Kiribati chemical and waste management advice and Banaba reconnaissance mission

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ABBREVIATIONS

GoK	Government of Kiribati
MELAD	Ministry of Lands, Agriculture and Development
POPs in PICs	Persistent Organic Pollutants in Pacific Island Countries
NIP	National Implementation Plan
PCBs	Polychlorinated Biphenyls
MSDS	Material Safety Data Sheet
TOR	Terms of Reference
PPE	Personal Protective Equipment
MHMS	Ministry of Health and Medical Services
SPREP	Secretariat of the Pacific Regional Environment Programme
KIR-EU	Kiribati-European Union
GPA	Global Programme of Action on Marine Pollution from Land-Based Sources
NPA	National Plan of Action
AFD	Agence Francaise de Développement
WHO	World Health Organisation
AusAID	Australian Agency for International Development
ECD	Environment and Conservation Division of MELAD

1. INTRODUCTION AND BACKGROUND

The Kiribati Chemical and Waste Management Advice and Banaba Reconnaissance consultancy was undertaken from 15–29 July 2008. The consultancy was necessary due to several hazardous waste management issues identified on Tarawa and Banaba since 2005.

Several of the hazardous waste management issues were identified during the clean up phase of the Persistent Organic Pollutants in Pacific Island Countries (POPs in PICs), through consultations between the GoK and the POPs in PICs Team. These issues were largely outside of the scope of the POPs in PICs Project and therefore could not be fully addressed. Also during the POPs in PICs clean up, the Ministry of Environment, Lands and Agricultural Development (MELAD) reported the existence of disused transformers on the island of Banaba. Due to the late stage of the identification of the transformers, the POPs in PICs team was not able to visit Banaba and assess the contamination status of the transformers.

Since mid-2005, the consultants, Melanie Ashton and Mike McRae Williams, Team Leader and Chemist respectively on the POPs in PICs Project, worked closely with MELAD to develop the terms of reference and identify available funds for the work.

In early 2008, funds were identified through the GoK’s remaining NIP budget and the consultant’s Terms of Reference (TOR) were drafted. GoK awarded the consultancy to GHD Pty Ltd (herein GHD), with Melanie Ashton and Mike McRae Williams subcontracted to GHD. It was agreed with AusAID that the consultancy would also serve as the reconnaissance for the POPs in PICs clean up of the Banaba transformers. AusAID confirmed available funds for this clean up, should test work confirm the presence of PCBs.

All work on this consultancy was undertaken together with MELAD staff to ensure staff received the maximum benefit of “on-the-job” training and capacity building, training was also provided to staff from several other departments, the details of which are included in the main body of the report.

The following report is organised according to the sections of the TOR (included as Annex 1). Each section describes the work undertaken, the results of this work, and the resultant recommendations. The final section includes concluding remarks and a collation of all recommendations.

The consultants wish to express their gratitude to the staff of MELAD for their facilitation, assistance and enthusiasm for this consultancy. Special thanks are offered to Farran Redfern for his ongoing commitment to this project and to the environment of Kiribati.

2. SCHOOL CHEMICALS

Work on the school chemicals was undertaken on 16, 17, 19 and 26 July, and included visits to four schools. The work focused on safe storage, neutralisation and stabilisation of disused chemicals.

The TOR required the consultants to:
- Work with local counterparts to neutralize school chemicals and stabilize metal-based salts;
- Make an inventory of metal based salts containing arsenic, mercury and cadmium (which cannot be stabilized);
- Provide a simple instruction manual on stabilization and neutralization; and
- Provide a copy of MSDS (internet access permitting).

2.1 Neutralisation, stabilisation and chemical storage

On 16 July 2008, the Team visited KGV school laboratory. The POPs in PICs Team visited this laboratory in 2006 and repacked three drums of disused chemicals including metal-based salts, unknown chemicals and acids. The Team visited the laboratory and confirmed the chemicals remained as stored in 2006.

MELAD organised teachers and laboratory technicians from schools in Kiribati to meet with the Team and discuss the situation in their own laboratories, a participants list is included as Annex 2. Melanie provided a contextual introduction and background to their work and Mike made introductory remarks on the treatment of laboratory chemicals. He noted that different chemicals require different treatments and actions. He stressed that teachers and laboratory technicians should review their chemicals and decide what they wish to keep and dispose of based on the science curriculum. Mike also highlighted that schools should only order chemicals that can be disposed of safely on Tarawa. It was noted that MELAD might be able to provide advice on this.

On 17 July, the Team undertook a demonstration and training on neutralisation, stabilization, appropriate storage of school chemicals and vessel cleaning and disposal. A simple training manual was provided; this is included as Annex 3.

The training on vessel cleaning and disposal involved a demonstration. Key points in the demonstration included:
- Bottles should be thoroughly triple rinsed in a bucket of water;
- Final rinse under the tap;
- If possible bottles should be reused for similar solutions (as per the label on the bottle), or for storage of spent solutions from laboratory tests;
- Glass bottles not being reused should be broken up prior to landfill disposal, plastic bottles should be punctured;
- The wash water in the bucket should be tested and the pH adjusted to approximately 8; and
- Water can then be disposed of down the sink.

Note: this does not apply to rinsed bottles that contained metal salts, or solutions. These should be washed separately and the rinsate (liquid used for washing) retained for stabilization.

The training on neutralisation involved separating disused acids and alkalis and neutralizing them. Key points included:

- Separate disused acids and alkalis;(note, this does not include acids or alkalis with metal based salts as these must be stabilized for disposal)
- Assess approximate volume of liquid;
- Using a strong plastic bin, fill with 5 times as much water as acid and alkali to be disposed of;
- Slowly add the acid to the water, until all acid has been added;
- Stir solution;
- Slowly add the alkali to the diluted acid;
- Stir solution;
- Test pH;
- Add acid or alkali to bring pH to >8; Coral sand can be used as an alkali. Sand should be added slowly and in batches, stirring occasionally until reaction is complete.
- Let the solution settle;
- Liquid can then be poured down the drain;
- Solids in the bottom of the bin should be collected for stabilization.

The training on stabilisation involved stabilisation of disused metal-based salts. Key points included:

- Identify a mixing place that allows you to mix cement without contaminating the surrounding environment. For example a tarpaulin, or an old piece of plywood of around 2m x 2m;
- Consider the type of chemical to be stabilized, reference the following table and sort chemicals accordingly;
- Neutralise all liquids requiring stabilisation; Metal based liquid acids can be neutralized by the addition of coral sand which should be stirred until reaction is complete.

Table 1: Stabilisation Ratios

Chemical type	**Amount of waste (grams)**	**Cement (grams)**	**Fly ash or coral sand (grams)**	**Lime (grams)**	**% volume change**	**Setting time**	**Description**
Copper, zinc, iron, magnesium, aluminium	100	100	100	50	100	26 mins	Hard
Lead	100	150	150	50	73	9mins	Hard
Barium	100	200	100	50	59	8mins	Hard
Manganese	100	100	100	50	110	24mins	Friable

- Follow the relevant recipe from the table. If lime is not available use additional coral sand as a substitute;
- Place cement on mixing area and use a consistent volume measure (for example a shovel);
- Add an appropriate volume/mass of the solid chemicals requiring stabilization
- Add sand and lime or additional coral sand;
- Mix thoroughly, while the mixture is still dry;
- Make a basin in the mix;
- Slowly add water or neutralized base metal liquids;

- The mixture will get warm, and some of the base salts may react with the coral sand and cement as they become wet (e.g. $FeSO_4$) but this reaction will quickly dissipate;
- Mix thoroughly, continuing to add water or neutralized waste water to achieve the consistency of concrete used for paving;
- Place in container (for example a plastic bag) as a mould;
- Allow to set (this may take several hours, it can be left overnight); and
- Once set this should ideally be disposed of in a designated chemical disposal site, which is managed appropriately, however in the case of Kiribati, where no such facility exists and the quantities are very small and the environment is alkali, burial in a pit or landfill above the water table would be acceptable.

The Team returned to KY5 on 19 and 26 July to complete the stabilisation of disused chemicals from KY5 and those disused chemicals collected from the other schools visited. Due to torrential rain on 26 July, 14 previously unknown chemicals were identified, but left unstabilised. MELAD agreed to work with Mere Teaabo (KGV EBS) to stabilise these at a later date.

The training on laboratory organization included review of several school laboratories. A schematic diagram was provided of an example laboratory plan, see Figure 1.
Key points included:
- Store oxidants away from organics;
- Separate liquids and solids;
- Store liquids on lower shelves;
- Separate acids and bases;
- Store metal-based salts together; and
- Keep the laboratory store secure.

Figure 1: Schematic plan of laboratory chemical arrangement

solids

Oxidants	Metal salts	Non-metal salts (eg	Alkali solids (eg NaOH)

acids	Organic liquids	Alkali liquids

liquids

2.2 School visits

On 16 and 17 July the Team visited four schools and reviewed the contents and organisation of the chemical laboratories.

JSS BTC: This chemical store was well organised. The Team collected a few empty vessels for washing and disposal and identified two unlabelled chemicals as curry powder and parmesan cheese.

Moroni: This store was well organised. One small bottle (500gm), half full or elemental mercury was identified, removed and taken to KGV School for secure storage. A previously unknown chemical was identified as sodium. Several unwanted acids and metal-based salts were collected by the Team for the neutralisation and stabilisation at the KY5 School.

JSS TUC: This store was well organised and secure. Unlabelled caustic soda was relabeled and Mike advised that oxidants should always be stored away from organics.

St Louis: This store was well organised. As St Louis is one of the oldest schools in Tarawa, the chemical store contained many chemicals no longer used (see Annex 4). A small vegemite jar with less than 10mL of liquid elemental mercury was identified. The teacher in charge advised he would like to keep it to show to students. The Team removed a large cardboard box of disused chemicals for neutralisation and stabilisation.

2.3 Inventory of metal-based salts, metals and solvents unsuitable for stabilization

Some metal-based salts and metals are unsuitable for stabilisation. Solvents are also unsuitable for stabilisation. An inventory of these chemicals, with options for disposal is included as Annex 4.

Mercury

Five small bottles of elemental and mercury metal and compounds identified were stored at KY5 (except for very small demonstration quantity left at St Louise). There are no on-island resale options for mercury metal or mercury compounds, so these should be stored safely. Kiribati is a participant in the UNEP Open-Ended Working Group on Mercury and UNEP Chemicals should be notified of the mercury remaining on Kiribati. The information can be emailed to Sheila Logan (SLogan@chemicals.unep.ch).

Dichromate

Dichromate – was located at all schools and it is assumed it must be required for science experiments on the Kiribati curriculum. Dichromate can be stabilized but requires treatment first. The treatment involves reducing the hexavalent chromium in dichromate to trivalent chromium. This is generally completed by adding sodium metabysulphite as the reducing agent. The trivalent chromium is suitable for stabilisation with other metal-based salts. No suitable reducing agent was available in Tarawa. As such old dichromate stock was organized for long-term storage until a future workshop to stabilize these chemicals could be arranged and funded.

Organic Solvents

Several organic solvents including chloroform and other chlorinated solvents (xylene, toluene) are stored at the schools. There are no appropriate on-island disposal options for these organic solvents. A possible disposal option could be export of the materials for disposal in Australia but this requires further investigation by MELAD. In the interim these chemicals must continue to be stored safely in the school laboratories ensuring that the appropriate labels are maintained.

Unknown chemicals

The Team identified several unknowns during the consultancy, but approximately 50 bottles of unknown chemicals (solids) and a similar amount of unknown chemicals (liquids) remain at KGV School. These chemicals have historically been used for school laboratory experiments, but their original labels have been lost. The Team stored the liquids in two separate labeled drums in the KGV laboratory store. The only option for identifying these chemicals is sampling them individually and sending them offshore for a suite of analyses. The analysis required could be refined by a review of the school science curriculum covering science experiment requirements over the last 10 years. This process is however, expensive.

2.4 Recommendations on the management of school chemicals

MELAD advise Ministry of Education on chemicals suitable for disposal on Tarawa and recommend that the science curriculums be evaluated to find alternative tests that include only these chemicals.

Mere Teaabo (KGV Laboratory Technician) – to train new laboratory technicians and run annual training on the organisation of school laboratory stores.

Mere Teaabo and MELAD work together to stabilise the remaining bottles of chemicals.

MELAD to investigate the status of school laboratories and disused chemicals in outer island schools including the occurrence of metal mercury or mercury based salts in the outer island school laboratories.

3. INCINERATOR ASSESSMENT AND PHARMACEUTICAL ISSUES

Work on the pharmaceutical chemicals and incinerator was undertaken on 18 July and 25 July and included a consultation with key officials, review of laboratory chemicals, expired pharmaceuticals and of the incinerator.

The TOR required the consultants to:

- Work with local counterparts to undertake a technical review of the incinerator
- Work with local counterparts to undertake an incinerator trial
- Work with local counterparts to assess the risk from toxic chemicals including cyanide at the Laboratory
- If concluded that the incinerator does not have the capacity to destroy the pharmaceuticals, work with local counterparts to develop an inventory of all expired pharmaceuticals
- Facilitate a meeting with donors and local counterparts over the issue of expired pharmaceuticals and the cost of export and destruction.

3.1 Consultation with key health officials

Farran Redfern facilitated a brief consultation with government health officials on 18 July. A list of participants is included as Annex 5.

The consultants provided an introduction to the work of the consultancy and issues related to the incinerator and expired pharmaceutical chemicals. In the ensuing discussion health staff discussed the challenges faced including: lack of knowledge on chemical disposal options; the apparent incomplete combustion of the incinerator waste, including increased volume and a black coke like substance remaining after combustion; the disposal of broken mercury thermometers in the incinerator; and the need for a assistance with management planning.

The consultants agreed to review all laboratory chemicals and advise on appropriate disposal and advised that broken thermometers should be stored in a separate bin to sharps and stored as mercury waste.

3.2 Review of laboratories and chemical stores

X-Ray Department: The X-Ray Department uses developer/fixer system supplied by Kodak (RPX-OMAT) for the preparation of X-Ray images. Approximately 40L per week of RPX-OMAT photographic waste is disposed of to the drain (first to septic tank and then to sewer) every week. The waste contains predominantly silver thiosulphate. This should not be disposed to sewer without prior removal of the silver, as silver is a biocide in the environment.

There are many methods of silver removal but most of these are too costly for the small quantities of photographic waste generated at the hospital. One technique however, is applicable to such a situation. It is based around the principle that iron (Fe) is more reactive than silver. If iron is placed in the silver-thiosulphate waste solution an oxidation-reduction reaction takes place and the silver is plated on the iron and the iron moves into solution. Good sources of iron are steel wool, iron filings etc. Several companies make small units based on this principle. One company, Greymart Environmental Services market a cheap and effective unit based on a 20 litre plastic bucket, which holds the steel wool (http://www.greymart.com/pdf/SteelWool-Bucket.pdf). This system is of quite a simple design and could be made on island. Alternatively, purchase of the complete system would not require a large investment.

