain levels of chemicals toxic to skin.	▪ low levels of atmospheric contaminants requiring low level of respiratory protection, known to occur at site; or ▪ medium level of skin protection required, given that work conducted will not generate high concentrations of vapours, gases or particulates, or splashes of material that will effect the skin.	▪ no contaminants are present; or ▪ work functions will not result in splashes, immersion or potential for unexpected inhalation of any chemicals.

EQUIPMENT DECONTAMINATION PROCEDURES

Whilst working with hazardous materials, it is likely that the equipment used on the site has become contaminated by some or all of the hazardous material present. To avoid transferring this contamination to a clean, uncontaminated site or to an area where people may be exposed to the contaminant, it is important to decontaminate all equipment used at the site, including PPE. Personal removing contaminated clothing, must also be careful not to come into contact with or inhale contaminants.

The level and type of **decontamination** required will normally depend on:

- the type of hazardous material present;
- the amount of contamination;
- the type of protective clothing worn; and
- the type of equipment used.

For example, decontamination at some sites may simply involve throwing disposal gloves in the bin and laundering any clothing worn. Alternatively, equipment decontamination at other sites may involve establishing a number of decontamination stations at the site, scrubbing earth-moving equipment with detergent and incinerating clothing.

As a general rule, the more harmful the contaminant, the more extensive decontamination must be.

Tip: Preventing equipment becoming contaminated in the first place, will reduce the level of decontamination required at the end of the project or task. This can be achieved by:

- use of remote sampling techniques;
- do not open containers by hand;
- place bags around monitoring equipment;
- water down dusty areas; and
- do not walk through obvious areas of contamination.

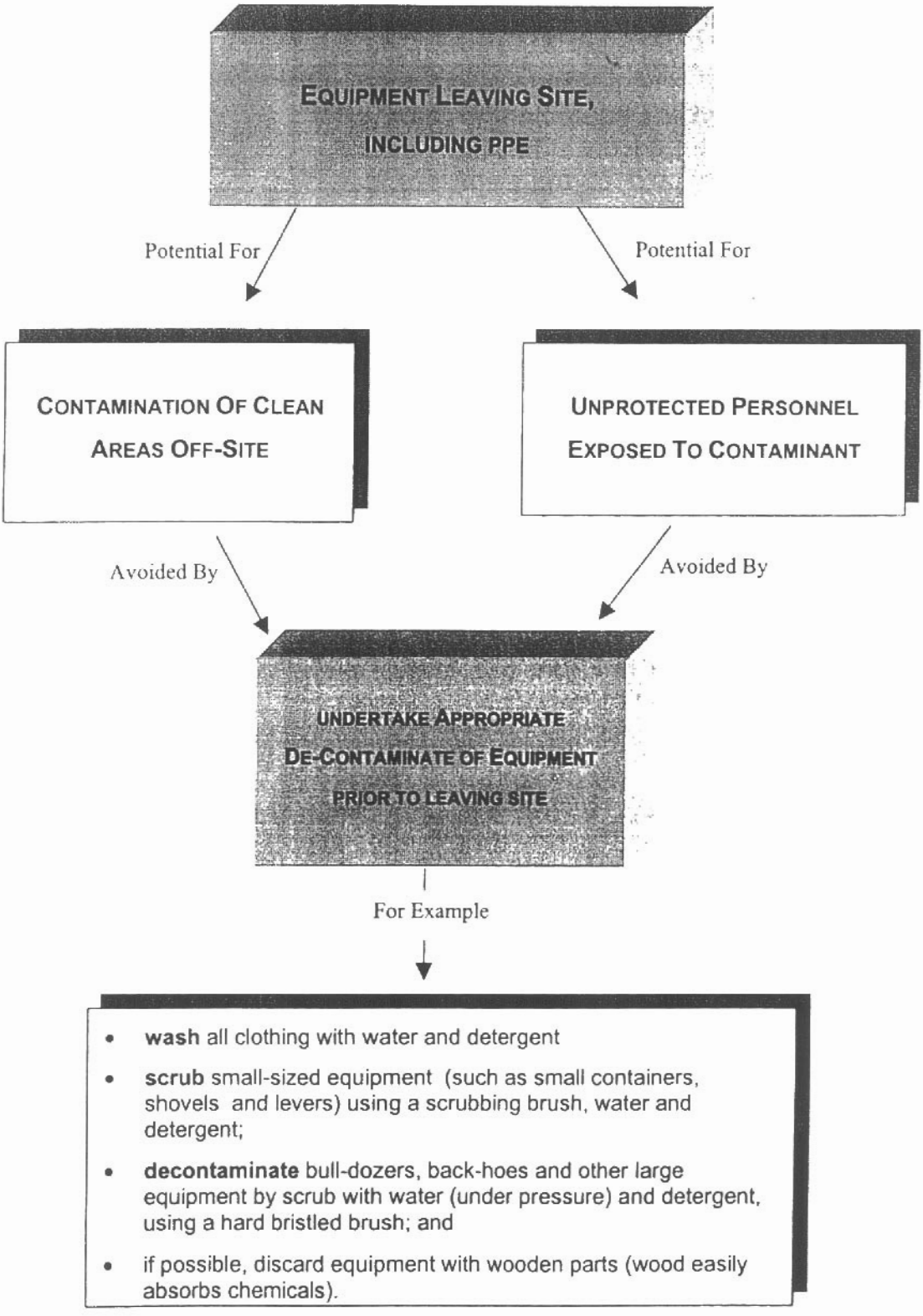
Note: Water is commonly used to wash down equipment and PPE on site. In some countries, water is a scarce commodity. Be aware of wastage and only use the minimum amount required.

Remember: **everytime equipment is removed off-site it must be decontaminated** – even if it is going to be used at the same site that afternoon or the next day.

An important step to remember in the decontamination procedure is that all materials and equipment used for decontamination must be disposed of properly. Contaminated equipment such as buckets, scrubbing brushes, disposable clothing and even wash water, should be placed in containers, preferably ones that can be sealed, and then labelled, then store and dispose of containers as you would for any hazardous materials or hazardous waste.

A general overview of the decontamination procedure is provided in Figure 6-2, located on the following page (page 12).

Figure 6-2: PROCEDURE FOR EQUIPMENT DECONTAMINATION



LIST OF RESOURCE MATERIALS

- Example of a Site Safety Plan (sourced: Golder Associates)

- "Personal Protective Equipment Information for Workers" – Department of Training and Industrial Relations – Brochure 019 (1997)

- Examples of PPE commonly used in Australia (exerts from Pro-safe Direct PPE Ordering Catalogue)

- Supplier of Specialised Personal Protective Equipment in Australia (Note: Details only provided below and not in Resource Materials section of manual)

  Company Name: Pro-Safe Direct
  Ph: + 617 8787 2944
  Fax: + 617 8787 2955
  E-mail: yourorder@prosafe.com.au
  Web-Site: www.prosafe.com.au

Selected information sourced from the National Safety Council of Australia (NSCA) 3 Day Contaminated Sites Training Course - Participant Notes (Chapter 13 and 19)

MODULE SEVEN
COUNTRY ISSUES

INTRODUCTION

The purpose of Module 7 is to review material presented in previous modules and turn any issues raised into country specific actions aimed at mitigating the problems associated with managing hazardous materials and contaminated sites.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

- Relate the safe materials storage and handling procedures (Module #4) to local conditions;
- Relate the hazardous waste management procedures (Module #5) to local conditions;
- Relate the personal safety procedures (Module #6) to local conditions; and
- Agree upon **a local action plan** for implementing procedures aimed at effective management of hazardous materials and hazardous waste.

ANALYSIS OF PROCEDURES FROM MODULES 4-6

Effective Management Procedures

Describe below, the reasons why the management procedures **would work** in my country:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Ineffective Management Procedures

Describe below, the reasons why some of the management procedures **would not** work in my country:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

MODULE SEVEN
COUNTRY ISSUES

ACTION PLAN

Action	Who	When
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop

DAY TWO
WORKSHOP EVALUATION

Your name: ..... (optional)

Organisation: .....

Country: .....

Date of Workshop: .....

MODULE 4

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

3. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

MODULE 5

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

4. The module was:

   Easy to understand/ Not easy to understand

DAY TWO
WORKSHOP EVALUATION

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

MODULE 6

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

5. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

OTHER COMMENTS

Please make any further comments about the training workshop:

_____

_____

_____

_____

_____

Thank you for taking the time to provide feedback on the training workshop.
Please hand this form to your workshop facilitator.

MODULE EIGHT
HAZARD CONTROL SYSTEMS

INTRODUCTION

The purpose of Module 8 is to familiarise participants with the concept of **Hazard Control Systems.** This will include learning about how to identify a substance and associated hazards; evaluating the risk of that substance to human health and the environment; and putting in place control mechanisms to prevent or minimise the any identified impacts.

Participants will undertake practical work examples of hazard control systems, by preparing a management plan for a site specific to their country.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

1. Understand the concepts and components of hazard control systems;
2. Understand basic principles for identifying hazardous substances;
3. Apply a simple risk assessment process to a site containing hazardous materials;
4. Be familiar with common techniques used to control hazardous materials;
5. Know how to obtain information required to effectively manage hazardous materials;
6. Be aware of various safety procedures that can be taken when dealing with hazardous materials; and
7. Apply basic hazard control principles to a local situation by preparing a hazardous site management plan.

HAZARD CONTROL SYSTEMS

At all sites containing hazardous substances, there is always a risk that something will happen that will result in harm to either the environment, human health or property.

For example: drums containing agricultural pesticides or other chemicals can rupture and the contents may leak into the ground or a nearby watercourse.

Such events are commonly called **incidents**, or in extreme cases are called emergencies, where the risk to the environment and/or humans is significantly high.

Incidents can happen at any site containing hazardous substances, however, there are many things that we can do, to minimise or reduce the chances of an incident occurring – and it is this that forms the basis of Hazard Control Systems.

Hazard Control Systems are based on **preventing** an incident from occurring by:

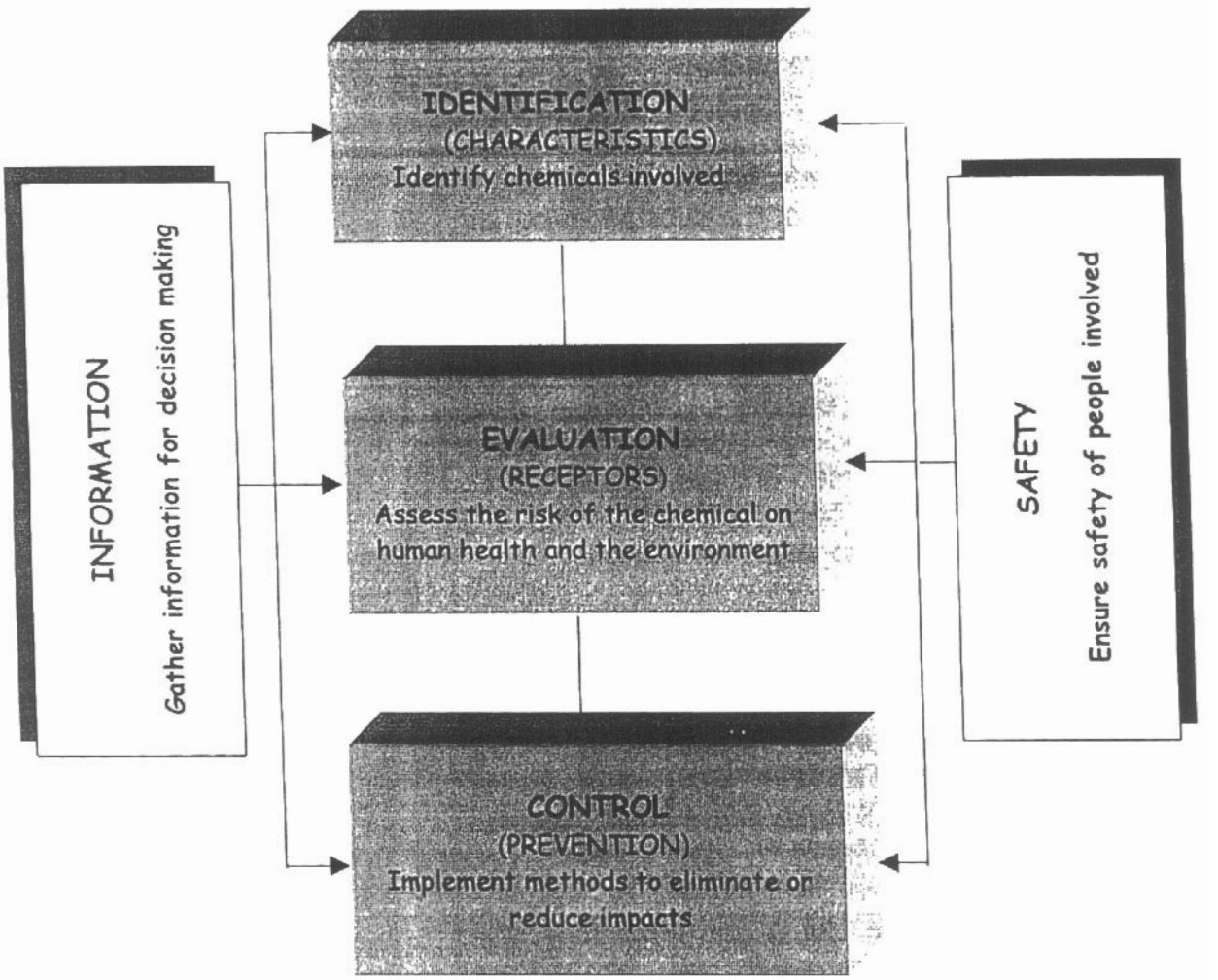
- **identifying any** hazardous substance's present;
- **evaluating** the likely risks associated with these substances; and
- putting mechanisms in place to **control** those risks.

Throughout the entire process, **information** is collected to assist in decision making, and consideration is also given to the **safety** of on-site personnel and others (eg: the public).

A summary of each component of a Hazard Control System is provided in Figure 8-1 on Page 3. Each component is then discussed in more detail on the following pages.

Figure 8-1: Components of a Hazard Control System

A Hazard Control System is made up of the following interacting components:



Note:

Hazard Control Systems are not perfect – sometimes incidents do happen, even under the most controlled situations. In the event that an incident does occur, there are still things that can be done to minimise any impacts arising from that incident. These are discussed in detail in Module 9 (Incident and Emergency Response).

HAZARDOUS SUBSTANCES IDENTIFICATION

Hazardous substances **identification** is the process of identifying which substances are present at a site that may be potentially harmful to the environment, human health or property. It provides basic information about the hazard including:

- name of substance;
- quantity of substance at site;
- properties of the substance that make it harmful;
- associated compounds; and
- dispersion pathways of the substance (eg: air, water, soil).

Hazardous substances identification is achieved by using all types of available information including visual observations, historical data, shipping receipts, package labels and reference material(MSDS). Some of these information sources have already been discussed in Module 4 – "Safe Materials Storage and Handling".

It is not always possible to identify what substances are present at a site, or alternatively, you may only have limited information available on particular substances present. In the event that this happens, **always assume a worst case scenario**, until more information becomes available.

Note: One way of avoiding this problem in the future, is to **make sure all hazardous materials imported into the country are properly labelled.** In addition, ensure that the name and quantity of all materials being imported are listed on the shipping receipts, purchase orders and other documentation, which should then be filed away for future reference if required.

Once you have identified the types of the hazardous substances present at a site, you can then proceed to determine the likely effects that substance may have on public health, property and the environment.

EVALUATION OF RISK

Risk is the probability of harm being done - it is a measure of the potential impact or effect of a substance.

Evaluation of risk (also called Risk Assessment) involves determining the **significance** (or importance) of all the potential impacts, a substance can have on public health, property or the environment. By doing this, you are able to **rank each impact**, from the most significant (and therefore requiring the greatest attention) through to the least significant (and therefore requiring less attention). Once this has been determined, you can then **prioritise which impacts require control** mechanisms to be implemented immediately and which require managing less urgently.

The presence of a hazardous substance constitutes risk, however the **level of risk** will vary, depending on the given situation.

Example: If chemically treated timber is used in cooking fires or is burnt in the open in a highly populated area, then the risk of people being exposed to poisonous gases is high. If that same timber was burnt in an enclosed facility (such as an incinerator) or away from populated areas, the risk of exposure is low.

One way of conducting a simple risk assessment, is to use a Risk Assessment Model, like the one provided on page 6. This is a qualitative assessment where impacts are ranked as being "high", "medium" or "low" depending on both the likelihood of the impact occurring and the possible consequence of the impact.

Note: If there ie more than one substance present at a site, the risk assessment should be undertaken for each of those substances present.

Evaluating Risk using a Risk Assessment Model

(Source: AS/NZS 4360:1999 Risk Assessment)

Step 1:

Using the table below, identify the likelihood (or probability) of the event or incident occurring.

Level	Description	Example
A	Almost Certain	*Is expected to occur in most circumstances*
B	Likely	*Will probably occur in most circumstances*
C	Possible	*Might occur at some time*
D	Unlikely	*Could occur at some time*
E	Rare	*May occur only in exceptional circumstances*

Step 2:

Using the table below, identify the consequence of the event or incident.

Level	Description	Example
1	Insignificant	*No injuries, low financial loss*
2	Minor	*First aid treatment, on-site release immediately contained, medium financial loss*
3	Moderate	*medical treatment required, on-site release contained with out-side assistance, high financial loss*
4	Major	*extensive injuries, loss of production capability, off-site release with no detrimental effects, major financial loss*
5	Catastrophic	*death, toxic release off-site with detrimental effect, huge financial loss*

Step 3:

Apply results of Steps 1 and 2, to determine the "level of risk".

LIKELIHOOD	CONSEQUENCES				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A – Almost Certain	H	H	E	E	E
B – Likely	M	H	H	E	E
C – Moderate	L	M	H	E	E
D – Unlikely	L	L	M	H	E
E – Rare	L	L	M	H	H

E = Extreme Risk; H=High Risk; M = Moderate Risk; L = Low Risk

MODULE EIGHT
HAZARD CONTROL SYSTEMS

IMPLEMENTATION OF CONTROL MECHANISMS

Once you have determined what the likely impacts of a hazardous substance may be, the next step is to put in place mechanisms for controlling or preventing those impacts.

Control measures include physical, chemical biological, and human resource techniques, including:

- providing adequate access to materials;
- use of bunding around storage areas;
- not storing incompatible chemicals together;
- storing materials in air tight containers;
- placing restrictions on who can access to a site;
- ensuring fire fighting equipment is readily available; and
- use of PPE.

Further details on specific control methods is provided in Module 4 - "Safe Materials Storage and Handling".

INFORMATION

Information is required through-out every stage of a Hazard Control System, from the initial process of identifying hazardous substances, through to the implementation of control mechanisms.

Information generally comes from three sources:

- Intelligence: information obtained from existing records and documentation as well as visual observations and personal communication;
- Direct Reading Instruments: information that can be obtained straight away from monitoring equipment. (Eg: temperature obtained from reading a thermometer); and
- Sampling: Information obtained from collecting samples which are analysed at a laboratory (eg: analysis of the level of contamination present in a soil sample).

The information obtained from all of the above sources, helps to define the extent of the problem and assists in deciding upon possible control actions.

SAFETY

The health and safety of both personnel working on site and other parties (eg: the public), is an important consideration when developing a Hazard Control System.

Site specific measures should be prepared to help minimise the dangers associated with working with hazardous materials, however some general things to consider include:

- Use of **signs** and warning **labels**;
- Use of Personal Protective Equipment (**PPE**) (Module 6);
- Employee **induction**;
- Provide Material Safety Data Sheets for employees to read (see Module 4);
- Use of Safe Handling and Storage Techniques (Module 4); and
- Preparation of Site Safety Plans and Site Control Plans (Field Demonstration).

SITE MANAGEMENT PLANS

Site Management Plans are a good way of collating all information obtained from a Hazard Control System, and presenting it in a workable document that is easy to read and practical to use.

Site Management Plan can be several pages or several volumes long, depending on the activities undertaken at the site and the type of hazardous materials present.

Site Management Plans should include the following information:

- a **site description** and information on site location and surrounding land-uses;
- description of **hazardous materials present** on the site;

- **procedures** for managing hazardous materials, such as safe handling and storage techniques;
- **list of personnel** responsible for conducting specific activities; and
- **instructions** on what to do in the event of an incident or emergency (see Module 9 for further information on incident and emergency response).

Activity: Preparing a Site Management Plan

Select a site specific to the country – ideally one that was visited earlier in the week, or possibly one discussed in the POPs in PICs Report.

For that site, start to prepare a site management plan based on the principles of Hazard Control Systems. (Additional information can be added to the management plan after completing Module 9 – Incident Response).

LIST OF RESOURCE MATERIALS

- Basic Hazardous Materials Control (article)
- How to Identify and Control Hazards (article)
- Workers and Hazardous Substances – Risk Assessment - Department of Training and Industrial Relations – Brochure 024 (1997) Page 2.
- Hazard Control (workshop notes)

Note: Selected information sourced from National Safety Council of Australia (NSCA) 3 Day Contaminated Sites Training, Participants Notes (Chapter 1).

MODULE NINE
INCIDENT AND EMERGENCY RESPONSE

INTRODUCTION

The purpose of Module 9 is to familiarise participants with the **incident and emergency** management process from prevention and response through to impact mitigation and monitoring.

Particular emphasis will be placed on reducing the risk of harm to public health and the environment through effectively responding to an incident or emergency.

At the end of the module, participants will be asked to prepare an Incident and Emergency Response Plan, to complement the Site Management Plan prepared in Module 8.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

1. Understand what an incident is and common causes of incidents;
2. Review the principles of incident prevention;
3. Understand the basic steps for responding to an incident or an emergency;
4. Be familiar with general procedures for responding to a hazardous material spill; and
5. Apply principles learnt during the module to prepare a basic Incident and Emergency Response Plan.

WHAT ARE INCIDENTS AND WHY DO THEY OCCUR?

An incident is an unplanned release, or potential release of hazardous materials, that can potentially harm the environment, human health and/or property.