Hospital laboratory: The laboratory had several sections used for varying processes. All sections had waste products and the staff were unsure of disposal options. These included:

- **Xylene/Methanol Solution:** (Approximately 30 litres, stored in approximately 8 amber bottles). There are no safe disposal options for these organic compounds on-island at present. These mixtures could be disposed in the high temperature incinerator if it was working at design specifications. However, this is not the case, as major equipment components necessary for complete high temperature combustion are no longer attached to the furnace. The only option at present is to safely store the chemicals in the hospital laboratory until a disposal option is available.
- **Cyanide and haemoglobin mixtures:** (Approximately 400L, stored in plastic vessels). These mixtures containing cyanide/cyanide complexes are waste test solutions resulting from haemoglobin testing. While the concentration of cyanide in these waste products is unknown, it is likely to be sufficiently high to be of concern. Cyanide is very toxic to marine life and should not be disposed to the sewer as the sewer discharges to the sea on the adjacent shore platform. The cyanide can be treated and destroyed by the controlled reaction with calcium or sodium hypochlorite. However, the treatment process involves redox measuring equipment and specific PPE, none of which was available during this trip. Should MELAD require it then the Team would be happy to provide such. In the mean time the waste reagent should be stored in a secure, dry and well-ventilated place.
- **Drabkin's reagent:** Drabkin's Reagent is used in the cyanmethemoglobin method of measuring haemoglobin. It consists of sodium bicarbonate, potassium cyanide and potassium ferricyanide. The KCN concentration is 4%. This is a toxic reagent as HCN gas can be generated from this reagent. It should be stored in a cool, dry and well-ventilated place well away from any acids. It should be opened only under controlled conditions preferably in a fume cupboard. It is very toxic to marine life and should not be disposed to the sewer as the sewer discharges to the sea on the adjacent shore platform. The cyanide can be treated and destroyed by the controlled reaction with calcium or sodium hypochlorite. However, the treatment process involves redox measuring equipment and specific PPE, none of which was available during this trip. Should MELAD require it then the Team would be happy to provide such. In the mean time the reagent should be stored as indicated above.
- **Easyelectrolyte analyser wastes:** These Medica made analysers are completely automated, microprocessor controlled electrolyte systems that use current ISE (Ion Selective Electrode) technology to make electrolyte measurements. These instruments can measure various combinations of sodium, potassium, chloride, lithium, calcium and pH in whole blood, serum, plasma, or urine. The waste from this analysis should then be treated as infectious waste and disposed of appropriately.
- **TB colour carbol fuchsin solution:** This reagent is used for microbiological staining and is very hazardous in relation to skin contact. It contains Basic Fuchin, phenol and ethyl alcohol and is an environmental toxin. There are no available on-island disposal methods available at present and the product should be stored in a secure, dry and well-ventilated environment.
- **Difco selenite broth:**Difco Selenite Broth is an agar medium used for the isolation of *Salmonella* from faeces, urine, water and foods etc. It is composed of agar plus lactose (4g/L), sodium Selenite (4g/L), and sodium phosphate (10g/L). While this product

contains selenium in small quantities (which is an environmental toxin when in high concentrations) the levels in the selenite broth indicate that disposal to the sewerage system provided the solutions are discarded in small quantities at any one time would be the most appropriate disposal method available on-island.

- Uranyl acetate is made from depleted uranium from which the radioactive isotopes have been greatly reduced. Nevertheless it is a mildly radioactive reagent. It is generally used for specific staining in electron microscope investigations so it is unclear why it is the laboratory. The reagent should be stored in the dark and away from other chemicals that are used more frequently. There are no acceptable methods of disposal available on-island.
- **Sodium tungstanate:** Sodium tungstanate is a base metal salt which can be stabilized with cement, lime and coral sand. After stabilisation ideally it should be disposed in a landfill or pit specified for stabilized wastes. As Tarawa does not have such a facility, and the quantity to be disposed is small, the most appropriate disposal option for the stabilized material is in the landfill. Effort should be made to ensure it remains above the water high tide level.
- **O-toluidine** Ó-toluidine is a Poison and Probable human carcinogen. It is harmful by inhalation or ingestion, may be harmful through skin contact and may cause cyanosis, dermatitis or nausea. It is a Class 6.1 hazardous substance containing compounds of benzene, toluene and aniline. There is no on-island disposal option available at present so the product should be stored away from any oxidants in a locked and well-ventilated area.

Disused chemicals stored in pharmaceutical store: The Team visited the Pharmaceutical Store to look at old and disused chemicals stored there. According to staff the chemicals had been there for several years and the staff were unsure of the uses for, or the hazards posed by the chemicals. The chemicals included:

- **Phenol** (1 amber bottle). Must be stored as no current disposal option available on-island. These should be transferred to the hospital laboratory and stored with similar chemicals.
- **Acetic acid** (1 bottle). Can be neutralised using coral sand using method described in MELAD workshop. This chemical is stored in close proximity to organic solvents (phenol, xylene, propenol), which is potentially dangerous. The organic liquids and acids should be separated and stored in the hospital laboratory (see comments in nitric acid below).
- **Dextrose in Na_2Cl** (1 bottle). Can safely be disposed to landfill. Contents should be poured from bottle and the bottle broken to ensure it is not reused.
- Sodium lactate (1 bottle). Can safely be disposed to landfill. Contents should be poured from bottle and the bottle broken to ensure it is not reused.
- **Creosol** (4 x amber bottles). Must be stored as no current disposal option available on-island.
- **O-Touluidine** (1 bottle). See above description for details. No safe on-island disposal options exist. The chemical should be removed from the pharmaceutical area and stored with similar chemicals in the hospital laboratory.
- **Uric acid** (1 bottle). Uric acid is an irritant of the skin and eyes and can be a significant danger if dust is inhaled. The product is not defined as having significant environmental effect but the products of degradation are thought to be potentially more environmentally harmful than the product itself. There are no safe on-island disposal options and the chemical should be stored in a secure well-ventilated and dry environment away from oxidizing agents and ignition sources. The existing storage in the pharmaceutical store is inappropriate and the chemical should be transferred to the hospital laboratory store where it can be stored with other organic acids.

- **Propanol** (1 x amber bottle). Propanol is highly inflammable with a flash point at 12^{o}C and is potentially explosive when concentrations in air reach 2%. It is harmful if inhaled. There are no safe on-island disposal options and the chemical should be stored in a secure and well-ventilated place away from strong acids, oxidising agents, halogens and aluminium. The present storage area in pharmaceuticals is inappropriate and the chemical should be transferred to the hospital laboratory and store with other organic solvents.
- **Nitric acid** (2 bottles). Can be neutralised using coral sand using method described in MELAD workshop. This chemical is in close proximity to several organic liquids, which is a dangerous storage issue. The organic liquids (eg. propenol, phenol, xylene) should be removed for safe storage to the hospital laboratory. The nitric acid should be removed for safe storage if neutralisation in not expected in a short time frame.
- **Orthophosporic acid**. Can be neutralised using coral sand using method described in MELAD workshop. See comments above with nitric acid.
- **Xylene sulphur**. Product contains xylene which when vapourised can cause severe human health issues. At temperatures up to 38^{o}C the hazard is minimal. Xylene is highly flammable and potentially explosive at concentrations of 1% in air. It is heavier than air and can accumulate in low points if ventilation is limited. No safe on-island disposal method is available and xylene and xylene compounds must be stored safely in a secure room, away from heat, sparks and open flames. Keep containers tightly closed and store away from strong oxidizing agents in a cool, dry place and well ventilate area. Storage in the pharmaceutical store is inappropriate and the chemical should be transferred to the hospital laboratory and stored with other organic solvents.
- **Acetone**. Acetone is highly flammable and potentially explosive at concentrations of 2.15% in air. It is heavier than air and can accumulate in low points if ventilation is limited. No safe on-island disposal method is available and acetone must be stored safely in a secure room, away from heat, sparks and open flames. Keep containers tightly closed and store away from strong oxidizing agents in a cool, dry place and well ventilate area. Storage in the pharmaceutical store is inappropriate and the chemical should be transferred to the hospital laboratory and stored with other organic solvents.
- **Diethyl ether**. This chemical is highly inflammable and is potentially explosive when concentrations in air reach 1.9%. It reacts violently with strong oxidants and acids and can form explosive mixtures with bromine compounds, perchloric acid, uranyl nitrate and boron triazide. It is harmful if inhaled. This chemical is presently stored in the pharmaceutical laboratory in close proximity to strong acids and should be removed immediately for safe storage in the hospital laboratory. There are no safe on-island disposal options and the chemical should be stored in a secure and well ventilated place away from strong acids, oxidising agents, halogens and uranyl compounds.
- **Unknown chemicals** (2 x amber bottles, likely to be acid and 1 clear glass bottle). Must be stored as no current disposal option available on-island. These should be removed and stored in the hospital laboratory.

On the final day of the Team's consultancy a further list of disused chemicals was received from the Hospital. There was not time to assess all of these chemicals, MELAD should add this list to the inventory (Annex 4), look up the MSDSs and provide necessary advice to the hospital. Two of the chemicals were noteworthy:

- **Benzidine (hydrochloride):** This reagent is hazardous to humans in the case of inhalation or skin contact. It is a proven carcinogen. There are no suitable on-island disposal options and the reagent should be stored in a well-ventilated area with other organic solids. MSDS http://www.sciencelab.com/xMSDS-Benzidine_dihydrochloride-9923046.

- **Polyvinyl Alcohol:** This reagent is slightly hazardous in the case of skin contact, ingestion and inhalation. No safe on-island disposal is available. The reagent should be stored in a secure, dry and ventilated space away from oxidizing reagents, metal salts, acid or alkalis. Store with other organic solvents. MSDS http://www.sciencelab.com/xMSDS-Polyvinyl_alcohol-9927396

3.3 Pharmaceutical chemicals stored in shipping containers

Several shipping containers are located at the front of the hospital complex. Four of the shipping containers currently store expired pharmaceuticals. The following paragraphs describe the contents and disposal options for each container.

Container 1- (ELLU200091, green) contains disused pharmaceuticals and other non-hazardous wastes. The Team noted a hole in the front right hand corner of the container and on 25 July removed several garbage bags of non-hazardous waste. Loose pharmaceuticals, including significant amounts of antibiotics were placed in 8 garbage bags and re-stored in container 2 (see below). Expired pharmaceuticals found to be in original packaging were stacked in to the dry area of the container. An inventory of these should be made, similar to the one included in Annex 6. Pharmaceutical companies should be approached to take back the drugs. An example letter is also included in Annex 6.

It should be noted at least three boxes of the expired pharmaceuticals (ferrous sulphate and folic acid) were labelled WHO and the Team advised Pamela Messervy , Country Representative, WHO (messervyp@kir.who.int) of this.

Container 2 - (JSSU070531, white) contains garbage bags of unused expired pharmaceutical waste. The pharmaceuticals in this container were repackaged during 2007, by SPREP Pollution Prevention and Waste Management Adviser, Dr Frank Griffin. These will need to be disposed of via incineration, when the there is an operating high temperature incinerator. They could also be exported for disposal, but the cost is likely to be prohibitive.

Container 3 – (SH2T3000, red) is filled with expired pharmaceuticals in degraded packaging. These will need to be disposed of via incineration, when the there is an operating high temperature incinerator, or exported for disposal.

Container 4 – (F132UU316, red) contains oral rehydration salts and antibiotics in original packaging. The salts are expired, but likely to be safe and effective. Although some of the electrolytes could still be used, anecdotal evidence from pharmaceutical staff indicate that residents will not accept out of date products. The electrolytes could be safely disposed to landfill. It would be best to drain the electrolyte satchels into the local sewer and place only the packaging in the landfill. Other pharmaceuticals should be retained in their original packaging and then should be added to the inventory in Annex 6.

Containers 1, 2 and 3 contain large quantities of antibiotics, mostly penicillin derivatives. Penicillin infiltrating the water supply is a high risk as it could cause immunity development rendering a valuable drug no longer useful. An inventory of all these chemicals should be made and added to the list in Annex 6.

In addition to the four shipping containers expired pharmaceuticals are also stored an offsite store close to the Environment and Conservation Division office. Although the shed is subject to frequent break-in by children looking for bandages, all pharmaceuticals stored in this location are contained in original packaging. An inventory of well-packaged expired pharmaceuticals from this store was prepared by Bribo Kararaiti (Assistant Pharmacist, Department of Health) and is included as Annex 6.

Therefore, there exists a significant amount of waste requiring disposal.

Two options appear to be practical for the disposal of expired pharmaceuticals such as antibiotics. Those in good packaging may be able to be returned to the manufacturer. If this could be achieved then more than 50% of the current stockpile of pharmaceuticals could be sent back. MELAD have prepared a letter from GoK directed to all manufacturers of the expired chemicals requesting that the manufactures take back the products as they were purchased but not used (Annex 6).

Those without packaging will need to be incinerated or disposed of as hazardous waste offshore. Incineration is probably the most appropriate on-island disposal option but it is reliant on the high temperature incinerator operating to specifications. This is clearly not possible with the existing incinerator condition (see incinerator review below). Removal of these pharmaceuticals offshore would only be viable with the involvement of an aid agency.

According to anecdotal evidence from hospital staff, it appears many pharmaceuticals have been commonly over-ordered. Lack of understanding of demand and adequate stock control are thought to be the primary causes of over-ordering. Discussions with Bribo Kararaiti, Assistant Pharmacist indicated he is developing a method of maintaining adequate stocks and understanding demand. During previous health care waste management meetings between the MELAD and MHMS, it was reported by the MHMS that not all of the expired drugs in the containers were owned the MHMS. They said some were donated by the churches and other charities, even though the Ministry did not need the donated drugs.

3.4 Incinerator assessment

The Team visited the incinerator with Bribo Kararaiti on 18 July, as the incinerator operator was not working. The incinerator is located at the rear of the hospital, 5m from the beach, on the ocean side of Tarawa. Approximately 20 cubic metres of hospital waste has been dumped adjacent to the beach and sharps can easily be found on the beach in this area. This area is accessible to the public and children were observed playing on the beach nearby. The incinerator yard needs to be tidy and hazardous material managed so that it does not contaminate the beach and surrounding area, causing not only environmental damage, but also adverse health impacts on the local community. .

Anecdotal evidence from MELAD and hospital staff indicated that neighbouring residents complain frequently about odours emanating from the incinerator. The Health Inspector advised that a black, coke-like product was found in the base of the incinerator after each burn, thus indicating incomplete combustion. The incinerator appears to have been installed around 2002 with the operator achieving extensive training in its use in Japan.

The Incinerator Operator was interviewed on 25 July. He indicated that the equipment began to deteriorate significantly late in 2007 when the blower fan, exhaust fan and the particulate removal system all fell off the equipment. While he reported the equipment failures it appears budgets and priorities did not allow for new parts to be ordered and installed. The current condition of the system indicates that a major rebuild or perhaps an entire renewal will be necessary if the incinerator is to be able to operate effectively.