The magnitude or severity of an incident will vary with any given situation. Some incidents can be minor, resulting in no personal injury or environmental impacts, however other incidents can have catastrophic events, such as loss of life and property, or irreparable damage to the environment. These are called emergencies and often require quick and effective response procedures to minimise impacts and damage.

Example: An incident might be when a bag of hypochlorite (used in water treatment) breaks open, releasing a small amount of the chemical onto the floor of the storage shed where it is being kept. An emergency might be when a truck transporting fifty bags of hypochlorite tips over whilst crossing a bridge, releasing all the contents into a lagoon.

There are many reasons why incidents and emergencies occur including:

- Human error;
- Vandalism;
- Unexpected environmental conditions (eg: cyclone or flood);
- Failure to establish or failure to follow safe working procedures and conditions; and
- Lack of knowledge or training.

(Note: Unless otherwise specified, when reference is made to an "incident" in the module, this also includes "emergencies").

INCIDENT PREVENTION

ncident prevention is one of the most mportant steps in the management of iazardous materials.

There are many benefits in preventing incidents from occurring including:

- protection of the natural environment;
- protection of the built environment;
- saves time and money spent on clean-up costs;
- can provide good publicity; and
- can save lives.

The process of incident prevention is described in detail in Module 8 "Hazard Control Systems", and so this topic will not be addressed further in this Module.

INCIDENT RESPONSE

The primary objective for responding to a hazardous materials incident is to prevent or reduce the detrimental effects of that incident on public health, property and the environment.

When an incident occurs, **it is important to know how to respond, in advance.** What is the first thing you should do immediately after becoming aware of an incident? Should you report the incident to anyone? What should you do after the incident has been controlled? etc.

The initial steps that should be followed when responding to an incident are essentially the same as those used in Hazard Control Systems, that is:

- **identify** on-site conditions and any hazardous substances present (Site Characterisation);
- **evaluate** the likely risks associated with these substances;
- put mechanisms in place to **control** those risks;
- through-out the entire process, obtain **information** to assist in decision making;

- always consider the **safety** of on-site personnel and others (eg: the public) when making decisions.

Remember that you will normally have to do these things quickly to minimise the impacts or damage caused as a result of the incident. This is why it is important to be organised and prepared in advance.

The following three steps should also be performed, once any risks have been controlled:

- **Monitor** conditions at the site to ensure control actions have been successful;
- **Review** why the incident occurred in the first place and undertaking **corrective action** to prevent it from happening again; and
- **Record** details about the incident and **report** these as agreed.

Each of the above steps are discussed in more detail below.

Note: Given the types and volumes of hazardous materials found in most PICs, if and when incidents do occur, they will usually be small in scale and will not generally give rise to an emergency situation. However, just because an incident isn't life threatening or potentially devastating to the environment, doesn't mean it isn't important. All incidents should be managed, regardless of size or severity.

IDENTIFY SITE CONDITIONS

When responding to an incident it is useful to know what condition and hazards are present at the site. This will allow you to make informed decisions about what sort of remedial action will be required and will also reduce the risk of further harm occurring.

Sometimes there may only be limited information available and you may not even know exactly what materials are present at the site. In these cases you should always assume a "worst-case" scenario until further information is available.

If possible however, try and obtain information on:

- name and quantity of substances involved; and
- properties of each substance that make them hazardous.

It is also important to note the general conditions at the site – Is it windy? Is it very hot? Are there sensitive land-uses nearby (such as a primary school, residential area, nature conservation area or drinking water supply system). This information will need to be considered when deciding on the nature and timing of control measures.

EVALUATE RISK

Once you have obtained background information on the site, the incident, and the types of hazardous materials present, the next step is to now evaluate or assess the potential impacts of the incident on the environment, human health, and property.

Ideally, this would be done using the Risk Assessment Model discussed in Module 8. This would allow you to rank potential impacts in order of significance, to determine the sequence with which control mechanisms should be implemented.

In some cases, particularly emergencies, you may not have the time, personnel or resources available to carry out an extensive risk assessment. If this is the case, you will need to assess impacts using your own judgement and information collected in the site characterisation stage.

CONTROL MECHANISMS

Once you have identified the possible and actual impacts of an incident, and then sorted these impacts into some sort of order ranging from the ones requiring immediate action through to those requiring less urgent action, it is now time to implement control mechanisms.

In an Incident Response System, control mechanisms are procedures or activities undertaken to prevent or minimise the impacts of that incident. **Control mechanisms aim to restore the effected site to the condition it was in, prior to the incident occurring.**

Control mechanisms used in incident response, can include:

- use of **temporary bunding** to prevent further release of chemicals;
- **fencing** areas off, to prevent access from unauthorised persons;
- **evacuating** an area if necessary;
- **transferring** hazardous material from broken containers into new containers that are in good condition; and
- **shut-down** of systems (eg: drinking water supplies).

MONITORING AND MEASUREMENT

Monitoring and measurement is undertaken at this stage of the incident response process to **ensure control measures that have been used are working effectively.**

Typically, monitoring will involve such things as collecting and analysing soil or water samples to determine the level of contaminants present, or measuring the concentration of a substance in air. These procedures however often require the use of specialised equipment and personnel often require specialised training, both of which may not be available in your country.

In the absence of any specialised equipment or training skills, one way of monitoring is to visually assess the site to determine if conditions appear to be changing or not.

For example: Mark out the location of any areas of contamination using chalk, wooden stakes, or ribbon – does the area of contamination appear to be increasing over time? Does the vegetation immediately within or surrounding the area of contamination appear to be dying? Are temporary structures such as fences and bund walls working properly? If possible, take photographs of the site both during and after the incident to provide records of site conditions.

REVIEW AND CORRECTIVE ACTION

The purpose of the Review and Corrective Action stage of incident response is to **work out why the incident occurred in the first place and what can be done to prevent it from happening again.**

As reported earlier, there are many reasons why incidents and emergencies occur including:

- Human error;
- Vandalism;
- Unexpected environmental conditions (eg: cyclone or flood);
- Failure to establish or failure to follow safe working procedures and conditions; and
- Lack of knowledge or training.

Remember, **incidents don't just happen – there is always an underlying cause.** For example - a council truck transporting drums of paraquat (a pesticide) from the shipping port to the hazardous goods store truck, tips over, releasing paraquat onto the road. Why did this occur? Why did the truck tip over and why did the drums of paraquat fall out onto the road? It may be due to any number of things (or a combination of several) including a tyre blow out; driver fatigue; overloading the truck; not adequately securing the cargo; poor condition of roads (eg: lots of potholes or wet and slippery conditions); speed, driver inexperience, and so on.

Once you have determined why the incident occurred, you can then work out what things can be done to prevent the same incident happening again.
It is also a good idea to record the details of the Incident review process. An example of an "Incident Review and Corrective Action" Reporting Form is provided on Page 10.

REPORTING REQUIREMENTS

The final step in incident response, is to **report the incident** to a supervisor, senior staff officer or other designated person.

You may wish to use a standard incident reporting form (an example of which is provided on page 9) which should then be filed away (with the Incident Review and Corrective Action Reporting Form) for future reference. You don't have to wait till the end of the incident to fill the reporting form out – in fact, it is best if you fill out the relevant details as you go along – this way you won't forget anything.

Keeping records of past incidents is good practice for several reasons, including the fact that it allows you to identify any areas of weaknesses (that is, if the same incident seems to be occurring over and over again then this indicates that there is an underlying problem that needs to be fixed).

Keeping records of past incidents is also a good way of monitoring any improvements over time – you may notice that an incident that occurred quite frequently six months ago, no longer seems to be occurring, even though the actual activity hasn't changed.

THE DIFFERENCE BETWEEN A HAZARD CONTROL SYSTEM AND AN INCIDENT RESPONSE SYSTEM

Question: What is the difference between a Hazard Control System and an Incident Response System?

*Answer:*_____

_____

_____

_____

_____

ACTIVITY

Activity: Using the information provided in the Site Management Plan prepared in Module 8, prepare an Incident Response Plan for that particular site.

LIST OF RESOURCE MATERIALS

- Example: Record of Incident Review and Corrective Action Form (also provided on page 10 of this module)
- Example: Incident and Emergency Reporting Form (also provided on page 11 of this module)
- Suppliers of Spill Response Equipment (Note: Details only provided below and not in Resource Materials section of manual)

  Company Name: Enviroequip Pty Ltd (Aust)
  Ph: +613 9572 3600
  Fax: +613 9572 3700
  E-mail: sales@enviroequip
  Web-Site: www.enviroequip.com

  Company Name: Spill-Sorb Canada Inc.
  Ph: 403 488 8881
  Fax: 403 482 2320
  E-mail: spillsorb@compusmart.ab.ca
  Web-Site: www.spillsorb.com

Note: Selected information presented in this module has been sourced from the National Safety Council of Australia (NSCA) 3 Day Contaminated Sites Training Course - Participant Notes (Chapter 18)

MODULE TEN
MONITORING & TESTING PROCEDURES

INTRODUCTION

The purpose of Module 10 is to increase the knowledge of participants concerning field testing procedures for identifying hazardous materials and monitoring the impacts of such contamination on the environment.

The emphasis of this module is on utilising local equipment and materials wherever possible to carry out field-testing and monitoring.

WORKSHOP OUTCOMES

At the end of this workshop module, you will:

- Be familiar with the concept of contaminant migration;
- Be aware of simple field procedures for identifying hazardous materials and contaminated sites;
- Understand procedures for monitoring the impacts of contamination on surface waters, groundwater, soil and air; and
- Be able to prepare a field testing and monitoring kit.

This module contains a lot of words and terms that participants may not be familiar with (eg: contaminant, leachate, contamination plume, purging, etc). It also describes sampling procedures that will not be easily undertaken in a Pacific Island Country. Your facilitator will discuss these issues with you.

CONTAMINANT MIGRATION PATHWAYS

Contaminants will flow along the pathway of least resistance. **Contaminants can be transported** by one of the following driver mechanisms:

- Dispersion;
- Diffusion;
- Concentration gradient;
- Pressure gradient;
- Hydraulic gradient;
- Temperature differences; and
- Density differences.

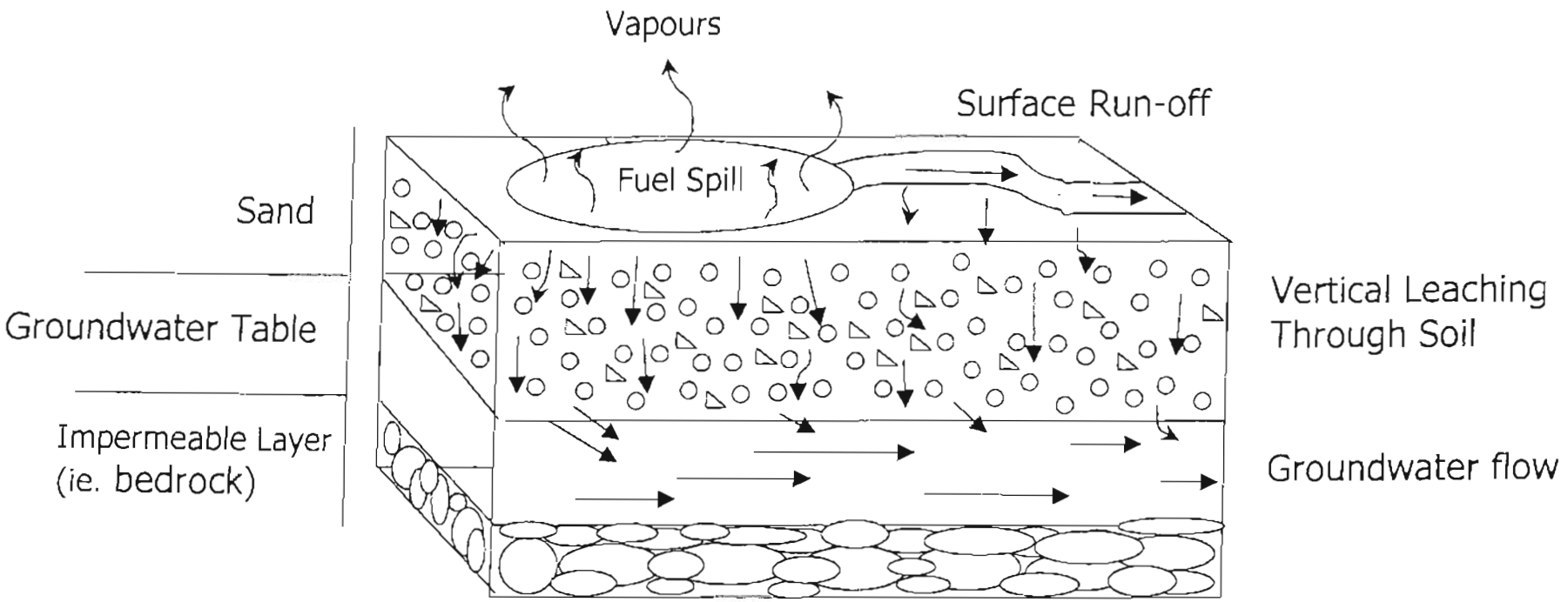
Contaminants are usually transported via surface water flow, groundwater flow, or vertical leaching. Contaminants from the surface soil layers can leach into the ground during a rainfall event. These contaminants can reach the watertable and then be carried off-site via the groundwater flow. A contaminated plume can result.

Surface earth drains and erosion channels can also act as **pathways** for contaminants to be transported via the ground surface. Contaminants can often be found to concentrate in these drains. Refer to Figure 10.1 illustrating various contaminant migration pathways.

The rate of contaminant migration will depend on the **physical properties** of the contaminant and the type of media containing the waste. The physical properties influencing contaminant mobility include soil-binding properties, solubility, and chemical reactivity. The **media** containing the contaminant will also influence the rate of migration. For example, a chemical spill in sandy soil will move more rapidly through the soil profile than if it occurred in a heavy clay soil.

Similarly, contaminants within surface waters will be dispersed depending on the current flow rate and the solubility of the contaminants.

Figure 10.1:
Contaminant Migration Pathways



CONTAMINATION OF SURFACE WATERS

Surface waters including creeks, rivers, channels, and gullies can carry contaminants long distances. Contaminants that dissolve into the water can poison fish, shellfish, plants and contaminate drinking water. Contaminants that are water-soluble include iron, aluminium, boron, organochlorine pesticides, acids, hypochlorite, and most solvents.

Other contaminants can settle out of the water and concentrate in the **sediments** at the bottom of the stream. These contaminants are less mobile, however may impact on bottom dwelling fish and plant life. For example, PCB's settle out and bind to organic particles and sediments.

Contaminants can also 'float' on top of the water and be dispersed via the rate of surface flow. Petroleum hydrocarbons (oil, petrol, and diesel) are examples of contaminants that 'float' on top of the water. Petroleum hydrocarbons form a **visible film** on top of the water. This film can reduce the amount of sunlight entering the water body thus lead to plant and fish kills.

SURFACE WATER SAMPLING

Sampling of contaminated water for analysis can be conducted using a clean bucket and rope. It is important to obtain a sample from the middle of the creek or stream as opposed to the near the edge. If sampling hydrocarbon contaminated water, the sample water needs to be collected from the top of the water.

Water samples need to be stored within either glass or plastic sampling containers and stored on ice within an esky.

CONTAMINATION OF GROUNDWATER

The **groundwater** can also act as a medium to transport contaminants. The groundwater flow can transport contaminants off-site below the ground. This is often "unseen" contamination. The rate of groundwater flow may be relatively slow, however a large plume can result.

Groundwater contamination is usually only detected when drawing water from the groundwater (ie. drinking wells, irrigation).

GROUNDWATER SAMPLING

Groundwater monitoring bores need to be installed to monitor the impact on groundwater quality from contaminated soil.

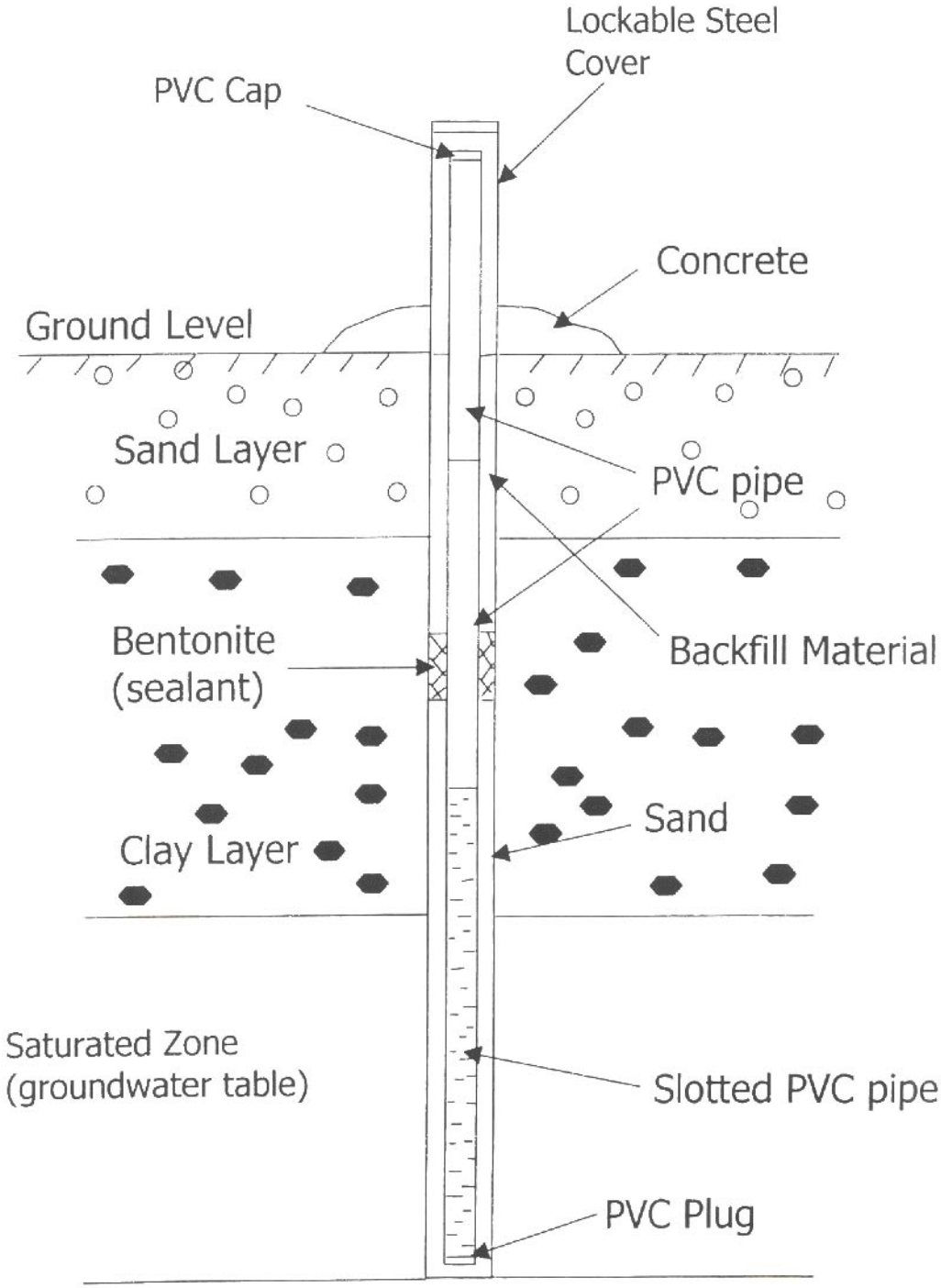
The direction of groundwater flow will need to be determined before installing any groundwater monitoring bores. As a general rule, groundwater usually flows down gradient or towards a creek, river or the ocean.

A groundwater monitoring bore comprises pvc piping inserted into a drilled hole. The piping is slotted at the bottom to allow groundwater to permeate for sampling. Filter sand is poured into the hole (not into the pvc) to cover the slotted pvc piping to prevent the soil clogging the slots. Normal pvc piping is attached until it reaches the ground level. Bentonite (sealant) is poured on top of the sand to prevent the infiltration of any surface water. A steel cover or lid is then concreted on top of the pvc pipe. Refer to Figure 10.2 for a cross-section of a typical groundwater monitoring bore.

Groundwater can be sampled using groundwater monitoring bores or test pits. A hand bailer is used for the groundwater monitoring bores, while a bucket can be used to collect water from test pits. Groundwater monitoring bores need to be purged prior to sampling.

Samples need to be stored in sealable plastic containers within an iced esky.

Figure 10.2:
Typical Groundwater Monitoring Bore



CONTAMINATION OF SOIL

As previously discussed, the type of soil medium can influence the rate of contaminant migration. Porous soils (ie. sands, gravels) do not have the ability to retain contaminants in a localised area like non-porous soils can (ie. clays). The differences in soil types need to be considered when sampling for contaminated soil. For example, the depth of drilling needs to extend to relatively impermeable layers to define the vertical extent of contamination.

SOIL SAMPLING

Soil sampling aims to identify what contaminants are in the soil, and the extent of contamination. Soil sampling requires collecting samples from various depths and locations to determine the vertical and lateral extent of contamination. Soil samples can be collected using a hand auger, or from the bucket of a backhoe.

Contaminated soil needs to be sampled with care to minimise cross contamination of samples. Appropriate personal protective equipment should be worn when sampling contaminated soil.

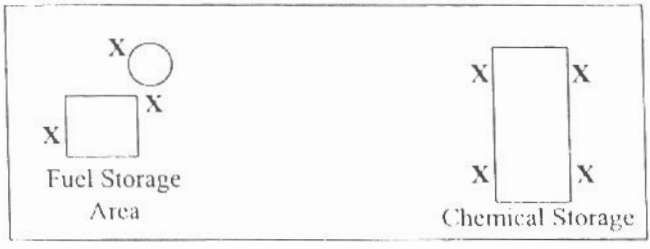
Most contaminants in soil can not be detected by smell or visual assessment. However, petroleum hydrocarbons can be detected by such means. A simple headspace test can be undertaken to determine the presence of petroleum hydrocarbons in soil. This involves placing a small amount of soil in a glass jar, placing the lid on, shaking it, and leaving it in the sun for a couple of minutes. A PID meter is used to detect the presence of volatile hydrocarbons within the jar.