The operator also indicated that he was required to sort infectious waste from non-infectious materials and this was done without any form of PPE such as gloves. Due to the large amount of waste and the need to use both the large and small incinerators on site – the waste must be sorted. The operator has received needle stick injuries. In addition, sharps were clearly seen on the ground in and around the facility and the operator did not have appropriate protective footwear (observed working in flip flops/thongs). This situation highlights several issues:

- The incinerator is seen as a low priority issue by the hospital administration as evidenced by the poor condition of the incinerator, the lack of appropriate protective equipment for the operator and the provision of only one operations personnel;
- That segregation of waste in the hospital wards is not being practised efficiently as waste is mixed. While sharps are segregated efforts should be made to separate infectious and non-infectious waste at the ward level; and
- That the current system of disposal is inadequate for the quantity of waste generated.
- Anecdotal evidence from staff indicated that broken mercury thermometers are place in the sharps boxes, which would indicate that they are incinerated with the sharps. This is a highly dangerous practise, as it will distribute mercury vapours over the surrounding households and the hospital. Mercury inhaled or ingested is toxic and is related to many human health issues. Broken thermometers containing mercury should be segregated from all other waste and stored in a robust container. Under no circumstance should they be disposed by incineration.

Operator indicated that quantities varied between 30kg and 90kg per day

The incinerator area comprises a high temperature incinerator as well as three small incinerators. The following sections include an operational and infrastructural assessment of the incinerators. Recommendations are included in Section 3.5.

High temperature incinerator

The high temperature incinerator was constructed in 2002, with the assistance of the SAPHE Project. It has a static fire box with blower air assisted gas firing. When operating effectively and to capacity the incinerator should operate at around 750^{o}C and have a capacity of approximately 50 kg per charge.

Numerous serious infrastructure problems were identified which would be inhibiting the operation of the incinerator and it is unlikely that combustion temperatures exceeding 250^{o}C would be achieved in the present system. These included:

- Broken blower forced air assembly for combustion chamber. This component of the incinerator was found on the ground beside the incinerator, having broken off. In addition, the forced air delivery pipe was observed to be nearly entirely blocked with ash. This indicates the fan has not been operational for a considerable amount of time. For complete combustion, air/oxygen must be forced into the combustion chamber. Without this the incinerator cannot reach high temperatures. The lack of a forced air is likely to be the cause of incomplete combustion and the subsequent formation of coke-product observed by hospital staff at the base of the incinerator chamber.
- Particulate removal cyclone pipe. This has broken off and consequently all recovered particulates drop out on the ground, whereas they should be collected in a container at the base of the pipe. However, because the forced air ventilation is not operating, the draft

velocity up the stack is inadequate to operate the cyclone in any case. At present, a significant portion of the particulate matter exits via chimney stack to the surrounding environment (hospital and residential environments).

- Stack forced ventilation fan to increase dispersal. Above the cyclone on the chimney there should be a ventilation fan to increase the velocity of the gases exiting the stack (for greater dispersal). This is no longer operating, meaning that dispersion of the stack gases are extremely limited and smoke and gases will be deposited on the surrounding buildings and houses. The lack of a ventilation fan is the likely cause of the odour that residents complain about.
- Operation of the furnace in its present condition is likely to result in the formation of dioxins and furans, which will be dispersed in the smoke over the hospital and local community. Dioxins form in the presence of chlorine at temperatures between 150 – 350^{o}C and operation of the furnace at around 250^{o}C suggests that the formation of these highly dangerous by-products of combustion is likely.

In addition to the operational problems identified above other issues identified include:

- Bags containing the medical waste should be small enough to fit through the entrance of the furnace. Sorting of waste should occur at the ward level and never be done at the incinerator. Bags should be sized and sorted so they can be placed directly into the furnace.
- The incinerator is fired by gas. It is operated or was operated on the basis of an 8-hour day, which allowed for two batch firings or around 100 kg of waste disposed per day. This system of operation wastes considerable energy and was clearly insufficient to treat the quantity of waste being generated. Stopping and starting furnaces uses energy to heat up the system and the constant heating and cooling results in enhanced corrosion of the operating components. Most efficient and effective use is obtained by running the system on a constant basis stopping when waste is no longer available for treatment. This would of course require more than one operator. In effect this may mean the incinerator is operated for three continuous days per week, then cooled and cleaned out and fired again the following week.
- Need for operational protocol. Blood was observed running from bags in the incinerator yard while boxes of sharps and other infectious materials were observed outside the incinerator yard. As indicated earlier segregation of waste is required at the ward level and bags should be sealed before being dropped at the incinerator yard. Bags should not be required to be opened at the incinerator. A priority system of disposal should also be in place. Sharps and infectious waste should be disposed first followed by non-infectious waste. It is clear that the incinerator operation and capacity as it presently exists are insufficient to accommodate the waste being generated, which has led to a build-up of materials awaiting disposal.

Three small incinerators

Three small cone shaped incinerators were sited close to the high temperature incinerator. According to the operator/hospital staff, these were originally installed in the pharmacy department but were moved to their present location as a mechanism to cope with the load being generated. It was observed that these incinerators were being used for almost all hospital waste (except for blood soaked materials) including infectious waste such as bandages, plastic wrappings, plastic containers and paper. These incinerators with equivalent capacities of 250L are standard low temperature systems. They burn at maximum of 200^{o}C and are suitable for burning paper and cardboard waste only. Burning plastics and infectious waste in these systems could result in the dispersion of contaminated materials via the smoke (probably accounting for the odours) and will in all probability result in the formation of dioxins and furans.

3.5 Recommendations

Chemicals

- MELAD should compile information in the list of chemicals provided on the consultants final day, to the inventory (Annex 4), look up the MSDSs and provide necessary advice to the hospital.

Pharmaceuticals

- An inventory of all pharmaceuticals should be made and added to the list in Annex 6.
- Send expired pharmaceuticals still in packaging back to manufacturers if the manufacturers acknowledge that they will accept these materials.
- Dispose of oral rehydration salts to landfill and repack other chemicals.
- Once incineration issue is resolved, pharmaceuticals without packaging can be incinerated or disposed of as hazardous waste offshore. This is clearly not possible with the existing incinerator condition.
- Complete protocol for ordering and returning unused pharmaceuticals

Incinerator

- MELAD should contact Dai Nippon Construction located in Betio who originally installed the incinerator to obtain a quotation on upgrading the existing facility so that it meets the original design specifications. If the cost of upgrading the system is not significantly cheaper than the purchase of a new system, then a new system should be purchased. Operating the system in its present condition should not be seen as an option.
- MELAD should undertake a clean up of the medical waste on the beach, bag the waste and ensure it is incinerated. Signage should be erected on the beach prohibiting waste dumping.
- Should it be decided to upgrade the existing equipment or renew the entire incinerator, a budget to cover operation and maintenance should be adopted to ensure that the system is operated effectively and for the longest possible time before another upgrade is required. The budget should provide for appropriate PPE for incinerator operators.
- Should the option for a new incinerator be chosen, MELAD should consider adopting best practise methods of disposal of medical waste through incineration. Most hospitals using incineration for infectious waste disposal use a two-chamber, hearth burning, pyrolitic controlled-air incineration unit. Waste is fed into the primary chamber, where it begins to burn with less than a stoichiometric quantity of air. More air is added in the secondary chamber to completely oxidize the waste. Ash is removed from the back end of the primary combustion unit. A complete system should include an air pollution control system to remove acid gas and meet the particulate standards. Such as system to accommodate the quantity of hospital waste generated, allow the treatment of expired pharmaceuticals and accommodate the treatment of selected laboratory chemicals would require a capital cost of around AUD150,000 for an installed unit. Operating costs would be around AUD40,000 per annum.
- MELAD staff should undertake regular audits of the incinerator operation.
- MELAD should request the Department of Health instigate a protocol for waste segregation at ward level in the hospital. This should also address thermometer disposal to ensure these are stored, not incinerated.

4. TARAWA AIRSTRIP SITE

The Team, together with MELAD staff, visited the Tarawa airstrip and residents and wells in the surrounding area on 18 July and returned to obtain groundwater samples on 29 July 2008.

The TOR required the Team to:

- Work with local counterparts to review bitumen on the southern side of the Tarawa airstrip
- Train local counterparts in groundwater collection and sampling protocol
- Collect groundwater from drinking water wells close to the coal-tar leak including groundwater from sites close to Power Stations and KOIL
- Export the samples to Australia for heavy chain hydrocarbon analysis, BTEX and polycyclic aromatic hydrocarbons.

4.1 Context

Bitumen was used to upgrade the airport runway, in the late 1980s. Excess bitumen was left in drums and in machinery at completion of the runway. The drums corroded over time allowing the bitumen to migrate from the drums into the environment. The natural temperature of the island environment has caused the bitumen to retain a fluid form. When it was assessed in 2006 the bitumen had moved to cover a considerable area. During the 2008 inspection, two main areas of contamination were observed, at the northern and southern sides at the eastern end of the runway. These are addressed separately in the following sections.

4.2 Bitumen at the northern side of runway

The first area is located to the north of the runway end and was the area used to heat the bitumen prior to application on the airport runway. In this area the bitumen had either been placed or moved after drum corrosion, onto the shore platform where it is regularly inundated by seawater.

The northern bitumen area condition was similar to that observed in 2006. Bitumen is still moving onto the shore platform and into dry depressions in the sand dunes along the low sea cliff. This also is clearly contaminating the seawater of the intertidal zone and the bitumen on the dunes is likely to be contaminating the ground water whenever it rains.

4.3 Bitumen at the southern side of the runway

At the south side of the runway field observations made in 2006 indicated that this area of bitumen had encroached on a village and appeared to be slowly flowing into an old well. As the depth to groundwater is less than 2 metres in this area it is highly likely that the water is contaminated by the bitumen. The nearest occupied houses are within 50 metres of the edge of the oozing bitumen and all rely on groundwater for all needs, including drinking water.

During the Team’s 18 July visit, it was observed that the southern bitumen area near the houses had been partially removed by machinery and deposited over the low sea cliff onto the shore platform. Much of the bitumen remained partially liquefied and was slowly covering the shore platform and entering the sea. Bitumen had also been pushed into a water-filled depression, which appeared to contain groundwater, as it was at the same level as the house well water table. This indicates that additional contamination of the water table is probable in the near future. Groundwater was extracted from the nearest household's well and a hydrocarbon odour was detected. Some bitumen remained around the area of the main deposit. Samples (GW8-GW11, inclusive) of the well water and the surface water in the depression were collected on 29 July for analysis for hydrocarbon contamination. The results and associated analysis are included as Annex 11.

4.4 Recommendations

To alleviate the clear environmental damage that has occurred since the construction of the runway and the recent deposition of the material on the shore platform and in the water filled depression, the bitumen source must be removed from the area and contained. It is not acceptable to leave it in its present condition, doing so will lead to continual contamination of the shore platform, surrounding soil and the water table. The source must be removed.

This process would involve an excavator scraping the bitumen from the shore platform, removing it from the edge of the water filled depression, and removing it from all other areas adjacent to the village houses.

It is not feasible to reuse the bitumen for its original purpose as much of the volatile components have volatilised through the long exposure to heat and sunlight and it is now mixed with substantial quantities of sand and gravel. The most cost effective solution to this problem is to contain and encapsulate the bitumen on site on land controlled by the Government of Kiribati, through the Department of Airport Management.

For this recommendation to be feasible MELAD must obtain permission for construction of a permanent bund at the end of the runway. This will need to be agreed to by the entity department managing the runway.

The encapsulation process involves the following:

1. Calculate the approximate volume of the bitumen to be contained;
2. Construct a square containment structure building the walls from locally occurring coral sand;
3. The volume contained by the structure should be sufficient to contain the bitumen with approximately 20% additional capacity;
4. The bunded containment structure should then be covered in plastic sheeting (0.5mm thick if available. If not then apply 2 layers of plastic);
5. Carefully load the recovered bitumen into the bunded area using an excavator avoiding rupturing the plastic;
6. When all bitumen is loaded into the bunded area, cover the bitumen and the bund walls with plastic sheet; and
7. Cover the entire bunded area with coral sand/gravel occurring in the local area.

This process will isolate the bitumen from the environment, prohibit it from spreading into surrounding land and negate further contamination of the intertidal zone seawater and the fresh water lens.

5. BANABA POPS IN PICS RECONNAISSANCE AND ASBESTOS REVIEW

The Team travelled with MELAD staff and other stakeholders to Banaba on 19 July 2008 on the Sea-Cat II, and the vessel arrived in Banaba on 20 July during the late afternoon. Work was undertaken on 21 July and the morning of the 22 July. The vessel sailed for Tarawa during the afternoon of the 22 July and arrived in Tarawa on the evening of the 23 July.

The TOR required the Team to:
- Travel to Banaba with local counterparts
- Train local counterparts in the use of field testing kits
- Test transformers (between 20 and 30 on the island)
- Collect samples of field positive samples
- Export samples for PCB analysis in Australia
- Decant any leaking oil into recycled oil drums (if available) and take drums back to Tarawa if no PCBs detected
- Make an inventory of hazardous waste materials present on island
- Investigate and train counterparts in identifying asbestos with their sound disposal
- Should PCB oils be identified, provide indicative costing for a future cleanup mission to Banaba under AusAID's POPs in PICs project. The costing will be provided to GoK subsequent to obtaining any laboratory results. Review and identify logistical factors which may assist or present challenges to a cleanup mission to Banaba under the POPs in PICs project

During the Banaba trip the Team undertook: a Persistent Organic Pollutants (POPs) in Pacific Island Countries (PICs) reconnaissance; a review of asbestos; a review of other hazardous waste issues on Banaba; and reviewed the potential for scrap metal and copper recovery. These activities are discussed in the ensuing sections.

5.1 POPs in PICs Reconnaissance

The Team together with MELAD staff and stakeholders undertook the POPs in PICs reconnaissance on 21 July 2008.

Transformers
A 2005 memo from Liz Duggan, Pollution Control Advisor Environment and Conservation Division, MELAD on environmental issues on Banaba stated that there were at least 27 transformers. The Team worked together with a local guide and identified 49 transformers on the island of Banaba.

All but four of the identified transformers were found to be empty. Anecdotal evidence from discussions with Banaba residents indicated that during the 1980s there was a severe fuel and oil shortage on the island. As a result all transformers were drained and the oil used for lubricating oil in trucks and motorbikes. It is unknown if these transformers contained PCBs.

The four transformers that contained oil were located in difficult to reach areas. Two of them were located high on the walls of disused phosphate processing buildings, the crushing station and drying building respectively. A further two were located high on power poles and were obscured by foliage in Uma Village. Two further samples were collected from soft starters containing oil in the old drying building. The location of these buildings and associated samples is included in Annex 7. All sample locations were marked with spray paint to ensure easy identification. Photographs are included in Annex 9.

The following table summarises the samples collected.

Table 2: Transformer Oil Samples Collected

Sample identification	Collection location	Collected from	Approximate volume of oil
BT1	Phosphate crushing station	Transformer, General Electric, 60 KVA	10L
BT2	Phosphate drying shed	Transformer, General Electric, 60 KVA	20L
BT3	Phosphate drying shed	Soft starter, Allen West.	10L
BT4	Phosphate drying shed	Soft starter x 2, Allen West	20L
BT5	Uma Village (west side)	Transformer located up a power pole, approximately 7m high	5L
BT6	Uma Village (east side)	Transformer located up a power pole, approximately 7m high	50L

Due to the unavailability of PCB test kits, the Team trained MELAD and other stakeholders in a crude field method of testing for PCBs. The method involved dropping a small amount of oil suspected to be contaminated with PCBs via an eye dropper below the surface into a glass of water. Regular engine oil is a light non-aqueous phase liquid and floats on oil. PCB is a dense non-aqueous phase liquid and sinks in oil. Therefore by checking if the drop of oil floats, sinks, or sits in the middle of the water column, one can understand if a sample is likely or unlikely to contain PCBs. If the drop floats, it is unlikely to contain significant levels of PCB; if it sinks, it is likely; and if it is in the middle of the water column is likely to contain some PCBs.