Soil samples contaminated with petroleum hydrocarbons **MUST** be immediately stored on ice to prevent volatile vapours escaping from the sample jar.

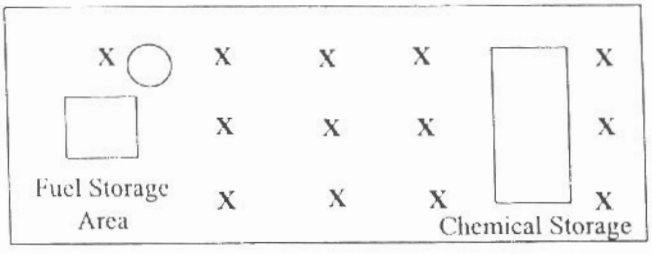
The three main types of sampling methodologies include random sampling, targeted sampling, and grid sampling. Refer to Figure 10.3 for more information on these types of sampling techniques.

Figure 10.3: Soil Sampling Methodologies

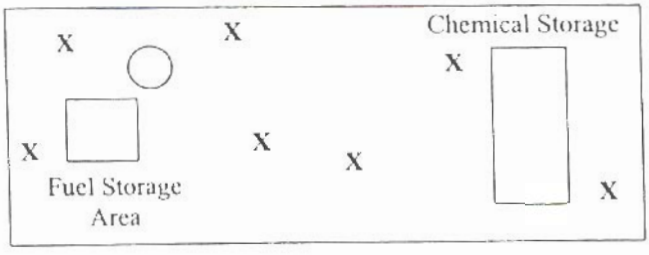
Targeted Sampling: Targeted sampling involves sampling at specific locations where contamination is likely to be detected. Targeted sampling requires knowledge of potentially contaminating sources that exist or previously existed on a site. For example, a farm may contain a dip, fuel tank storage area, and a chemical storage shed. Sampling would be concentrated at these locations.



Grid Sampling: Grid sampling involves sampling in a grid pattern across a site at regular intervals. Grid sampling is usually chosen for a large site where contamination sources are unknown. For example, grid sampling would be used for a crop field sprayed with pesticides.



Random Sampling: Random sampling is undertaken when there is no known sources of contamination. Random sampling involves taken samples at random locations across the site. Random sampling is usually the methodology employed for the sampling of stockpiled material.



CONTAMINATION OF AIR

Hazardous **volatile compounds**, gases and air-borne particles can result following a chemical spill or the excavation of contaminated soil. Some of the common hazardous gases include lead, cadmium, hydrogen sulphide, carbon monoxide, carbon dioxide, chlorine, hydrocarbon fumes. Hazardous air-borne particles include asbestos fibres.

AIR SAMPLING

There are a number of hand held gas monitors available to detect a variety of toxic and combustible gases. These gases include carbon monoxide, hydrogen sulfide, sulfur dioxide, nitrogen oxides, hydrogen cyanide, ammonia, hydrogen chloride, methane, hydrocarbons, etc.

Respirators (breathing apparatus) should be used when working around sites suspected to contain hazardous gases or vapours.

FIELD TESTING KITS AND EQUIPMENT

Laboratory analysis of samples collected in the field can be time consuming, expensive and may not even be possible in smaller Pacific Island Countries where such facilities are not available.

In most PICs, it will therefore be more appropriate to use on-site **field testing kits and equipment**, when determining the type and level of contamination of a particular hazardous material. These kits are specifically designed for use in the field and are typically **easy to use, require minimum personnel training** and are **often cheaper than** sending samples away to a **laboratory for testing**.

Field testing kits and equipment are ideal for conducting **initial screening tests** to determine if more detailed analysis is required.

A number of different field testing kits and equipment are available and some of these are listed in Table 10-1 on the following page (page 10).

Table 10-1: Examples of Simple Field testing Kits and Equipment

NAME OF EQUIPMENT	USED FOR TESTING	DESCRIPTION	EXAMPLE OF SUPPLIER
Chlor-N-Oil*	PCBs	Testing **electrical insulating fluids** for the presence of **PCBs**. Action Levels: 20, 50, 100 & 500 ppm Approx Cost: AUS $20-$31/kit depending on the quantity ordered (1 kit = 1 test).	Dexsil Corporation Hamden, USA Ph: 203-288-3509 Fax: 203-248-6253 E-mail: info@dexsil.com Internet: www.dexsil.com
Clor-N-Soil*	PCBs	Testing **soil** for the presence of **PCBs**. Can test any type of soil (sand, topsoil, clay, etc). Approx Cost: AUS$55/kit	Dexsil Corporation as above
PetroFLAG*	Hydrocarbons	Tests for presence of **total hydrocarbons** (fuels, oils & greases) (does not distinguish between different types). Approx Cost: $AUS1,879 initial purchase then AUS$530 for box of 10 tests.	Dexsil Corporation as above
CLOR-D-TECT 1000*	Chlorine (halogens)	"Go", "No-Go" screening test for chlorine in used (waste) oil. Approx Cost: AUS$29/kit	Dexsil Corporation as above
CLOR-D-TECT Q4000*	Chlorine (halogens)	Quantitative test for chlorine levels in used (waste) oil. Approx Cost: AUS$26/kit	Dexsil Corporation as above
HydroClor-Q*	Organic chlorine	Measures organic chlorine contamination in oil/water mixtures and used antifreeze. Approx Cost: AUS$49/kit	Dexsil Corporation as above
Litmus Paper	pH	Measures pH in aqueous (water based) solutions. Approx cost: AUS$35 pack of 100 (pH range 0-14).	EnviroEquip Australia, Philippines and New-Zealand Ph: 613 9572 3600 Fax: 613 9572 3700 E-mail: sales@enviroequip.com Internet: www.enviroequip.com
Draeger Bellows Hand Pump*	Gaseous substances	Measures the concentration of various gases in air Approx Cost: US$275 second hand	On-Site Instruments, LLC Ohio, USA Ph: 614-846-1900 Fax: 614-846-1991 on-siteinstruments@iwaynet.net www.on-siteinstruments.com/

* Registered Trade Name

MODULE TEN
MONITORING & TESTING PROCEDURES

FIELD PACKS

Before heading out in the field, consider what sort of field and testing procedures you may be required to undertake and what sort of monitoring equipment will be needed to do this. This should be a step by step process to identify the necessary field equipment required in your **field packs**. A field pack may include:

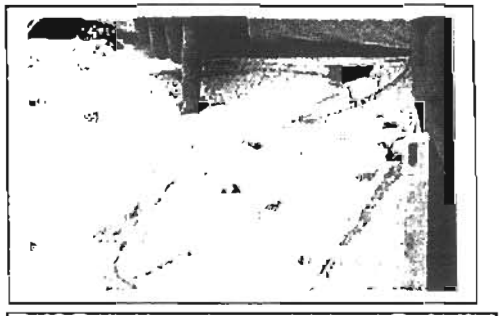
- Gas meters (depending on the type of toxic gases);
- Personal protective equipment (gloves, respirators, safety glasses, hard hat);
- Detergents;
- Cloth for washing and drying equipment;
- Demineralised water (1 litre);
- Tape measure;
- Rope;
- Bucket;
- Litmus paper (pH testing);
- Disposable camera;
- Duct tape; and
- Bailers (for ground water sampling).

THE CONTAMINATED LAND ASSESSMENT PROCESS.

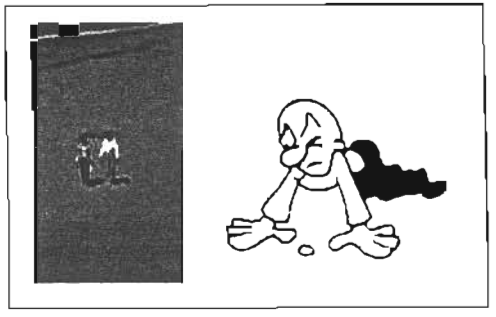
Refer to Figure 10.4 (page 12) for a summary of the contaminated land assessment process.

Figure 10.4: The Contaminated Land Assessment Process

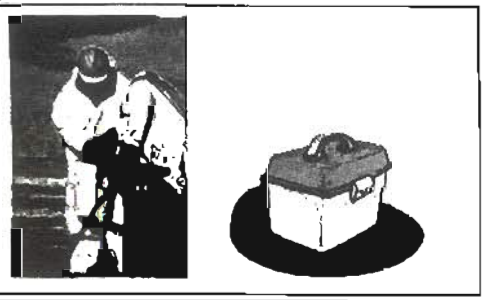
Step 1: Undertake a site history review to determine the likely type of contaminants present on-site. This involves reviewing aerial photography, and conducting interviews with previous and current land-owners.



Step 2: Prepare a site sampling plan, based on site history review. The sampling plan will define sample locations and the number of samples to be collected.

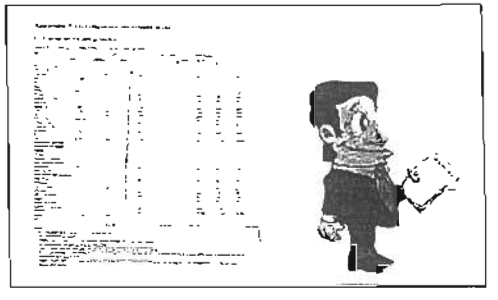


Step 3: Conduct a site walk-over inspection to assess any current contaminating sources. Amend site sampling plan, if necessary.



Step 4: Collect soil samples then place them in an iced esky.

Step 5: Fill out the chain of custody form and promptly deliver the chilled samples to the laboratory for analysis.



Step 6: Compare laboratory results to the guidelines. Write report to summaries procedures and findings.

LIST OF RESOURCE MATERIALS

- *Contaminant Fate and Transport* – North Belmont PCE Site Remedial Investigation

- United States Environmental Protection Agency, Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies.

- Field Sampling and Analysis Guide: Field Sampling and Collection Techniques. (Also available on the internet at www.frtr.gov/site/samplematrix.html.

- AS 4482.2-1999, Guide to the sampling and investigation of potentially contaminated soil – volatile substances (not included in Resource Materials but available from Standards Australia at www.standards.com.au).

- AS 4874-2000, Guide to the investigation of potentially contaminated soil and deposited dust as source of lead available to humans (not included in Resource Materials but available from Standards Australia at www.standards.com.au).

- Useful web-sites:

www.epa.gov.nsw.au/mao/tec/co2/

www.env.qld.gov.au/environment/business/contaminated/cl_guide.pdf

www.env.qld.gov.au/environment/business/contaminated/

MODULE ELEVEN
COUNTRY ISSUES

INTRODUCTION

The purpose of Module 11 is to review material presented in previous modules and summarise any issues raised into **country specific actions** aimed at mitigating the problems associated with managing hazardous materials and contaminated sites.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

- Relate the hazard control systems (module #8) to local conditions;
- Relate the incident and emergency response procedures (module #9) to local conditions;
- Relate the monitoring and testing procedures (module #10) to local conditions; and
- Agree upon a **local action plan** for implementing procedures for effective management of hazardous materials and hazardous waste.

Note: There are no Resource Materials for this Module.

Effective Management Procedures

Describe below, the reasons why the management procedures **would work** in my country:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Ineffective Management Procedures

Describe below, the reasons why some of the management procedures **would not** work in my country:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

MODULE ELEVEN
COUNTRY ISSUES

ACTION PLAN

Action	Who	When
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop
		Within ___ **month** after workshop

DAY THREE
WORKSHOP EVALUATION

Your name: ..... (optional)

Organisation: .....

Country: .....

Date of Workshop: .....

MODULE 8

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

3. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

MODULE 9

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

3. The module was:

   Easy to understand/ Not easy to understand

DAY THREE
WORKSHOP EVALUATION

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

Please circle the correct words:

MODULE 10

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

4. The module was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

Please make any further comments about the training workshop:

OTHER COMMENTS

_____

_____

_____

_____

_____

Thank you for taking the time to provide feedback on the training workshop.
Please hand this form to your workshop facilitator.

MODULE TWELVE
FIELD DEMONSTRATIONS

INTRODUCTION

The purpose of the field program is to provide participants with on-site training skills in particular management techniques covered in previous modules.

The field demonstrations will include role play activities aimed at:

- demonstrating the importance of personal protective equipment, equipment decontamination and site control; and
- demonstrating cost effective techniques for remediating contaminated soil.

The field demonstration will also include a site visit of several existing hazardous materials and hazardous waste storage facilities, to determine **what improvements or changes can be made to ensure materials are adequately contained and managed.**

FIELD PROGRAM OUTCOMES

At the end of this field program I will:

- Be aware of the importance of using personal protective equipment;
- Be apply to apply basic equipment decontamination procedures
- Understand the concept of site control, including the use of site work zones
- Be familiar with a number of simple techniques for remediating contaminated land;
- Prepare a number of action items for improving current storage and handling techniques at existing hazardous materials and hazardous waste stockpiles.

LIST OF RESOURCE MATERIALS

- Handout 1 – Site Control
- Handout 2 – Site Safety Planning

FIELD DEMONSTRATION 1

PERSONAL SAFETY, EQUIPMENT DECONATMINATION AND SITE CONTROL

Field demonstration 1 will include the illustration of:

- Appropriate use of personal protective equipment;
- Basic decontamination procedures; and
- Site control measures.

Purpose:

- To illustrate the value in using PPE and decontamination procedures;
- To demonstrate how PPE and decontamination stops contaminated material becoming absorbed via the skin or ingested via the mouth;
- To demonstrate decontamination of field equipment (ie. triple washing); and
- To demonstrate the use of site control measures to human contact with contaminated material and to minimise the spread of the contaminated material.

Equipment:

- Half face respirator, safety goggles, a pack of disposable gloves, long-sleeve shirt, steel-capped boots, plastic hand trowel, shovel, spray paint or food colouring, three cans of aftershave, black tarpaulin (5m x 5m), a cloth (suitable as a blindfold), hat, overalls or long pants, small soil sampling bags (3), two apples, three plastic garbage bins, hand scrubber, detergent.

Field Demonstrations

Role Play 1: Use of Personal Protective Equipment

Make a pile of shaving cream on in the middle of the tarpaulin. Spray the shaving cream pile with pink spray paint and mix well. Have participants standing in a circle around tarpaulin. The shaving cream represents a pile of heavily contaminated soil.

Choose one participant without a long-sleeve shirt and minimal protection. Blind fold that participant spin them around a few times. Place the plastic trowel within the middle of the shaving cream pile. Ask the blind-folded participant to retrieve the trowel. After the trowel is retrieved, keep the participant blind folded. Tell them that they feel an itch on their face (get them to scratch their face). Tell them an insect is crawling on their leg (make them slap their leg). Get them to scratch their head, etc. The aim is to get shaving cream will all over the participant.

Give the blind folded participant an apple, as if to eat it. Get them to put it on the ground for display. Take off the blind fold and get the participant and audience to see how far the shaving cream has spread over the tarpaulin and over the participant. Explain the potential health risk that has resulted due to the contact with skin, potential digestion (apple), etc.
Choose another participant. Put the full protective clothing on them (ie. gloves, long-sleeve shirt, boots, overalls, face mask, safety goggles). Restock the shaving cream

pile and place the hand trowel in the centre. Get them to go through the exact same scenario as the last participant. Get them to take off their protective clothing, them give them an apple. The participant should have little to no shaving cream that has come into contact with their skin.

Discussion:

Give a discussion on how the person wearing the PPE has significantly reduced potential health risks. Get them to discuss other ways of decontamination, like thorough washing of hands, arms, face, etc.

Discuss the decontamination procedures are also necessary for equipment when sampling contaminated soil to prevent cross-contamination. Make two small piles of shaving cream. Colour one with food colouring or spray paint and leave the other one white. Get a participant to put on the PPE and then give them the plastic trowel. Ask them to sample the coloured (ie. contaminated soil) shaving cream first. Them ask them to sample the white (clean soil) shaving cream shortly after without them cleaning the trowel. Specs of coloured shaving cream should be evident in the 'clean' pile. Discuss how this could affect lab results and cause incorrect results, ultimately costing the land owner money in unnecessary remediation costs. Discuss the need to 'triple' wash all equipment between the collection of each sample.

Role Play 2: Equipment Decontamination (triple washing) Demonstration

Set up three plastic garbage bins for a triple wash demonstration. Fill the first bin with water, second bin with water and detergent, and the third bin with water. Go through the triple wash procedure technique with the plastic trowel.

Discussion:

This discussion needs to lead into site control measures. Discuss how avoiding contact with the contaminated material is also a means of spreading contamination. Get the participants to look at the mess on the tarpaulin. Get them to imagine that this is a construction site and the shaving cream is contaminated material. Get them to discuss how this contaminated material could be spread over the site. Discuss what measures can be taken to prevent this material from spreading. Talk about the use of barriers, tarpaulins, truck washes, etc.

Role Play 3: Site Control Measures Demonstration

Place some witches hats around the tarpaulin and illustrate how this would stop trucks from driving over it and spreading the contamination. Ask the questions would this alone stop the potential spread of the contaminated material. What about erosion from the wind or rain?

Discuss the existing stockpiles of contaminated material and how these management principles can be applied to minimise the spread of contamination. Discuss the use of tarpaulins, etc.

FIELD DEMONSTRATION 2

CONTAMINATED SOIL REMEDIATION

Field Demonstration 2 will focus on the remediation techniques of land farming and fixation.

Role Play 1: Land Farming

Purpose:

To illustrate cost effective means of remediating contaminated soil.

Equipment:

Fertilizer (manure), hay bale, tarpaulin, backhoe, rake

Demonstration:

Explain the process of bioremediation

1. All soil has naturally occurring bacteria which breaks down organic matter. This is the same bacteria which causes fruit and dead animals to decay.

2. Organic contaminants like petroleum hydrocarbons are organic substances which are also broken down by the bacteria.

3. The bioremediation process is greatly enhanced by creating the best conditions for the bacteria to multiply and biodegrade the petroleum hydrocarbons. The addition of water, fertilizer (ie. manure) and hay speed up the process. These ingredients need to be mixed in with a plough or by hand, depending on the quantity of contaminated soil.

Use the organic composting waste located on the concrete slab. Explain the reason for having an impermeable layer to accommodate the contaminated soil for the land farming process.

Add ingredients one at a time and explain the reason for adding that ingredient.

Water – Use a hose and give the soil (organic matter) a light hose for about 10 seconds. Too much water will clog up the microbial activity.

Reason: The bacteria break the hydrocarbons down at the soil-water interface. Water needs to added to create that interface.

Fertilizer – Add manure to the soil (organic matter).

Reason - Manure introduces another source of carbon (food) for bacteria to feed on and multiply. The manure also represents another source of bacteria.

Hay – Break up a hay bale and add to soil (organic matter).

Reason - Mainly used in clayey soils to form a soil matrix that allows more air into the soil. Air is vital for the aerobic bacteria.

Effectively mix all the ingredients with a backhoe. Explain that the soil needs to be turned with the backhoe. The bioremediating soil will need to be turned at least twice a week to allow further oxygen into the soil, and also expose any volatile compounds to the sunlight.

4. Optimal temperature and ph levels will also influence the rate at which microbial activity multiple.

5. The rate of bioremediation can be monitored by taking soil samples every two weeks or once a month to determine when the TPH concentrations are acceptable.

Role Play 2: Fixation

Purpose:

To demonstrate a means of containing hazardous substances prior to disposal.

Equipment:

Cement, 44 gallon drum, cement mixer, shovel, old batteries

Demonstration:

Place batteries into drum. Mix cement and pour into drum. Allow time to set before disposal at landfill.

Discussion:

Discuss leachability of hazardous substances. Groundwater contamination and off-site contamination.

FIELD DEMONSTRATION 3

HAZARDOUS MATERIALS STORAGE, SPILL RESPONSE PROCEDURES AND HANDLING PROCEDURES

Field Demonstration 3 will illustrate:

- The constituents of a safe hazardous materials storage facility;
- A spill response situation; and
- Safe materials handling techniques.

Equipment:

Cardboard boxes (10), hazchem labels, empty shed, pallets (3), water container, hazchem chart, cordial bottle, lime, plastic walls for bunding, MSDS's to match the substances with labels.

Setting Up:

Label the cardboard boxes with the hazardous material labels. Set up a poorly designed and managed storage area with hazardous materials not separately, stored on the ground, in direct sunlight, etc. Place a water container (ie. cordial bottle) in one of the boxes labelled with an acid sticker.

Put the hazchem code guide on the shed wall.

Role Play 1: Constituents of a Safe Hazardous Materials Storage Facility

Get the participants involved in a 'what is wrong with this picture' game. Following this, get the participants to re-organise the storage area so it complies with the hazchem code, dangerous goods storage principles, etc.

The storage shed should be bunded, chemicals separated according to labelling codes, stored off the ground, out of the sunlight, etc.

Discussion:

Discuss what has been done and how this now reduces the risks to human health and the environment.

Role Play 2: A Spill Response Situation

Knock over a cardboard box containing the water container to create a 'chemical' spill scenario. Ask the participants what do we do to resolve the situation?

Some may suggest basic things like mop up, etc. as a knee jerk reaction. However, get them to think about the process and discussed in the module.
The steps should be as follows:

. Identify what the chemical is.
. Consult the hazchem labelling and the MSDS for the chemical.
. Follow the hazchem and MSDS directions (ie. PPE, add lime, etc.)

Role Play 3: Safe Materials Handling

Purpose:

To demonstrate safe handling of hazardous materials including the areas of transport, unloading, and repacking.

Equipment:

44 gallon drums (6), water, ropes, pallets, trolley, forklift, truck

Setting Up:

Half fill the 44 gallon drums with water. Drill a couple of holes above the water line so water can spill out. Provide cardboard boxes to have an array of hazardous materials. Get truck set up.

Demonstration:

Ask the participants to load the truck with the drums.

Discussion:

Discuss how they could have loaded the truck better. If drums are loaded by forklifts discuss ways of securing the pallet. Discuss pulley systems for loading drums.

Demonstration:

Get the participants to secure the load for transit.

Discussion:

Discuss separation of goods, pallet storage (keeps goods off surface), quality o ropes, knots (ie. truckies knot), covering load, labelling facing outwards for reading driver awareness of the load he is carrying.

Go through some 'what if' situations. For example, what if the drum tipped ove during transit?