Samples were exported to Australia for analysis by MGT Laboratories for PCBs and a copy of the chain of custody documentation is included as Annex 8. The results of the analysis, together with recommendations regarding clean up are included as Annex 9.

Identification of logistical factors

Although the Team received no explicit instructions or framework for this task, the following logistical factors were identified:

- Accommodation: Banaba Guesthouse provides adequate accommodation for AUD15 per night. It is suggested to bring your own food.
- Transport on island: There are three trucks on Banaba; one of them is a crane truck with the capacity to lift drums with a drum lifter. Truck rental is approximately AUD100 per day.
- Harbour: The harbour at Banaba is very small and shallow at low tide and unsuitable for larger vessels. A landing craft type vessel could access the shore to load and unload materials in a protected area of shore platform adjacent to the small harbour. Access would be restricted to several hours around low tide and in sea conditions where no or limited swell was entering the area. Alternatively, a vessel could anchor offshore, as was the case with the Super-Cat II and smaller boats used to ferry passengers and equipment to and from the shore.
- Drum handling: As there will be a lot of manhandling of drums, as drum trolley is recommended.

- The transformers are all located several metres off the ground and an extension ladder will be required to facilitate access.
- The location of the transformers will require removal of the units from the poles and high structures to facilitate draining and flushing should they be shown to contain PCB. To facilitate this process a small chain block and tackle should be included.

5.2 Review of asbestos

The Team investigated the situation of asbestos waste on Banaba and trained counterparts in identifying asbestos on 22 July. Options for safe collection and appropriate disposal were discussed and MELAD discussed these issues with the local community in their consultative review. Any asbestos cleanup will require a means of asbestos disposal and the most appropriate for Banaba would be land disposal and burial. Consultations with residents indicated burial on-island was acceptable. Any project development for an asbestos cleanup should include an extensive consultation process prior to the development of the terms of reference. The terms of reference should reflect the requirements of the residents and may include employment of local people in the cleanup process. The terms of reference should inform project implementation and tenders for the project should be asked to provide detailed information on the processes and strategies to be utilised should they win the tender. It will be important that the approach of the cleanup team is sensitive to the needs of the local community as much of what needs to be cleaned up is located within the boundaries of existing dwellings.

Training in identification of asbestos

The Team visited a burned out building for training staff in identification of asbestos types. The walls and roof of the building were constructed of asbestos products and were reduced to rubble during a fire. Roof sheeting and cement sheeting was collected and participants trained in the visual identification of asbestos fibres. Samples of each were collected and stored in labelled zip-lock bags for participants to keep in the office for future reference.

A hot water service containing fibrous lagging was also identified. The lagging may have been asbestos and was sent to Australia for testing. Results are provided in Annex 9. Samples of this were zip-locked in plastic bags and provided to participants.

Review of asbestos waste

Nearly every building (houses and phosphate mining buildings) on Banaba has asbestos roofing and many buildings walls are constructed with asbestos cement sheeting.

Many buildings have lost, or are losing their roofs and asbestos is a common sight around dwellings as well as phosphate mining buildings and currently poses a significant exposure risk.

Any attempt to recover scrap metal from Banaba would need to be preceded with a process to clean up the asbestos. Asbestos currently litters the inside and surrounding areas of many phosphate mining buildings. It was also clearly present around many occupied houses. This broken asbestos would require removal in any cleanup program.

Many buildings are already in a state of major disrepair and if an asbestos removal option was developed then the remaining asbestos roof and wall cladding and on these buildings should be removed.

Several of the larger mining buildings containing machinery (power house, drying shed) have relatively intact rooves and walls. Removal of the machinery for scrap could be accomplished in these buildings without the removal of asbestos cladding. However, consultation with the local community to determine if they wish to retain these buildings for other uses should occur would be necessary. If the local community determined that the buildings were not required then the asbestos should be removed prior to removal of the machinery for scrap.

Several sheds and many of the houses/units of the island are used for storage or are occupied as houses. Most of these have intact cladding and rooves. While the cladding and roof materials remain intact they present little danger to the residents and will not necessarily require removal in any asbestos cleanup.

There are many buildings that are unused and unoccupied and some of these are in a condition which could allow use in the future. Before any asbestos cleanup consultation with the residents should proceed to determine which buildings they wish to retain. Buildings that are not to be retained and which contain asbestos roofing or cladding should be included in any asbestos cleanup.

5.3 Review of other hazardous waste issues on Banaba

The Team visited the Banaba Hospital on 22 July and learned that medical waste is currently burned in a 205 litre drum and then disposed of in a hole. While this technique for disposal of infectious waste would be inappropriate in a highly populated area it probably represents the best option available on Banaba. It is also understood that the KIR-EU project will construct a new incinerator system to disposal of infectious waste. Expired pharmaceuticals should not be disposed in this way. Rather they should be returned to the hospital on Tarawa for storage and disposal.

The Team visited the engine house on 22 July. A small amount of waste oil was identified in a sump. This should be recovered into a 205 litre drum and returned to Tarawa for waste oil recycling.

5.4 Review of potential for scrap metal and copper recovery

Substantial quantities of equipment remain on the island after the cessation of phosphate mining in 1978. Many large buildings remain in various levels of repair. These all contain substantial quantities of structural steel. Some of the buildings remain in reasonable condition and several of these contain substantial quantities of old mining equipment and associated services equipment. The old powerhouse still contains several very large generators and associated equipment, several gyratory crushing units and the large rotary drying kilns remain in relatively good condition in the mineral processing area and a substantial quantity of mobile equipment exists in one area. Overall the quantity of scrap steel is likely to be around 3000 tonnes with up to 100 tonnes of copper and other metal scrap available. Specific observations were made in several of the buildings containing major equipment items.

These are as follows:

- Open shed near roundabout –
  Copper wire – approximately 5 tonne
  Steel bars – approximately 30, varying diameter: approx 3 tonne
  Shelving – approximately 1 tonne

- Power house –
  3 generators/engines and accessory equipment including copper tube heat exchangers, air compressors pumps. Estimate at least 250 tonne steel and 20-30 tonne copper
- Electrical storehouse –
  Miscellaneous electric motors and motor components. Estimated copper content at least 10 tonne.
- Heavy mobile machinery maintenance shed –
  This shed contains a dozer and tractor with component parts, at least 6 dump trucks, several drag line excavators, cranes etc which represent at least 200 tonne of steel scrap in equipment
- Phosphate feed system and crusher shed –
  These sheds contain bins, conveyers, primary crushers, gyratory crushers and support equipment, which represent at least 100 tonne of scrap steel in equipment.
- Phosphate drying shed –
  This shed contains 2 large rotary drying kilns with associated equipment, which represents at least 200 tonne of scrap in equipment.
- Transformers –
  49 disused transformers of various sizes were identified within the township and mining infrastructure. The largest were 750 KVA. 43 of these transformers have already been drained of oil.

5.5 Recommendations

The following recommendations pertain to asbestos issues, scrap metal and copper recovery. Note the recommendations relating to cleanup of transformer oil are included as Annex 9.

- MELAD to continue consultation with the local Banaba community to determine their wishes in relation to a potential cleanup of asbestos and sale and removal of steel and base metal scrap.
- MELAD to advise the local Banaba community on the dangers of exposure to asbestos by inhalation. MELAD should also advise the community that asbestos is less hazardous when saturated and therefore that any small asbestos clean ups around houses, undertaken by residents clearing their properties, should involve saturating the asbestos, before moving it.
- MELAD to develop the terms of reference in consultation with the Banaba community for an asbestos cleanup for the island.
- MELAD to develop the terms of reference in consultation with the Banaba community should they decide to support the sale and cleanup of scrap steel and base metals on the island
- An asbestos cleanup should be completed prior to any removal of machinery and structural steel for scrap
- AFD solid waste management initiative. A feasibility study is currently underway for this initiative and MELAD should be in contact with the team leader of this project (Melanie Ashton) to ensure that Kiribati is included in any regional initiatives in relation to scrap metal.

6. AGRICULTURAL CHEMICALS

The Team visited the Department of Agriculture on 24 July. Although one Agricultural Officer provided and access to the Agriculture Department Storeroom and two others provided assistance in clearing out rubbish, work was completed with the assistance of MELAD staff.

The TOR required the Team to:
- Work with local counterparts to prepare manifest on the pesticides
- Provide advice on alternative storage of obsolete pesticides including the possibility of using the shipping container
- Work with local counterparts to dispose of agricultural chemicals and other chemicals currently stored in the Agricultural Shed that are safe for disposal on the island

6.1 Summary of work

The Agriculture Department storeroom was found to be poorly organised and full of old files, with other wastes and hazardous chemicals strewn among these wastes. The Team worked with counterparts to clear a shelving unit to safely store chemicals.

It was not considered necessary to identify alternative storage, such as a shipping container for the chemicals. The Agriculture Department storeroom is adequate and secure, it required only tidying.

Chemicals were then arranged safely according to the plan recommended in Annex 3. Each of the shelves was labelled, so the arrangement is clear to all staff. MELAD staff also posted a sign on the shelves asking people to store only chemicals on the shelves.

An inventory was made of all chemicals, including recommended disposal options and this is included as Annex 4.

Significant quantities of unused metal-based salts were identified. Anecdotal evidence suggests these were procured for an experiment and never used. These will be stabilised by Department of Environment staff, who will also train Department of Agriculture staff in this method of disposal. After stabilisation the metal based salts can be disposed in a plastic lined pit located above the water table. The stabilised chemicals should then be placed in the pit ensuring the plastic is not punctured. The chemicals should then be covered in plastic to prohibit downward movement of rain and then the whole system should be covered with sand. A map should be drawn to clearly locate the position of the disposal pit and this should be distributed to both Agriculture and MELAD staff.

Several toxic and difficult to dispose of chemicals were identified in the storeroom. These included significant volumes of Restrictive Poison, a copper arsenate. Anecdotal evidence from discussions with site staff indicates this chemical was used for a pilot coconut palm wood treatment project. At least 650L of the substance remains stored in open-top plastic buckets as a solid around the perimeter of the storeroom. This poses a very significant environmental risk if released to the environment and must be kept secure. Other chemicals identified that cannot be treated on island were several organic solvents and 2 bottles of concentrated formaldehyde (Annex 4).

One small jar of picric acid was also identified. The small jar contained some water and so is stable at present. It was placed in a tin with sand packing to minimise vibration and taped up to minimise any evaporation. The container was then placed in a drum of water to ensure safety. This reagent is however very dangerous (see MSDS comment below):

> DANGER! KEEP WET. EXPLOSIVE IF DRY. FLAMMABLE SOLID. CAUSES SEVERE EYE IRRITATION. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY CAUSE ALLERGIC SKIN REACTION. AFFECTS LIVER, KIDNEYS AND BLOOD.

As part of MELAD's auditing of chemicals on Tarawa they should ensure that the drum always retains water.

Approximately 20 unlabelled chemicals were noted, but their composition could not be identified. These chemicals were packed into an open-top drum and covered in vermiculite. Identifying the chemicals will require expensive laboratory sampling, or identification by one of the staff that used them. As such, it is recommended that MELAD undertake a consultation with all staff in attempt to identify the chemicals, and label any that are identified through this process.

As the Department of Agriculture deals with both plants and animals, the Department also uses some pharmaceutical chemicals. Six garbage bags were filled with expired and waste animal pharmaceutical chemicals. These should be disposed of by incineration, when the incinerator is working effectively.

6.2 Recommendations

- MELAD staff trained in stabilisation stabilise the metal-based salts and use the opportunity to train Department of Agriculture staff, unavailable for training during the Team's visit;
- Future ordering of agricultural chemicals should be audited by MELAD and orders made only to companies who agree to take-back of unused chemicals;
- MELAD undertake a consultation with Department of Agriculture Department staff, particularly the older staff, and show them the bottles of Unknown Chemicals and ask if they recall what they were. If any are identified they should be labelled and disposed of according to advice in Annex 3. If no advice exists MELAD should email mmcrae_williams@hatlar.com.
- MELAD should audit the Agricultural Department storeroom annually to check the chemicals remain safely stored and clearly labelled. This is particularly important due to the presence of copper arsenate and the picric acid.
- Animal pharmaceuticals should be incinerated, once the high temperature incinerator is operational.
- As the chemical store area of the shed has been cleaned and reorganised, and the majority of the chemicals can be stabilised there does not appear to be any justification for the purchase of additional storage such as a shipping container to house the chemicals. The Team understands that the Department of Agriculture may need to use this shed for other purposes in the future and therefore relocate the chemicals. The chemicals should be moved and relocated with the assistance of MELAD staff and organised according to the plan included as Annex 3. A secure shed is a preferable storage option to a shipping container. Shipping containers corrode over time and there is also a higher degree of temperature fluctuation, than in a shed.

7. KIRIBATI OIL

The Team visited the Kiribati Oil (KOIL) bulk fuel store on 26 July 2008. The TOR required the Team to:

- Collect groundwater from drinking water wells close to the coal-tar leak including groundwater from sites close to Power Stations and KOIL

The site is owned and managed by KOIL and was purchased from Mobil in June 2007. According to site staff groundwater monitoring in the form of checking the thickness of separate phase is undertaken regularly. Samples of the groundwater however are not collected and sent offshore for analysis. Anecdotal evidence suggests that when Mobil owned the site, URS undertook some sampling. MELAD and KOIL staff have no records of environmental assessments or copies of reports.

A short site inspection was undertaken. The site is situated adjacent to the port area on the lagoon front. Residential dwellings border the east side of the site. A site plan is provided in Annex 10. The site comprises a central bunded area with three foots walls. The base of the bund is made of permeable coral and spills are likely to permeate directly into the water table.

Four samples were collected from the bulk fuel store, one on each side of the site (see Annex 10 for sample and groundwater well locations). On-site training in groundwater sampling was undertaken for MELAD staff.

Key components of groundwater sampling include:

- Use of PPE, primary latex gloves;
- Use of appropriate sampler, in the case of KOIL a 205 litre drum sampler;
- Use sampler to measure depth to groundwater;
- Abstract water;
- Observe qualities including colour, odour, presence or absence of sheen;
- Decant water into labelled sampling vessels;
- Store in a chilled esky; and
- Wash sampler thoroughly before abstracting next sample.

Details of samples collected are included in Table 3.