MODULE TWELVE
FIELD DEMONSTRATIONS

ACTIVITY

IDENTFICIATION OF ACTION ITEMS FOR EXISTING STOCKPILES

Site:

Current Problems:

Suggested Improvements / Changes

HANDOUT 1 – SITE CONTROL

SITE CONTROL

Imagine a site containing hazardous materials where workers could enter and exit wherever when and they liked, where equipment used at the site was parked wherever the driver felt like leaving it, where the public could enter the site and walk around, touching and picking things up. A site like this would be uncontrolled – in other words, there are no procedures for controlling the activities and movement of personnel and equipment at the site. At a site like this, this is a greater risk that something will happen that will harm either the environment or human health, However, this risk can be minimized or reduced, by implementing site control.

The purpose of site control is to:

1. Prevent personnel (workers and the public) from coming into contact with any hazardous material present on the site; and
2. Prevent contaminants being taken off-site by personnel or equipment, onto a clean, uncontaminated site.

This can be achieved in a number of ways, including:

- erecting fencing, barriers or signage to exclude unauthorised personnel, (eg: the public) from accessing the site;
- minimising the number of people and equipment required on-site without compromising the effectiveness of the task at hand or personnel safety;
- implementing safe work practices to be undertaken at the site;
- creating work zones on the site (these are discussed in more detail on page x); and
- undertaking appropriate decontamination procedures.

Specific control procedures and activities to be adopted at a site can be presented in *a Site Control Plan*. Site Control Plans can be 1 or 2 pages long or several volumes long, depending on such things as the nature of work being undertaken, and the sorts of hazardous materials present. The amount of control required at a site will depend on site characteristics (including the nature of hazardous materials present), site size, and surrounding land-uses.

An integral component of site control is the delineation of the site into a number of different work zones or areas, within which specific operations take place. There are three main types of work zones and these are summarised in the table below.

Site Work Zones

Main features	Other Features
Exclusion Zone	
Areas where contamination does or could occur	▪ hot Line ▪ access control points
Contamination Reduction Zone	
Area where decontamination of equipment and personnel takes place.	▪ contamination reduction corridor ▪ access control points ▪ contamination control line ▪ equipment parking area (before decontamination)
Support Zone	
Outermost part of the site which is considered the non-contaminated or clean area	▪ site office (if applicable) ▪ equipment parking areas (after decontamination)

As noted in the table above, within each work zone, there are the following number of smaller work areas:

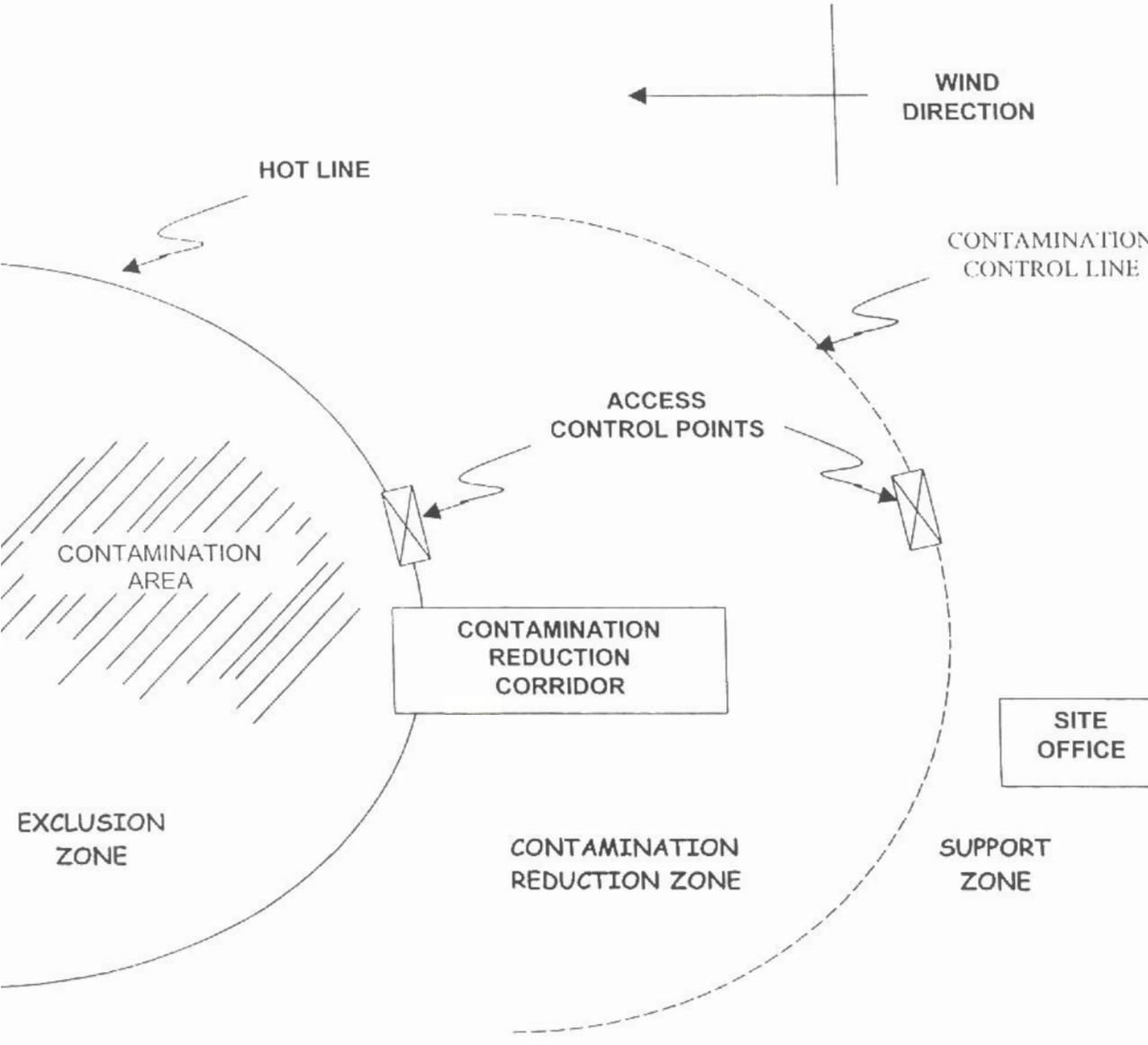
- Hot Line – a clearly marked boundary separating the Exclusion Zone from the Contamination Reduction Zone;
- Access Control Points – specific points designated for entry and exit onto the site and into each work zone;
- Contamination Reduction Corridor – an area designated for carrying out decontamination procedures;
  Contamination Control Line – boundary line between the Contamination Reduction Zone and the Support Zone; and
  Equipment Parking Areas – areas set aside for the parking (or temporary storage) of equipment both before and after decontamination procedures.

ıe approximate location of each zone should be marked a site map and included in the Site Control Plan. An ample of a site map, showing each of the above work ıes and features is provided in Figure 12-1.

: Control" Information sourced from the National Safety Council of Australia
:A) 3 Day Contaminated Sites Training Course - Participant Notes (Chapter 18).

Figure 12-1 – Diagram of Site Work Zones*

*based on diagram provided in National Safety Council of Australia (NSCA) 3 Day Contaminated Sites Training Course - Participant Notes (Chapter 18)



Note: Wind direction is an important consideration when locating work zones. If possible, always situate work zones so that the prevailing wind flows through the Support Zone and Contamination Reduction Zone respectively, and then onto the Exclusion Zone.

MODULE TWELVE
FIELD DEMONSTRATIONS

Possible Activity: Preparing a Site Control Plan

Note: This activity may be completed during the Field Demonstrations, if time permits

Select a site visited early in the week and prepare a Site Control Plan, including a diagram showing the location of work zones and areas.

HANDOUT 2 – SITE SAFETY PLANNING

SITE SAFETY PLANNING

The purpose of site safety planning is to protect the health and safety of all employees working at a site.

Site safety planning includes:

- Identifying all potential hazards at the site;
- Making sure that people who will be working at or near the site are aware of these hazards; and
- Putting in place necessary procedures to avoid or minimise the impacts of identified hazards on site personnel.

As part of the Site Safety Planning process, a Site Safety Plan should be prepared. A Site Safety Plan (SSP) is a 1-2 page form that provides instructions and procedures for minimising accidents and injuries that may occur whilst conducting activities at a site.

The Site Safety Plan typically contains a summary of the likely hazards a worker may encounter at a site, and what measures should be taken to avoid or minimise incidents relating to these hazards.

The Site Safety Plan should be completed by the site manager or another person familiar with the site, prior to activities commencing at the site. All people working at a site must be familiar with the Site Safety Plan for that particular site.

Site Safety Plans can be generic (covering many sites and many situations) or specific (covering one site and one situation only) depending on the given situation.

Activity: Requirements of a Site Safety Plan

On the next page, list the sort of things that you think would need to be recorded on a Site Safety Plan, for a site that is known to contain hazardous materials.

An example of a Site Safety Plan is provided in the "Module 6 - Resource Materials" section of this manual.

A formal checklist, which can be used each time a Site Safety Plan is prepared, is provided at the end of this module.

Possible Activity: Framework for a Site Safety Plan

Note: This activity may be completed during the Field Demonstrations, if time permits

List below, the sort of things that you think would need to be recorded on a Site Safety Plan, for a site that is known to contain hazardous materials.

- _____
- _____
- _____
- _____
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- _____
- _____
- _____
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- _____
- _____

SITE SAFETY PLAN CHECKLIST
FOR SITES CONTAINING HAZARDOUS MATERIALS

Have You Listed:

- [ ] The Date
- [ ] Site location and description

MODULE TWELVE FIELD PROGRAM

Question: What is the difference between a Site Safety Plan and a Site Control Plan ?

Answer: A **Site Safety Plan** is a short form containing written information on what hazards are anticipated to occur at the site and instructions on what action is required to avoid incidents relating to these hazards. It typically includes contact details of site management personnel and emergency services such as the fire brigade and ambulance service, as well as instructions on what sort of PPE is required to be worn.

In contrast, a *Site Control Plan* provides detailed information that is used to minimise personnel coming into contact with contaminants as well as reducing the possibility of transferring contaminants from a contaminated site to a clean site. This is achieved through designating different work zones (such as decontamination areas, exit / entry points and contamination free zones) around the site, and the location of which should be illustrated on a site sketch.

MODULE THIRTEEN
CONTAMINATED SITE REMEDIATION

INTRODUCTION

The management approach for addressing contaminated sites in the Pacific is to firstly **prevent further contamination**, recover spilled or dumped material wherever possible, contain contaminants on site and to then treat or remediate the site.

Module 13 aims to take participants through this hierarchy of hazardous waste management and provide participants with practical and effective solutions to treating and disposing of contaminants in their country.

WORKSHOP OUTCOMES

At the end of this workshop module, you will:

1. Understand the waste management hierarchy for containing, treating and disposing of contaminated soil;
2. Be aware of options for treating and disposing of contaminated soil either locally or remotely;
3. Be aware of the costs associated with treating and disposing of contaminated soil; and
4. Understand the public health and environmental hazards associated with contaminated site remediation.