Table 3: Groundwater Samples Collected From KOIL

Sample ID	**Collected from**	**Odour**	**Colour**	**Sheen**	**Depth to gw (m)**	**Other comments**
GW1	Remediation bore	Strong petroleum odour	Yellowish	Slight	2.0	Small diameter hole (5cm)
GW2	Remediation bore	Very strong odour	Fawn	Thin surface film	2.0	Approx – 2mm separate phase.
GW3	Household well	Strong oily odour	Slightly yellowish	Oil sheen	1.2m	Residents no longer using the well
GW4	Remediation bore	None	Clear	Slight sheen	2.0m	

The samples were sent to Australia for analysis of light and heavy chain hydrocarbons and BTEX. The interpretation of the analysis and the laboratory results are included as Annex 10.

Oil Recyclers in Australia

It is understood KOIL are seeking a company to send recycled oil to. The link below details most of the oil recyclers by state in Australia. The two largest recyclers are Nationwide and Triple R. Mike has had experience with Triple R and found them to be a reputable company. Should you wish to pursue this contact please ring Ross Cooper on the numbers indicated in the following link: http://www.oilrecycling.gov.au/collectors.html.

7.1 Recommendations

MELAD staff should contact David Lambourne, Solicitor General, Attorney General's Office, Kiribati. Mr Lambourne reportedly handled the purchase of the ex-Mobil site and will therefore have copies of Environmental Site Assessment reports provided with the transfer of ownership documents.

Coral in bulk fuel bund should be replaced with cement.

MELAD should include investigation of KOIL in their GPA preparations. It is understood that a National Plan of Action (NPA) will be completed by 2008. Given the GPA focuses on marine pollution from land-based activities and that KOIL's site has historically, and is likely to be currently polluting the marine environment, the NPA provides an excellent opportunity to address this.

8. OTHER SITES VISITED

Several other sites were visited briefly by the Team. These are described in the following sections.

The TOR required the Team to:
- General review of hazardous waste issues on Tarawa including investigation on asbestos and their sound management

8.1 Plant nursery

The Team visited the nursery on 28 July. Staff were concerned about out of date fertilisers and wanted information on disposal options. The Team confirmed that fertilisers do not go off and can be used past their use by date and advised to use the fertilisers.

8.2 Customs

MELAD received a request from Customs to provide advice on paints stored in the Customs store. The Team visited the Customs on 28 July and identified significant stocks of blackboard paint and machine colourant (lead based with diethyl glycol). After advising that the blackboard paint should be donated to schools for use and the machine colourant used to paint engines and machines, the Team learned that Customs was not prepared to do this because Customs Duty on the good had not been paid. The Team advised Customs to attempt to overcome their bureaucratic hurdles, so the paint that could be used, otherwise the paints will continue to rust and degrade and cause environmental issues.

8.3 Betio Power Station

On 28 July the Team visited Betio Powerhouse. MELAD were concerned about contamination from the site. Anecdotal evidence from residents living to the north and south of the site indicated at least two wells had been backfilled, after residents realised they were filled with oil. No site plan was available. Three groundwater samples were collected from the site and surrounding areas, these included:
- GW5: collected from a well inside the site. Water from this well had a degrading organic odour. The depth to groundwater was approximately 1m.
- GW6: collected from a residential well, across the street to the west of the site. Water had an organic odour. Water from the well is not currently used, due to a broken pump. He depth to groundwater was approximately 2.0m.
- GW7: collected from a residential well approximately 50m north of the site. Residents use the well water for washing and bathing. The water had a slight organic odour and the depth to groundwater was approximately 1.2m.

The samples were analysed in Australia for hydrocarbons. Laboratory results and associated analysis are included in Annex 10.

MELAD should conduct further investigation at the site. Site staff should be interviewed and a site and infrastructure plan attained. Residents' reports about groundwater wells filled with fuel indicate a serious contamination issue and should be investigated. There could be historical underground storage tanks at the site, or the contamination may be caused by leaking of the aboveground storage tanks, but further investigation is necessary to understand the cause of contamination.

9. RECOMMENDATIONS AND CONCLUSIONS

The following sections provide a summary of recommendations made throughout the report, describe the outcomes of the stakeholder workshop and donor's meeting and provide concluding remarks.

9.1 Summary of Recommendations

School chemicals
MELAD advise Ministry of Education on chemicals suitable for disposal on Tarawa and recommend that the science curriculums be evaluated to find alternative tests, which include only these chemicals.

Mere Teaabo (KGV Laboratory Technician) – to train new laboratory technicians and run annual training on the organisation of school laboratory stores.

Mere Teaabo and MELAD work together to stabilise the remaining 14 bottles of chemicals.

MELAD to investigate the status of school laboratories and disused chemicals in outer island schools including the occurrence of metal mercury or mercury based salts in the outer island school laboratories

Incinerator Assessment and Expired Pharmaceuticals
Send expired pharmaceuticals still in packaging back to manufacturers if the manufacturers acknowledge that they will accept these materials

MELAD should compile information in the list of chemicals provided on the consultants final day, to the inventory (Annex 4), look up the MSDSs and provide necessary advice to the hospital.

MELAD should contact Dai Nippon Construction (located on Betio Island) who originally installed the incinerator, to obtain a quotation on upgrading the existing facility so that it meets the original design specifications. If the cost of upgrading the system is not significantly cheaper than the purchase of a new system, then a new system should be purchased. Operating the system in its present condition should not be seen as an option.

MELAD should undertake a clean up of the medical waste on the beach, bag the waste and ensure it is incinerated and instigate protocol for waste management (waste segregation in hospitals, thermometer management, waste storage, etc). Signage should be erected on the beach prohibiting waste dumping.

Should it be decided to upgrade the existing equipment or renew the entire incinerator, a budget to cover operation and maintenance should be adopted to ensure that the system is operated effectively and for the longest possible time before another upgrade is required. The budget should provide for appropriate PPE for incinerator operators.

Should the option for a new incinerator be chosen, MELAD should consider adopting best practise methods of disposal of medical waste through incineration. Most hospitals using incineration for infectious waste disposal use a two-chamber, hearth burning, pyrolitic controlled-air incineration unit. Waste is fed into the primary chamber, where it begins to burn with less than a stoichiometric quantity of air. More air is added in the secondary chamber to completely oxidize the waste. Ash is removed from the back end of the primary combustion unit. A complete system should include an air pollution control system to remove acid gas and meet the particulate standards. Such as system to accommodate the quantity of hospital waste generated, allow the treatment of expired pharmaceuticals and accommodate the treatment of selected laboratory chemicals would require a capital cost of around AUD150,000 for an installed unit. Operating costs would be around AUD40,000 per annum.

MELAD staff should undertake regular audits of the incinerator operation.

MELAD should request the Department of Health instigate a protocol for waste segregation at ward level in the hospital. This should also address thermometer disposal to ensure these are stored, not incinerated.

Betio Power Station

MELAD should conduct further investigation at the site. Site staff should be interviewed and a site and infrastructure plan attained. Residents' reports about groundwater wells filled with fuel indicate a serious contamination issue and should be investigated. There could be historical underground storage tanks at the site, or the contamination may be caused by leaking of the aboveground storage tanks, but further investigation is necessary to understand the cause of contamination.

Tarawa Airstrip

The most cost effective solution to this problem is to contain and encapsulate the bitumen on site on land controlled by the Government of Kiribati, through the department of airport management.

For this recommendation to be feasible MELAD must obtain permission for construction of a permanent bund at the end of the runway. This will need to be agreed to by the entity department managing the runway.

Banaba Asbestos and Scrap metal

MELAD to continue consultation with the local Banaba community to determine their wishes in relation to a potential cleanup of asbestos and sale and removal of steel and base metal scrap.

MELAD to advise the local Banaba community on the dangers of exposure to asbestos by inhalation. MELAD should also advise the community that asbestos is less hazardous when saturated and therefore that any small asbestos clean ups around houses, undertaken by residents clearing their properties, should involve saturating the asbestos, before moving it.

MELAD to develop the terms of reference in consultation with the Banaba community for an asbestos cleanup for the island.

MELAD to develop the terms of reference in consultation with the Banaba community should they decide to support the sale and cleanup of scrap steel and base metals on the island.

An asbestos cleanup should be completed prior to any removal of machinery and structural steel for scrap.

AFD solid waste management initiative: A feasibility study is currently underway for this initiative and MELAD should be in contact with the team leader of this project (Melanie Ashton, melanie@iisd.org) to ensure that Kiribati is included in any regional initiatives in relation to scrap metal.

Agricultural chemicals

MELAD staff trained in stabilisation stabilise the metal-based salts and use the opportunity to train Department of Agriculture staff, unavailable for training during the Team's visit.

Future ordering of agricultural chemicals should be audited by MELAD and orders made to only companies who agree to take-back of unused chemicals.

MELAD undertake a consultation with Department of Agriculture Department staff, particularly the older staff, and show them the bottles of Unknown Chemicals and ask if they recall what they were. If any are identified they should be labelled and disposed of according to advice in Annex 4. If no advice exists, MELAD should email mmcrae_williams@hatlar.com.

MELAD should audit the Agricultural Department storeroom annually to check the chemicals remain safely stored and clearly labelled. This is particularly important due to the presence of copper arsenate and the picric acid.

Animal pharmaceuticals should be incinerated, once the incinerator is operational.

As the chemical store area of the shed has been cleaned and reorganised, and the majority of the chemicals can be stabilised there does not appear to be any justification for the purchase of additional storage such as a shipping container to house the chemicals. The Team understands that the Department of Agriculture may need to use this shed for other purposes in the future and therefore relocate the chemicals. The chemicals should be moved and relocated with the assistance of MELAD staff and organised according to the plan included as Annex 3. A secure shed is a preferable storage option to a shipping container. Shipping containers corrode over time and there is also a higher degree of temperature fluctuation, than in a shed.

KOIL

MELAD staff should contact David Lambourne, Solicitor General, Attorney General's Office, Kiribati. Mr Lambourne reportedly handled the purchase of the ex-Mobil site and will therefore have copies of Environmental Site Assessment reports provided with the transfer of ownership documents.

Coral in bulk fuel bund should be replaced with cement.

MELAD should include investigation of KOIL in their GPA preparations. It is understood that a National Plan of Action (NPA) will be completed by 2008. Given the GPA focuses on marine pollution from land-based activities and that KOIL's site has historically, and is likely to be currently polluting the marine environment, the NPA provides an excellent opportunity to address this.

9.2 Stakeholders meeting

The Environment and Conservation Division (ECD) convened a stakeholder's meeting on 28 July 2008. The meeting was attended by over 30 stakeholders.

The Team summarised their work and the findings, recommendations and outcomes. Stakeholders named the asbestos clean up on Banaba, the clean up of the Tarawa airstrip and the incinerator as their primary priorities.

9.3 Donor's meeting

A donor's meeting was convened by the ECD on 28 July. The meeting was attended by representatives from AusAID, Taiwan, WHO and UNICEF, as well as senior ECD staff. The Team presented the three priority "big ticket" issues identified during the consultancy:

- The necessary clean up of asbestos on Banaba;
- The need to urgently replace or upgrade the incinerator; and
- The need to clean up and contain several tonnes of bitumen near Tarawa airstrip.

After the presentation, a frank exchange of views occurred. Donor's made clear the need for GoK commitment to health waste management. It was noted by WHO that a recent strategic plan for the Ministry of Health, made no mention of medical waste. ECD acknowledged inter-agency collaboration was an ongoing problem that was difficult to surmount, but agreed to work on this.

The representative from UNICEF highlighted the development of a 5-year plan for UN System involvement in Kiribati as a "golden opportunity" for the GoK to submit to the UN priority projects. He said he would be discussing priority issues with the Minister of Finance very soon and that the ECD had to transmit the information to the Environment Minister and ensure it was a priority.

AusAID noted that they would take the priorities back to the office. She also said AusAID supports activities that are included in development plans, thereby stressing the need for ECD to ensure their superiors were aware of the three urgent issues. She encouraged ECD to put the issue of bitumen contamination in a proposal and submit it, noting AusAID has emergency funds available.

WHO suggested perhaps donors could work together, perhaps each contributing AUD40K for the incinerator. She encouraged ECD to make a collective request to donors and for the need to use donors effectively.

It was also noted that Kiribati has a huge amount of money coming in through the UN System, including through the Global Fund.

Taiwan said there is money available and suggested the ECD provide a Cabinet paper to the embassy. He said the projects would be supported if ECD laid out a clear plan.

9.4 Concluding remarks

The key outcomes of the consultancy included:

- Over 100 kg of school chemicals stabilised;
- An inventory made of all other chemicals and advice regarding storage and disposal provided;
- Training provided to MELAD and school staff;
- Four potentially contaminated transformers sampled and identified for potential cleanup;
- Training provided to MELAD in asbestos identification;
- Sampled groundwater at airport bitumen site, KOIL and power station to assess contamination by hydrocarbons;
- Trained MELAD staff in water sampling;
- Technical review of incinerator completed; and
- Overview of scrap metal quantities potentially available for recovery on Banaba.

As well as the above outcomes, the consultancy identified three urgent environmental issues. During the consultancy the awareness of these issues was raised among donors. There is now significant interest from donors in funding these initiatives, however the next step requires ECD to ensure the Minister is aware and agrees with the importance of the issues. The Team will continue to be on hand to assist with any specific elements of this task as well as to provide advice on implementing any of the aforementioned recommendations.

Annex 1

Terms Of Reference for POPs International Consultants

1. Banaba (Ocean Island)
    a. Travel to Banaba with local counterparts
    b. Train local counterparts in the use of field testing kits
    c. Test transformers (between 20 and 30 on the island)
    d. Collect samples of field positive samples
    e. Export samples for PCB analysis in Australia
    f. Decant any leaking oil into recycled oil drums (if available) and take drums back to Tarawa if no PCBs detected
    g. Make an inventory of hazardous waste materials present on island
    h. Investigate and train counterparts in identifying asbestos with their sound disposal
    i. Should PCB oils be identified, provide indicative costing for a future cleanup mission to Banaba under AusAID's POPs in PICs project. The costing will be provided to the Republic subsequent to obtaining any laboratory results
    j. Review and identify logistical factors which may assist or present challenges to a clean up mission to Banaba under the POPs in PICs project

2. School chemicals and metal based salts
    a. Work with local counterparts to neutralise school chemicals
    b. Work with counterparts to stabilise metal-based salts
    c. Make an inventory of metal based salts containing arsenic, mercury and cadmium (these cannot be stabilised).
    d. Provide simple instruction manual on how to undertake (a) and (b)
    e. Provide copy of MSDS (if internet access permits)

3. Pharmaceutical chemicals
    a. Work with local counterparts to undertake a technical review of the incinerator
    b. Work with local counterparts to undertake an incinerator trial
    c. Work with local counterparts to assess the risk from toxic chemicals including cyanide at the Laboratory
    d. If concluded that the incinerator does not have the capacity to destroy the pharmaceuticals, work with local counterparts to develop an inventory of all expired pharmaceuticals
    e. Facilitate a meeting with donors and local counterparts over the issue of expired pharmaceuticals and the cost of export and destruction.

4. Bitumen at the eastern side of the Tarawa air strip

a. Work with local counterparts to review the site
b. Train local counterparts in groundwater collection and sampling protocol
c. Collect groundwater from drinking water wells close to the coal-tar leak including groundwater from sites close to Power Stations and KOIL
f. Export the samples to Australia for heavy chain hydrocarbon analysis, BTEX and polycyclic aromatic hydrocarbons.