WASTE TREATMENT AND DISPOSAL OPTIONS

There are a number of options available for the management of soil contaminated with hazardous material. These include **on-site treatment** (ie. bioremediation, vertical mixing, soil washing), **on-site containment, off-site treatment and off-site disposal.**

Contaminated soil may be treated on-site depending on the type of waste, waste concentrations, and site conditions. On-site remediation is usually suitable for soil contaminated with petroleum hydrocarbons (bioremediation), and low-level heavy metal contamination (vertical mixing).

The on-site containment option needs to consider the type of waste and the surrounding environmental receptors. On-site containment needs to prevent contaminated material from moving into groundwater, creeks, rivers and the ocean.

The most suitable method will depend on a number of factors including the type of waste, quantity of waste, availability of waste facilities and the potential human and environmental risks presented by the contaminated soil.

Note: The type and quantity of waste is typically determined by soil sampling and laboratory analysis. Laboratory analysis needs to determine the concentration of the waste, and possibly its leachability. The laboratory results will help determine which treatment option is the most suitable. Generally, soil containing high concentrations of leachable hazardous material will require off-site treatment and disposal at a lined landfill facility.

On-site Treatment

Bioremediation

Bioremediation is the process where naturally occurring bacteria within the soil breaks down the hydrocarbon fractions. Sunlight also helps to evaporate some of the volatile hydrocarbons.

The soil is prepared by adding fertiliser and water to encourage the naturally occurring bacteria in the soil to break down the hydrocarbon fractions. The soil is spread out on a pad in a layer of approximately 300mm thick. The soil is ploughed with a rotary hoe to accelerate the bioremediation process.

Bioremediation can take a number of months before the hydrocarbons are reduced to an acceptable level. Heavier fractioned hydrocarbons like oil can take up to several months to totally break down. The bioremediation time is dependent on the initial amount of contamination and how often the soil is ploughed.

Sampling of the soil will need to be undertaken each month of the bioremediation process to determine when the soil is uncontaminated.

Vertical Mixing

Low-level contaminated soil can be diluted with uncontaminated soil using the vertical mixing technique. Vertical mixing involves the rotary tilling of contaminated surface soil with the underlying 'clean' soil. Vertical mixing can only be used where the contamination is limited to the soil surface (ie. <100mm deep).

Soil Washing

The soil is usually dewatered and pulverised to minimize soil particle size as pretreatment. Soil washing involves the addition of surfactants or acids to the soil to 'clean' the soil of contaminants. Surfactants are added to release organic wastes from the soil particles, while acid release heavy metals from the soil particles.

On-site Containment

On-site containment encapsulates the contaminated material using appropriate barriers like concrete, geo-fabric and clean soil. The barriers aim to prevent leaching of the contaminated soil.

The contaminated soil is usually buried at depth to prevent human contact. Contaminated soil may require liming to neutralise acids and reduce the leaching potential of chemicals.

Off-site Treatment

There are a number of treatment technologies available for the remediation of contaminated soil. These include plasma arc, thermal desorption, high temperature incineration, fixation / cementation.

Local landfill facilities are not likely to have the capability to incorporate these treatment technologies. Off-island disposal may be required for some contaminated materials.

Off-site Disposal

Soil contaminated with pesticides, heavy metals, PCB's or PAH's will often require off-site disposal to a controlled landfill. Landfill facilities may require adequate lining to prevent these chemicals from leaching into the ground and watertable. Various chemicals have different leaching rates.

Landfill Facilities

WASTE DISPOSAL INFRASTRUCTURE

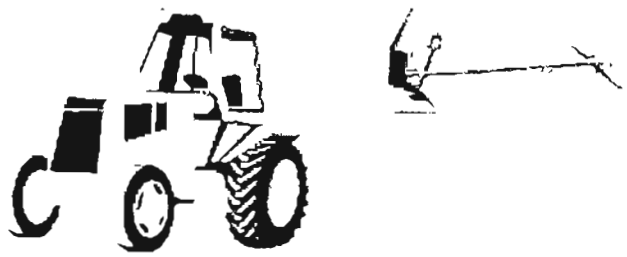
There are two types of landfill facilities, lined and unlined landfills. Lined landfills have an impermeable barrier (usually thick compacted clay) to contain leachate within the landfill cell. Lined landfills can usually accept highly contaminated soil.

Unlined landfills do not have any impermeable lining. These landfills should only accept low to moderately contaminated soil given the potential for groundwater contamination.

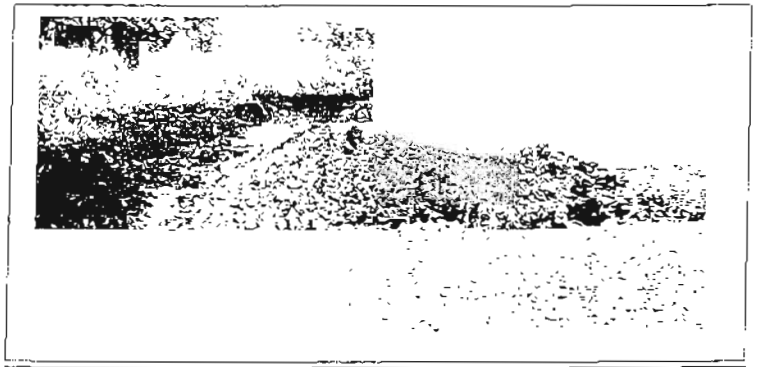
The level of contamination and its leachability will determine which type of landfill is appropriate to receive the contaminated soil.

Refer Figure 13.1 (page 5) for examples of some of the above treatment technologies.

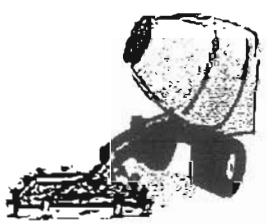
Figure 13.1: Treatment Technologies for Contaminated Soil



Vertical Mixing: Contaminated surface soils are mechanically mixed (ie. ploughing) with the cleaner soil below. This process dilutes the contaminated soil to acceptable concentrations, thus lowering the human risk to surface exposure.



Bioremediation: Naturally occurring micro-organisms break down organic contaminants into non-toxic substances. Soil is usually spread out in thin layers on a pad. Fertiliser and water are added to the soil to encourage microbial activity.



Fixation / Solidification: The contaminated soil is mixed with wet cement. When the cement sets, the contaminants are stabilised in a solid form, thus preventing leaching.

On-site Containment: Contaminated soil can be encapsulated and buried at depth using a combination geo-fabric, concrete, and compact clay liners. This method also aims to prevent leaching and human contact.

WASTE TREATMENT COSTS

In general, less contaminated soil will require lower treatment costs compared with highly contaminated material.

The remediation technique costs are grouped below:

Low Costs:

Vertical tilling, landfill disposal (unlined)

Moderate Costs:

Bioremediation, landfill disposal (lined), soil washing.

High Costs:

Incineration, plasma arc,

PUBLIC HEALTH & ENVIRONMENTAL HAZARDS

The management of contaminated soil needs to be assessed against potential public health issues. The level of **human health risk** needs to be determined to implement the most suitable remediation technique. The level of risk is determined by assessing the location of the waste, the type of waste, and the potential receptors.

For example, heavily contaminated PCB soil adjacent to a pre-school would be considered to pose a high human health risk. The same soil located in the middle of a disused field would be considered to pose a low human health risk. Therefore, the implemented remediation approach will differ for both sets of circumstances. The level of remediation should aim to reduce or nullify the level of potential risk.

The risk assessment also needs to incorporate the **potential risks to the environment**. For example, a stockpile of heavily contaminated soil adjacent to a creek would pose a considerable environmental risk.

LIST OF RESOURCE MATERIALS

- Department of Environment (1998). *Assessment and Management of Contaminated Land in Queensland.* Appendices 5, 7 and 9.
- United States Environmental Protection Agency, (1996). *Bioremediation in the field.* EPA/540/N-96/500.
- United States Environmental Protection Agency, (1997). Technology Alternative for the Remediation of Soils Contaminated with As, Cd, Cr, Hg and Pb. EPA/540/S-97/500.
- United States Environmental Protection Agency, (1997). *Geosynthetic Clay Liners Used in Municipal Solid Waste Landfills.* EPA/530/F-97/002.
- *Treat, Store and Dispose of Waste* – USA EPA (Office of Solid Waste)
- Web sites:

www.epa.nsw.gov.au/mao/tec/co2/

www.epa.nsw.gov.au/mao/tec/ve/

www.epa.gov/swertio1/products/citguide/thermdsp.htm

www.epa.gov/swertio1/products/citguide/biorem.htm

www.epa.gov/swertio1/products/citguide/soilflsh.htm

www.epa.gov/swertio1/products/citguide/sve.htm

www.epa.gov/swertio1/products/citguide/soilwash.htm

MODULE FOURTEEN
REVIEW MODULE

INTRODUCTION

The emphasis for this review module will be on examining the **workshop expectations** given by participants on the first day of the program and ensuring that all expectations have been met. Furthermore, this session will allow an opportunity to address any outstanding matters.

This module will also allow **complex modules** to be reviewed so participants maximise the benefits of the program.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

1. Be satisfied that all my expectations for the training workshop have been met; and
2. Have clarified any outstanding matters or issues relating to the workshop material.

Note: There are no Resource Materials for this Module.

MODULE FOURTEEN
REVIEW MODULE

REVIEW OF WORKSHOP EXPECTATIONS

Please list here, any workshop expectations that have not been met so far in the program:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

MODULE FOURTEEN
REVIEW MODULE

List here any modules or matters you would like to review during this session:

- _____

_____

- _____

_____

- _____

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- _____

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- _____

_____

REVIEW OF MODULES

MODULE FIFTEEN
DRAFT WORKSHOP REPORT

INTRODUCTION

The purpose of Module 15 is to collate the issues and actions suggested by participants into a **draft workshop report** for presentation to SPREP. Actions will be divided into those that can be taken immediately and those that will be taken in the longer term. The resource implications of various actions will also be reflected in this draft workshop report.

WORKSHOP OUTCOMES

At the end of this workshop module, I will:

- Relate the training program to local conditions;
- Review and collate the action plans complied in previous sessions; and
- Agree upon specific actions that can be undertaken **in-country** (with little or no reliance upon external support).

Note: There are no Resource Materials for this Module

MODULE FIFTEEN
DRAFT WORKSHOP REPORT

Major Issues

SUMMARY OF WORKSHOP ISSUES

Describe below, the major hazardous materials, waste and contaminated sites issues in the country:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Please list below some of the major workshop evaluation issues recorded on the daily workshop evaluation forms.

WORKSHOP EVALUATION ISSUES

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

MODULE FIFTEEN
DRAFT WORKSHOP REPORT

ACTION PLAN

Action	Who	Timeline

DAY FIVE
WORKSHOP EVALUATION

Your name: ..... (optional)

Organisation: .....

Country: .....

Date of Workshop: .....

FIELD PROGRAM

Please circle the correct words:

1. The objectives of the field program were:

   Clear / Unclear.

2. The content of the field program was:

   Relevant to me / Not relevant to me.

3. The field program was:

   Easy to understand/ Not easy to understand

4. I would like further discussion or more information on the following issues:

_____

_____

_____

_____

MODULE 13

Please circle the correct words:

1. The objectives of the module were:

   Clear / Unclear.

2. The content of the module was:

   Relevant to me / Not relevant to me.

3. The module was:

   Easy to understand/ Not easy to understand