5. Agricultural obsolete pesticides
   a. Work with local counterparts to prepare manifest on the pesticides
   b. Provide advice on alternative storage of obsolete pesticides including the possibility of using the shipping container
   c. Work with local counterparts to disposal of agricultural chemicals and other chemicals currently stored in the Agricultural Shed that are safe for disposal on the island

6. General review of hazardous waste issues on Tarawa including investigation on asbestos and their sound management

7. Assist MELAD to complete the Kiribati POPs National Implementation Plans based on the information collected from the trip to Banaba Island. The GoK will provide necessary assistance to complete the NIPs before the Consultants left Kiribati. The GoK will provide office space and whatever information needed including meeting with concerned government staff.

8. Prepare and make a powerpoint presentation to local counterparts on the highlights and important findings from the consultancy work and recommendations

9 Outputs
   a. Writing reports and will include the findings from the above list of tasks with specific recommendations on how each issues identified should be addressed and identify funding opportunities for potential clean ups, etc.
   b. The reports will provide useful information when developing national sound chemical management and policy to form the basis of chemical protocol under the Amended Environment Act 1999

Annex 2

School Chemicals Workshop – Participants list

Name	School/University	Contact phone and email
Enoka	PUB	26292
Namouta	SLHS	Namouta.t@yahoo.com
Melitiana	JSS BTC	92209
Tetobi	Moroni	28075
Temnakai	JSS TUC 2	95432 temnakai_taati@hotmail.com
Mere Teaabo	KGV EBS	28153/96936 m_teabbo@yahoo.com
Vika Tifinga	ECD	28000/98274
Mike Foon	ECD	28000
Noketi Karova	ECD	28000
Farran Redfern	ECD	28000

Kiribati, July 2008
School Chemicals worksheet
"stabilisation, neutralisation and storage"

For all of the below methods, appropriate personal protective equipment must be worn. This includes gloves, safety glasses and long sleeve shirt, as a minimum.

Stabilisation: This refers to a method to stabilise metal-based salts. The stabilisation process involves neutralisation and setting of the metal-based salts in concrete. The concrete blocks should then be disposed of via burial. Burial in the inter-tidal zone should be avoided.

The following include some general formulations:

Chemical type	Amount of waste (grams)	Cement (grams)	Fly ash or sand (grams)	Lime (grams)	% volume change	Setting time	Description
Copper, zinc, iron, magnesium, aluminium	100	100	100	50	100	26 mins	Hard
Lead	100	150	150	50	73	9mins	Hard
Barium	100	200	100	50	59	8mins	Hard
Manganese	100	100	100	50	110	24mins	Friable

Common species suitable for stabilisation:
Copper species: copper chloride, copper carbonate, copper sulphate, copper oxide, copper nitrate.
Zinc species: zinc sulphate, zinc oxide, zinc carbonate, zinc nitrate.
Lead species: Lead chloride, lead oxide, lead carbonate, lead nitrate.
Barium species: barium chloride, barium nitrate.
Manganese species: potassium permanganate, manganese dioxide.
Iron species: ferric nitrate, ferric sulphate, ferric oxide.
Aluminium species: aluminium sulphate, aluminium oxide, aluminium hydroxide.
Other species: magnesium sulphite, potassium sulphate, potassium chloride, potassium nitrate, yellow sulphur.

Metal based salts not suitable for stabilisation include: Dichromate (unless reduced to Chromium III); and oxidants including metal-based chlorates. These should be stored in a secure location.

Neutralisation: It is important to neutralise any acid prior to disposal via sink in laboratory, by adding excess alkali ($CaCO_3$, NaOH, $Na_2 CO_3$). The following process involves neutralising acids using alkalis, or the reverse and can only be used for acids or alkalis that do not contain base metals (for these compounds, use the stabilisation process described above). Once chemicals are neutralised they can be disposed of in landfill.

Acids from the laboratory can be neutralised using alkalis from the laboratory, or using coral sand, which is alkali (calcium carbonate). Alkalis require acids for neutralisation.

Procedure: The following example aims to neutralise an acid. To begin the process acid should be diluted with water, using the following ratio: 1L chemical: 3L water. Note: the acid must be added to the water, do not add the water to the acid.

Progressively add small amounts of alkali or coral sand to the diluted acid slowly and observe the reaction (fizzing). As the fizzing reduces add more alkali. Add alkali until addition of alkali does not create fizzing, or add until mixture is near neutral (pH7) using an indicator.

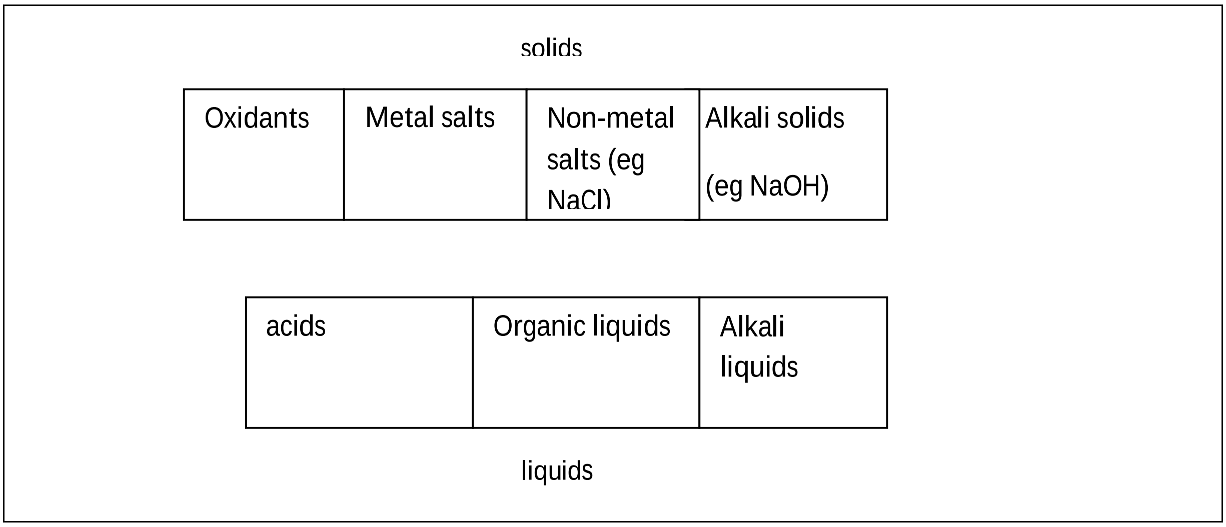
Note: the process of neutralisation causes fumes. Therefore it should be undertaken in an open-air environment (stand upwind), for example at the landfill.

Storage: To ensure a safe laboratory store, chemicals must be stored appropriately and the store secured, with regulated access.

Handy hints

- Store acids and alkalis away from each other.
- Store liquids and solids away from each other.
- Store oxidants away from everything else, particularly organic materials including oil, grease and organic liquids.
- Group base metal salts together, away from other chemicals.
- Store liquids on bottom shelves, or on the floor, to minimise impact of leaks.

Plan of laboratory storeroom.



Reuse ideas: Many chemicals can be reused. For example:

- Nitrogen based chemicals (not with base metals), e.g. ammonia solution, nitrates, can be reused as fertiliser on crops, for example banana, breadfruit, taro and coconut. To use dilute 1L of chemical in 100L of water.
- Sulphates (not with base metals), can be reused as fertiliser on crops, for example banana, breadfruit, taro and coconut. To use dilute 1L of chemical in 100L of water.

Contact details:
Melanie Ashton – melanie@iisd.org, Mike McRae-Williams – mmcrae_williams@hatlar.com

Annex 4

Inventory of remaining chemicals on Tarawa

Includes metal-based salts, metals and organic chemicals, not suitable for stabilisation or neutralisation, metal-based salts yet to be stabilised, disposal options and weblinks to MSDS.

Chemical Name	Location	Description	Options for disposal	MSDS link
Metal-based salts unsuitable for stabilisation				
Mercury sulphate	KY5 School laboratory storeroom	1 x small bottle, half full 1 x small plastic jar, half full	No options, store safely	http://msds.chem.ox.ac.uk/ME/mercury_II_sulfate.html
Nessler's reagent Mercuric chloride	Agricultural Department Storeroom	1 x 300ml bottle (1.5% weight for volume)	No options, store safely	http://msds.chem.ox.ac.uk/NE/Nesslers_reagent.html
Mercuric sulphate	KY5 School laboratory storeroom	1 x 100mL amber jar (half full)	No options, store safely	http://msds.chem.ox.ac.uk/ME/mercury_II_sulfate.html
Mercurous oxide (black)	KY5 School laboratory storeroom	1x 100mL small bottle (half full)	No options, store safely	http://www.sciencelab.com/xMSDS-Mercuric_oxide-9924619
Mercuric oxide (white)	KY5 School laboratory storeroom	1 x 50mL bottle (half full)	No options, store safely	http://www.sciencelab.com/xMSDS-Mercuric_oxide-9924619
Strontium nitrate	KY5 School	1 x small	No options,	http://msds.chem.ox.ac.uk/ST/strontium_nitrate.html

	laboratory storeroom	bottle, half full	store safely	
Sodium bromide	KY5 School laboratory storeroom	1 x 500gm bottle, half full	No options, store safely	http://msds.chem.ox.ac.uk/SO/sodium_bromide.html
Ammonium thiocyanate	KY5 School laboratory storeroom	1 x 500gm bottle, half full	No options, store safely	http://msds.chem.ox.ac.uk/AM/ammonium_thiocyanate.html
Strontium chloride	KY5 School laboratory storeroom	1 x 500gm plastic bottle, half full	No options, store safely	http://msds.chem.ox.ac.uk/ST/strontium_chloride_hexahydrate.html
Dichromate	KY5 School laboratory storeroom	9 bottles of various sizes and brands.	Reduction to Cr^3 required before stabilisation	http://www.sciencelab.com/xMSDS-Potassium_dichromate-9927404
Sodium nitroprusside $NO_2Fe(CN)_8NO.2H_2$ 0	Agriculture Department storeroom	1 x 1L bottle	No options, store safely	http://fscimage.fishersci.com/msds/30681.htm
Restrictive poison – Clean Cure, Culcure, Rentokil 30% copper sulphate 28.5% Arsenic pentoxide 32% Sodium dichromate 9.5% Sodium pyroarsenate	Agriculture Department storeroom	65 x 10L white plastic buckets (all half full with powder)	Special reagents required for stabilisation. Until adequately treated store safely in dry environment	http://www.woodtreaters.com/NewAssets/PDF/MSDS-CCA-WT-11-2006.pdf

Red phosphorus	KY5 School laboratory storeroom	1 x 2L amber bottle		http://msds.chem.ox.ac.uk/PH/phosphorus_red.html
Sodium	KY5 School laboratory storeroom	1 x 300mL amber bottle		http://msds.chem.ox.ac.uk/SO/sodium.html
Uranyl acetate	Hospital laboratory			http://www.tedpella.com/msds_html/19481msd.htm
Metal-based salts suitable for stabilisation				
Zinc sulphate	Agricultural Department storeroom	14 x 1Kg plastic jars (unopened)	Should be stabilised	http://msds.chem.ox.ac.uk/ZI/zinc_sulfate_7-hydrate.html http://msds.chem.ox.ac.uk/ZI/zinc_sulfate_monohydrate.html
Manganous sulphate	Agricultural Department storeroom	50 x 1Kg plastic jars (unopened)	Should be stabilised	http://msds.chem.ox.ac.uk/MA/manganous_sulfate_monohydrate.html
Calcium borogluconate	Agricultural Department storeroom	4 x 1L amber bottles	Should be stabilised	http://www.durvet.com/MSDS/155_MSDS.pdf
Yellow sulphur	Agricultural Department storeroom	1 x 1Kg plastic jar 2 x 1.5Kg plastic bags	Should be stabilised	http://msds.chem.ox.ac.uk/SU/sulfur.html
Potassium permanganate	Agricultural Department storeroom KY5 School	2 x 300gm small plastic jar 4 x small glass jars 1 x small amber jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/P6005.htm
Ammonium	Agricultural	1 x 50 mL	Should be	http://www.jtbaker.com/msds/englishhtml/a5916.htm

hydroxide	Department storeroom	glass bottle	neutralised and stabilised	
Magnesium chloride solution	Agricultural Department storeroom	3 x 500mL plastic bottles	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/m0156.htm
Sulphuric acid	Agricultural Department storeroom	1 x large amber jar	Should be neutralised then stabilised	http://msds.chem.ox.ac.uk/SU/sulfuric_acid_concentrated.html
Sodium tetraborate	Agricultural Department storeroom	30 x 2Kg plastic jars 1 x 1Kg plastic jars	Should be stabilised	http://msds.chem.ox.ac.uk/SO/sodium_tetraborate.html
Calcium nitrate	Agricultural Department storeroom	1 x large plastic red jar (100mL remaining)	Should be stabilised	http://www.hvchemical.com/msds/cani.htm
Magnesium sulphate	Agricultural Department storeroom	1 x 1Kg plastic bag	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/m0234.htm
Sodium thiosulphate	Agricultural Department storeroom	1 x 500mL plastic jar	Not classified as hazardous, but should be stabilised	http://users.bigpond.net.au/tuscany/deltrex/products/s222.htm
Zinc acetate	Agricultural Department storeroom	1 x 200gm plastic jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/z1140.htm
Sodium hydroxide	Agricultural Department storeroom	1 x small jar (10 gm remaining)	Should be neutralised then stabilised	http://www.chem.tamu.edu/class/majors/msdsfiles/msdssodiumhydroxide.htm
Hydrogen peroxide	Agricultural	1 x 2L	Should be	http://www.bu.edu/es/labsafety/ESMSDSs/MSHydPeroxide.html

	Department storeroom	amber bottle 1 x 500mL amber bottle	diluted and disposed to land	
Acetic acid concentrate	Agricultural Department storeroom	1 x 500mL amber bottle	Should be neutralised then stabilised	http://www.bu.edu/es/labsafety/ESMSDSs/MSAcetic.html
Potassium iodide	Agricultural Department storeroom	1 x 500mL amber jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/P5906.htm
Magnesium chloride solution	Agricultural Department storeroom	1 x 500mL amber bottle	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/m0156.htm
Injectable iron	Agricultural Department storeroom	1 x 200gm sachet	Should be stabilised	http://www.durvet.com/prods/IRON_381/DetailSheet.html
Potassium hydroxide	Agricultural Department storeroom	1 x 500mL amber	Should be neutralised then stabilised	http://www.jtbaker.com/msds/englishhtml/P5884.htm
Lead acetate	Agriculture Department storeroom	4 x boxes of 3 H_2S indicator	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/l2434.htm
Zinc nitrate	Agriculture Department storeroom	1 x1L amber bottle, pellets	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/z3137.htm
Iron filings	Agriculture Department storeroom	1 x 5Kg cardboard box 1 x 2Kg	Should be stabilised	http://www.sciencestuff.com/msds/C1928.html

		plastic bag		
Ferrous sulphate	Agriculture Department storeroom	1 x 1Kg plastic jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/f1802.htm
Soda lime	KY5 School laboratory storeroom	3 x 1L amber	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/s2546.htm
Lime	KY5 School laboratory storeroom	3 x 1L amber	Should be stabilised	http://www.sciencestuff.com/msds/C1450.html
Copper or nickel salt	KY5 School laboratory storeroom	2 x 500ml amber bottle	Should be stabilised	Not applicable
Potassium sulphate	KY5 School laboratory storeroom	1 x small amber jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/p6137.htm
Manganese oxide	KY5 School laboratory storeroom	1 x small amber jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/m0720.htm
Lead oxide	KY5 School laboratory storeroom	2 x small amber jars	Should be stabilised	http://msds.chem.ox.ac.uk/LE/lead_II_oxide.html
Copper solution	KY5 School laboratory storeroom	1 x small amber jar	Should be stabilised	http://www.jtbaker.com/msds/englishhtml/C5170.htm
Dextrose in sodium chloride	Pharmacy Department Storeroom (at hospital)	1 x 1L amber bottle	Can be disposed of down sewer	This product is not hazardous, based upon the Occupational Safety and Health Administration (OSHA) Hazard Communication 29 CFR 1910.1200, and does not require a Material Safety Data Sheet.
Sodium lactate	Pharmacy	1 x 1L	To landfill	http://www.jtbaker.com/msds/englishhtml/S4226.htm

	Department Storeroom (at hospital)	amber bottle		
Sodium tungstanate	Hospital laboratory		Should be stabilised	http://fscimage.fishersci.com/msds/21741.htm
Acids suitable for neutralisation or stabilisation				
Ortho phosphoric acid	Agricultural Department storeroom Pharmacy Department Storeroom (at hospital)	1 x 500mL plastic jar 1 x 500mL plastic jar	Should be neutralised, then stabilised	http://www.rockemat.com/upc/msds/English/REM079.pdf
Acid	Agricultural Department storeroom	3 x 2L amber bottles 1 x 500mL acid	Should be neutralised then stabilised	Not applicable
Nitric acid	Agricultural Department storeroom Pharmacy Department Storeroom (at hospital)	1 x 2L amber bottle 2 x 2L amber bottles	Should be neutralised then stabilised	http://www.jtbaker.com/msds/englishhtml/n3660.htm
Formic acid	Agricultural Department storeroom	1 x 500mL amber bottle	Should be neutralised then stabilised	http://www.jtbaker.com/msds/englishhtml/f5956.htm

Metals				
Mercury	St Louise School laboratory storeroom KY5 School laboratory store (collected from Moroni school) Environment Department Office	1 x small vegemite jar, approximately 15mL 1 x 500gm bottle Approximately 5mL in old beer bottle (recovered from broken thermometer at hospital)	No options, store safely	https://fscimage.fishersci.com/msds/96252.htm
Organic liquids				
Pyro...... crystals C_6...OH	KY5 School laboratory storeroom	1 bottle, half full, approximately 100gms	No options, store safely	Not applicable
Tetracycline	KY5 School laboratory storeroom	1 x 50mL bottle, half full	No options, store safely	http://www.sciencelab.com/xMSDS-Tetracycline-9925200
....N_2OIC (could be	KY5 School	Approximat	No options,	Not applicable

acetic acid crystals?)	laboratory storeroom	ely 20gms	store safely	
l-octanol	KY5 School laboratory storeroom	1 x amber bottle	No options, store safely	http://www.sciencelab.com/xMSDS-2_Octanol-9927680
Acetamide	KY5 School laboratory storeroom	1 x plastic bottle, 200gms remaining 1 x empty plastic bottle	No options, store safely Should be keep away from water	http://www.sciencelab.com/xMSDS-2_Octanol-9927680
Aniline hydrochloride	KY5 School laboratory storeroom	1 x bottle	No options, store safely	http://www.sciencelab.com/xMSDS-Aniline_hydrochloride-9922943
Ethyl ether	KY5 School laboratory storeroom	1 x amber bottle	No options, store safely.	http://www.sciencelab.com/xMSDS-Ethyl_ether-9927164
Butanone (ethyl methyl keytone)	KY5 School laboratory storeroom	1 x bottle, 50mL remaining	No options, store safely	http://physchem.ox.ac.uk/msds/BU/2-butanone.html
Cinnamaldehyde (cinematic aldehyde)	KY5 School laboratory storeroom	1 x 500mL amber bottle, half full	No options, store safely	http://www.sciencelab.com/xMSDS-trans_Cinnamaldehyde-9923482
4-chlorophenol	KY5 School laboratory storeroom	1 x small amber jar, 30mL remaining	No options, store safely	http://www.sciencelab.com/xMSDS-o_Chlorophenol-9923430
Trimethoprim (with sulphur methox	KY5 School laboratory	1 x plastic 200mL	No options, store safely	http://www.drugbank.ca/drugBank/drugStructureFile/drug_files/msds_sheets/DB00440.pdf

azole)	storeroom	bottle, 100mL remaining		
Organic chlorinated solvents (Various chemicals including chloroform, xylene and toluene)	St Louise	Approximately 10 plastic bottled (unopened)	No options, store safely	See above for various solvents
Isopropal alcohol	Agriculture Department storeroom	1 x 1L amber bottle	No options, store safely	http://physchem.ox.ac.uk/msds/PR/2-propanol.html
Unknown organic solvent	Agriculture Department storeroom	1 x 2L black plastic bottle 2 x 2.5L amber bottles	No options, store safely	Not applicable
Iodine/ethanol solution	Agriculture Department storeroom	1 x 250mL bottle	No options, store safely	http://www.jtbaker.com/msds/englishhtml/i2682.htm
Glycerol	Agricultural Department storeroom	1 x 2L amber bottle	No options, store safely	http://msds.chem.ox.ac.uk/GL/glycerol.html
Etching primer acetone	Agriculture Department storeroom	1 x 500mL tin (50mL remaining)	No options, store safely	http://www.csrdistilleries.com.au/MSDS/Acetone.pdf
Phenol	Pharmacy Department Storeroom (at hospital)	1 x 2L amber bottle	No options. Transfer to hospital lab, store safely	http://msds.chem.ox.ac.uk/PH/phenol.html

o-Touluidine	Pharmacy Department Storeroom (at hospital)	1 x 1L amber bottle	No options, store safely	http://msds.chem.ox.ac.uk/TO/o-toluidine.html
Propanol	Pharmacy Department Storeroom (at hospital)	1 x 2L amber bottle	No options. Transfer to hospital lab, store safely	http://physchem.ox.ac.uk/msds/PR/2-propanol.html
Acetone	Pharmacy Department Storeroom (at hospital)	1 x 1Lbottle	No options, store safely	http://www.csrdistilleries.com.au/MSDS/Acetone.pdf
Diethyl ether	Pharmacy Department Storeroom (at hospital)	1 x 1L amber bottle	No options. Transfer to hospital lab, store safely	http://www.sciencelab.com/xMSDS-Ethyl_ether-9927164
Picric acid	Agriculture Department storeroom	1 x small plastic jar	Potentially explosive. No options, store safely	http://www.sciencelab.com/xMSDS-Picric_acid-9926556
Formic acid (Ameisensaure, 85%)	Agriculture Department storeroom	1 x 40L blue plastic drum	No options, store safely	http://www.sciencelab.com/xMSDS-Formic_acid_85_F_C_C-9924100
Concentrated formaldehyde solution	Agricultural Department storeroom	2 x 1L plastic bottles	No options. Transfer to hospital lab, store safely	http://www.kendon.com.au/Catalogue/MSDS/Industrial/Formaldehyde.htm
Acetic acid	Pharmacy Department Storeroom (at hospital)	1 x 1L amber bottle	Neutralise with coral sand and dispose	http://www.sciencelab.com/xMSDS-Acetic_acid-9922769

Creosol	Pharmacy Department Storeroom (at hospital)	4 x 1L amber bottles	No options. Transfer to hospital lab, store safely	http://www.oxfordchemicals.com/oxford%5Cocweb.nsf/LMSDS/M0300/$File/M0300.pdf?OpenElement
Uric acid	Pharmacy Department Storeroom (at hospital)	1 x 1L amber bottle	No options. Transfer to hospital lab, store safely	http://www.sciencelab.com/xMSDS-Uric_acid-9925393
Xylene sulphur	Pharmacy Department Storeroom (at hospital)	1 x 1L amber bottle	No options. Transfer to hospital lab, store safely	http://www.trconsultinggroup.com/safety/msds/xylene.pdf
Xylene	Hospital laboratory	30L 8 x amber bottles	No options, store safely	http://www.trconsultinggroup.com/safety/msds/xylene.pdf
Other chemicals				
Unknown chemicals	Agriculture Department storeroom	Approx. 20 bottles of unidentifiable and unlabelled chemicals. Packed in an open-top lidded drum.	MELAD undertake consultation with Agriculture staff and check if they know what any of the chemicals are. If so, label them.	Not applicable
Captan	Agricultural Department storeroom	1 x small plastic packet	No options, store safely	http://www.sdix.com/TechSupport/msds/9998027.1.pdf
Yates Zero glyphosphate	Agricultural Department	17 x 200mL plastic	Use it	http://msds.orica.com/pdf/shess-en-cds-010-000000020515.pdf

	storeroom	bottles		
Bacseal pruning paint	Agriculture Department storeroom	2 x 500mL plastic bottles	Use it	http://msds.orica.com/pdf/shess-en-cds-020-000000020899.pdf
Developer and Fixer: RPX-OMAT (spent solution)	Hospital X-ray laboratory	40L produced every week	See comments in report. Store until treated	No specific MSDS. Thiosulphate is main active constituent. MSDS below. http://www.vinvicta.com.au/catalogue/c275/information/SodiumThiosulphateMSDS.pdf
Cyanide and haemoglobin mixture	Hospital laboratory	400L	See comments in report. Store until treated	http://www.clin-tech.co.uk/pdf/61020X.pdf
Drabkin's Reagent	Hospital laboratory		See comments in report. Store until treated	http://www.clin-tech.co.uk/pdf/61020X.pdf
Easyelectrolytes	Hospital laboratory	13L	Treat as infectious waste	Not applicable
Difco selenite broth	Hospital laboratory		Dispose to sewer in small quantities with dilution	http://msds.sourcemedical.com/Docs/Selenite%20Broth.pdf
TB-colour carbol fuchsin	Hospital laboratory		No options, store safely	http://www.sciencelab.com/xMSDS-Carbol_Fuchsin_Kinyoun-9925738

Annex 5

Participants in Department of Health consultation

July 18 2008

Name	Department	Contact details
Beri Tum	Environmental Health	btum@yahoo.com
Tianure Taeuea	Environmental Health	ttaeuea@yahoo.com
Rosemary Tekoana	Medical Laboratory	rtekoaua@yahoo.com
Teboranga Tioti	Deputy Secretary - MELAD	
Ata Itibita	Radiology Services	
Bribo Kararaih	Assistant Pharmacist	

South Austral Pty Ltd
4 Meadow Way
Banksmeadow
Sydney
Australia

25 July 2008

To whom it may concern,

I am writing in regard to some recently expired South Austral pharmaceutical products, which the Government of Kiribati has in storage. Kiribati's usual course of action would be to incinerate excess and expired pharmaceutical products, however our incinerator is not operational and requires replacement.

Therefore we are requesting that South Austral accept the return of the pharmaceuticals. The following is a list of chemicals we would like to return to you:

Name	Batch No.	Cartons	Packets (per carton)	Expiry date
Oral rehydration salts	50101	178	12	January 08
Aspirin 300mg	41243	4	50	December 07
INH 100mg	5110	2	100	January 08
Chloramphenicol 250mg	DJ4133	2	144	March 07
Rifampicin 300mg	TGL55	9	40	December 07
Chloroprozine 100mg	50148	1	50	January 08
Ampicillin 500mg	41251	54	20	December 07

We look forward to your reply.

Kind regards

Farran Redfern

Expired pharmaceutical Products

Item	Form	Batch No.	Expiry date	Quantity			Total Qty Expired	Company Name	Date rec'd	Qty rec'd	Total Qty	Qty used	PHO
				Ctns	Pack	Unit							
Oral rehydration salt	P	50101	Jan-08	178	12	50	106800	South Austral Australia	6/13/2005	181x12x50	108600	1800	487
Aspirin 300mg	T	41243	Dec-07	4	50	1000	200000	South Austral Australia	6/13/2005	20x50x1000	1000000	800000	485
INH 100mg	T	5110	Jan-08	2	100	1000	20000	South Austral Australia	6/13/2005	3x100x1000	300000	280000	494
Mebendazole	T	VERMT3007	Nov-06		82	500	82	Shing poong pharm, Korea	4/13/2004	27x82x500	1107000	1106918	403
Metoclopramide Hcl 10mg	T	GH0509	Dec-07		37	1000	37000	Apotex Inc. Toronto, Canada	4/13/2004	100x500	50000	13000	403
Trihexyphenidyl 2mg	T	TGK60	Oct-07		59	1000	59000	Medopharm	7/8/2005	98x1000	98000	39000	471
Depo Provera 150mg/ml	I	K60950	Jan-08		200	25	5000		8/26/2003	400x25	10000	5000	UNFPA
Depo Provera 150mg/ml	I	K70549	Apr-08		40	25	1000					-1000	
Chloramphenicol 250mg	C	DJ4133	Mar-07	2	144	100	28800	South Austral Australia	8/12/2005	100000	100000	71200	481
Atenolol 100mg	T	DA4654	Oct-07	3	36	280	30240	Cipla Mumbai, India	8/12/2005	147000	147000	116760	481
Potassium Chloride SR 600mg	T	46872	Jun-07	4	48	200	38400	Aspen Pharm Australia	4/30/2005	5x48x200	48000	9600	472
Pyrazinamide 500mg	T	TGL60	Nov-07	18	20	1000	360000	Multichem, NZ	6/21/2005	18x20x1000	360000	0	473
Frusemide 40mg	T	4ML60	Nov-07	2	100	1000	200000	Multichem, NZ	11/28/2005	15x100x1000	1500000	1300000	471
Erythromycin 250mg	T	50301	Mar-08	9	40	1000	360000	Shangai Shipex Pharm, China	5/31/2005	10x40x1000	400000	40000	509
Metformin 500mg	T	40003	Oct-07	4	24	1000	96000	Pure Pharma. Ltd, India	8/12/2005	372x1000	372000	276000	482
Phenoxymethylpenicillin 250mg	T	TGK63	Oct-07	6	30	1000	180000	Multichem, NZ	7/8/2005	12x30x1000	360000	180000	472
Griseofulvin 125mg	T	50301	Mar-08	6	40	1000	240000	Shangai Shipex Pharm, China	5/31/2005	14x40x1000	560000	320000	511
Tolbutamide 500mg	T	THA25	Dec-07	2	20	1000	40000	Multichem, NZ	7/8/2005	11x20x1000	220000	180000	473
Rifampicin 300mg	C	TGL55	Nov-07	5	30	1000	150000	Multichem, NZ	7/8/2005	9x30x1000	270000	120000	473
Prochloperazine 5mg	T	TGK64	Oct-07	1	96	1000	96000	Multichem, NZ	7/8/2005	1x96x1000	96000	0	473
Rifampicin 150mg	C	41247	Dec-07	9	40	1000	360000	South Austral Australia	6/13/2005	10x40x1000	400000	40000	494
Chlorpromazine 100mg	T	50148	Jan-08	1	50	1000	50000	South Austral Australia	6/13/2005	4x50x1000	200000	150000	485
Benzylpenicillin sod. 5M	I	412848	Dec-07	29	50	12	17400	South Austral Australia	6/13/2005	50x12x50	30000	12600	489
Multi-Vit	T	TGL58	Nov-06	6	30	1000	180000	Multichem, NZ	7/26/2005	30x30x1000	900000	720000	473
Ampicillin 1G	I	412604	Dec-07	54	20	50	54000	Sinochem, China	5/2/2005	580x50	29000	-25000	474
Ampicillin 500mg	I	41251	Dec-07	32	20	50	32000	South Austral Australia	6/13/2005	50x20x50	50000	18000	489
Promethazine HCL 25mg	T	TGL53	Nov-07	4	100	100	40000	Multichem, NZ	11/28/2005	20x100x100	200000	160000	473
Erythromycin 125mg/5ml	S	50001	Jun-07	8	50	100mls	400	Pure Pharma. Ltd, India	7/19/2006	500x100mls	500	100	172006
Norethisterone 5mg	T	407073	Jul-07	5	60	500	150000	UPHA pharm, Malaysia	6/13/2005	7x60x500	210000	60000	486
Mefenamic Acid 250mg	C	50249	Mar-08	4	15	1000	60000	Flammingo Pharm ltd, India	8/25/2005	100x1000	100000	40000	472

Erythromycin 250mg	T	40003	Jan-08	5	24	1000	120000	Pure Pharma. Ltd, India	8/12/2005	192x1000	192000	72000	481
Doxycycline 100mg	C	50001	May-07	8	100	100	80000	Pure Pharma. Ltd, India	8/19/2005	10x100x100	100000	20000	481
Propanolol Hcl 40mg	T	X40267	Nov-07	4	3000	10	120000	Alpharmed pty ltd, Austr.	8/10/2005	2500x100	250000	130000	483
Potassium Chloride SR 600mg	T	170305	Feb-08	2	125	100	25000	BDH Industries ltd, India	2/5/2007	80x125x100	100000	75000	T232006
abbr: T- Tablets, S- Suspension, P- Powder, I- Injection/IV, C- Capsule, N- Nebules													
	Not recorded in GRR												


BT 1
BT 2
BT 3
BT4
BT5
BT 6
Image © 2008 DigitalGlobe
© 2008 Europa Technologies
Google
Pointer 0°51'57.57" S 169°32'21.84" E
Streaming |||||||||| 100%
Eye alt 2208 ft

CHAIN OF CUSTODY RECORD

GHD

GHD Melbourne
180 Lonsdale Street, Melbourne 3000
Telephone: 613 8687 8000 Facsimile: 613 8687 8111
Email: vic_enviro_labreports@ghd.com.au

GHD Geelong
Email: gexmail@ghd.com.au

GHD Morwell
Email: mwlmail@ghd.com.au

Job Number: 3123191
GHD Office: Melbourne.
Project: Kiribati Chems + Waste Mgt.
GHD Project Manager: Katie Butler
GHD Contact: Katie Butler.
Requested Completion Date:
Purchase Order Number: Please contact K.Butler

Laboratory: MGT Environmental Consulting
Address:
Laboratory Contact: Glenn Jacksen.

Sample I.D.	Date	Time	Composite Sample	Sample Matrix (S: Soil SL: Sludge W: Water A: Air GW: Groundwater)	Preservative	Container Type (J: soil jar B: bag V: vial G: glass bottle P: plastic bottle)	Container Number	Container Volume (mL)	PCBs	HYDROCARBONS (6-C30)	Remarks
BT 1	21/7/08	AM	No	Oil	–	G	1	50	✓		
BT 2	↓	AM	No	Oil	–	G	1	↓	✓		
BT 3		AM	No	Oil	–	G	1		✓		
BT4		PM	No	Oil	–	G	1		✓		
BT5		PM	No	Oil	–	G	1		✓		
BT6	↓	PM	No	Oil	–	G	1		✓		
GW1	26/7/08	PM	No	GW	–	3xG	3			✓	KOIL (3 Glass missing / only tubs found)
GW2	26/7/08	PM	No	GW	–	3xG	3			✓	KOIL
GW3	↓	PM	No	GW	–	3xG	3			✓	KOIL
GW4	↓	PM	No	GW	–	3xG	3	↓		✓	KOIL
GW 5	28/7/08	PM	No	G.W	–	3xG	3	50		✓	BETIO POWER HOUSE
GW6	28/7/08	PM	No	G.W	–	3xG	3	50		✓	BETIO POWER HOUSE

PLEASE NOTE:
Sign white copy on receipt and release of samples.
Samples are to be delivered to the Laboratory Address.
On receipt of samples, the **laboratory contact should sign white copy** and fax to GHD Contact.
On completion of analyses please **return white copy with results**.
Yellow copy is retained by laboratory.
Pink copy is returned to the sampler once the courier has signed for the samples.
E-mail results to the e-mail address of the relevant GHD office and cc GHD Project Manager and GHD Contact with the GHD Job Number in the e-mail subject line.
Results to provided in ESDAT compatibile format

Sampled by:	Date/Time	Relinquished by:	Date/Time
Received by: Gary 30/7 @ 6:15 pm	Date/Time	Relinquished by:	Date/Time
Received by Courier: MGT	Date/Time 30/7/08 @ 7pm	Relinquished by:	Date/Time
Received by Lab:	Date/Time		

Remarks: Rep# 231310

CHAIN OF COUSTODY RECORD

GHD

GHD Melbourne
180 Lonsdale Street, Melbourne 3000
Telephone: 613 8687 8000 Facsimile: 613 8687 8111
Email: vic_enviro_labreports@ghd.com.au

GHD Geelong
Email: gexmail@ghd.com.au

GHD Morwell
Email: mwlmail@ghd.com.au

Job Number: 3123191	GHD Office: MELBOURNE
Project: KIRIBATI CHEM & WASTE MANAGEMENT	
GHD Project Manager: KATIE BUTLER	GHD Contact: KATIE BUTLER
Requested Completion Date:	Purchase Order Number:

Laboratory: MGT ENVIRONMENTAL CONSULTING

Address:

Laboratory Contact: GLENN TAELIESEN

PLEASE NOTE:
Sign white copy on receipt and release of samples
Samples are to be delivered to the Laboratory Address.
On receipt of samples, the **laboratory contact should sign white copy** and fax to GHD Contact.
On completion of analyses please **return white copy with results.**
Yellow copy is retained by laboratory.
Pink copy is returned to the sampler once the courier has signed for the samples.
E-mail results to the e-mail address of the relevant GHD office and cc GHD Project Manager and GHD Contact with the GHD Job Number in the e-mail subject line.

Results to provided in ESDAT compatibile format

Sample I.D.	Date	Time	Composite Sample	Sample Matrix (S: Soil SL: Sludge W: Water A: Air GW: Groundwater)	Preservative	Container Type (J: soil jar B: bag V: vial G: glass bottle P: plastic bottle)	Container Number	Container Volume (mL)		HYDROCARBON C6-C36	PAH	HEAVY CHAIN H/C	BTEX	Analyses Required	Remarks
GW7	28/7/08	PM	NO	GW	–	G-X3	3	50		✓				- Glass Missing - only tub found	BETIO POWER HOUSE
GW 8	29/7/08	PM	NO	GW	–	1LG	1	1L			✓	✓	✓		AIRPORT BITUMEN
GW 9	29/7/08	PM	NO	GW	–	1LG	1	1L			✓	✓	✓		AIRPORT BITUMEN
GW 10	29/7/08	PM	NO	GW	–	1LG	1	1L			✓	✓	✓		AIRPORT BITUMEN
GW 11	29/7/08	PM	NO	GW	–	1LG	1	1L			✓	✓	✓		AIRPORT BITUMEN

Sampled by:	Date/Time	Relinquished by:	Date/Time
Received by: Gary 30/7 6:15 pm	Date/Time	Relinquished by:	Date/Time
Received by Courier:	Date/Time	Relinquished by:	Date/Time
Received by Lab:	Date/Time		

Remarks: Rep #231310.

mgt Environmental Consulting Pty. Ltd.
3 Kingston Town Close, Oakleigh, Victoria 3166, Australia
Postal address: P. O. Box 276, Oakleigh, Victoria 3166, Australia
Telephone: (03) 9564 7055
Fax: (03) 9564 7190
Email: mgt@mgtenv.com.au

CERTIFICATE OF ANALYSIS

GHD Pty Ltd VIC
Level 8, 180 Lonsdale St
Melbourne
Victoria 3000
Site: KIRIBALI CHEMS + WASTE MGT 3123191

Report Number: 231310
Order Number:
Date Received: Jul 30, 2008
Date Sampled: Jul 21, 2008
Date Reported: Aug 7, 2008
Contact: Katie Butler

Methods

- VICEPA 6013 Polychlorinated Biphenyls in Oils & Greases
- USEPA 8270C Polycyclic Aromatic Hydrocarbons
- USEPA 8260B - MGT 350A Monocyclic Aromatic Hydrocarbons
- MGT100A-GC (based on USEPA8015)Total Recoverable Hydrocarbons

Comments

Notes

1. The results in this report supersede any previously corresponded results.
2. All Soil Results are reported on a dry basis.
3. Samples are analysed on an as received basis.
4. LOR's are matrix dependent. Stated LOR's may be raised where sample extracts are diluted due to interferences.

ABBREVIATIONS
mg/kg : milligrams per kilograms, mg/L : milligrams per litre, ppm : parts per million,
LOR : Limit of Reporting
RPD : Relative Percent Difference
CRM : Certified Reference Material
LCS : Laboratory Control Sample

Authorised

Report Number: 231310

Michael Wright
Laboratory Manager
NATA Signatory

Glenn Jackson
Client Manager

Orlando Scalzo
Chief Organic Chemist
NATA Signatory

Environmental Consulting Pty. Ltd.
3 Kingston Town Close, Oakleigh, Victoria 3166, Australia
Postal address: P. O. Box 276, Oakleigh, Victoria 3166, Australia
Telephone: (03) 9564 7055
Fax: (03) 9564 7190
Email: mgt@mgtenv.com.au

GHD Pty Ltd VIC	Client Sample ID		BT1	BT2	BT3	BT4
Level 8, 180 Lonsdale St	Lab Number		08-JL11882	08-JL11883	08-JL11884	08-JL11885
Melbourne	Matrix		Oil	Oil	Oil	Oil
Victoria 3000	Sample Date		Jul 21, 2008	Jul 21, 2008	Jul 21, 2008	Jul 21, 2008
Analysis Type	**LOR**	**Units**				
Polychlorinated Biphenyls in Oils & Greases						
Aroclor-1016	2	mg/kg	< 2	< 2	< 2	< 2
Aroclor-1221	2	mg/kg	< 2	< 2	< 2	< 2
Aroclor-1232	2	mg/kg	< 2	< 2	< 2	< 2
Aroclor-1242	2	mg/kg	< 2	< 2	< 2	< 2
Aroclor-1248	2	mg/kg	< 2	< 2	< 2	< 2
Aroclor-1254	2	mg/kg	< 2	< 2	< 2	< 2
Aroclor-1260	2	mg/kg	< 2	7.2	< 2	< 2
Total PCB	2	mg/kg	< 2	7.2	< 2	< 2

COMMENTS:

3 Kingston Town Close, Oakleigh, Victoria 3166, Australia
Postal address: P. O. Box 276, Oakleigh, Victoria 3166, Australia
Telephone: (03) 9564 7055
Fax: (03) 9564 7190
Email: mgt@mgtenv.com.au

GHD Pty Ltd VIC	Client Sample ID		BT5	BT6
Level 8, 180 Lonsdale St	Lab Number		08-JL11886	08-JL11887
Melbourne	Matrix		Oil	Oil
Victoria 3000	Sample Date		Jul 21, 2008	Jul 21, 2008
Analysis Type	**LOR**	**Units**		
Polychlorinated Biphenyls in Oils & Greases				
Aroclor-1016	2	mg/kg	< 2	< 2
Aroclor-1221	2	mg/kg	< 2	< 2
Aroclor-1232	2	mg/kg	< 2	< 2
Aroclor-1242	2	mg/kg	< 2	< 2
Aroclor-1248	2	mg/kg	< 2	< 2
Aroclor-1254	2	mg/kg	< 2	< 2
Aroclor-1260	2	mg/kg	< 2	< 2
Total PCB	2	mg/kg	< 2	< 2

COMMENTS:

3 Kingston Town Close, Oakleigh, Victoria 3166, Australia
Postal address: P. O. Box 276, Oakleigh, Victoria 3166, Australia
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Email: mgt@mgtenv.com.au

GHD Pty Ltd VIC	**Client Sample ID**		**GW1**	**GW2**	**GW3**	**GW4**
Level 8, 180 Lonsdale St	**Lab Number**		**08-JL11888**	**08-JL11889**	**08-JL11890**	**08-JL11891**
Melbourne	**Matrix**		**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Victoria 3000	**Sample Date**		**Jul 26, 2008**	**Jul 26, 2008**	**Jul 26, 2008**	**Jul 26, 2008**
Analysis Type	**LOR**	**Units**				
Total Recoverable Hydrocarbons						
TRH C6-C9 Fraction by GC	0.02	mg/L	0.19	1.4	< 0.02	< 0.02
TRH C10-C14 Fraction by GC	0.05	mg/L	2.3	26	0.08	0.06
TRH C15-C28 Fraction by GC	0.1	mg/L	2.4	31	0.6	0.8
TRH C29-C36 Fraction by GC	0.1	mg/L	< 0.5	2.1	< 0.5	< 0.5

COMMENTS:

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GHD Pty Ltd VIC	Client Sample ID		GW5	GW6	GW7	GW8
Level 8, 180 Lonsdale St	Lab Number		08-JL11892	08-JL11893	08-JL11894	08-JL11895
Melbourne	Matrix		Groundwater	Groundwater	Groundwater	Groundwater
Victoria 3000	Sample Date		Jul 28, 2008	Jul 28, 2008	Jul 28, 2008	Jul 29, 2008
Analysis Type	**LOR**	**Units**				
Total Recoverable Hydrocarbons						
TRH C6-C9 Fraction by GC	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C10-C14 Fraction by GC	0.05	mg/L	< 0.2	< 0.2	< 0.2	< 0.05
TRH C15-C28 Fraction by GC	0.1	mg/L	< 0.5	< 0.5	< 0.5	< 0.1
TRH C29-C36 Fraction by GC	0.1	mg/L	< 0.5	< 0.5	< 0.5	< 0.1
Monocyclic Aromatic Hydrocarbons						
Benzene	0.001	mg/L	-	-	-	< 0.001
Toluene	0.001	mg/L	-	-	-	< 0.001
Ethylbenzene	0.001	mg/L	-	-	-	< 0.001
Xylenes(ortho.meta and para)	0.001	mg/L	-	-	-	< 0.001
Fluorobenzene (surr.)	1	%	-	-	-	92
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.0001	mg/L	-	-	-	< 0.001
Acenaphthylene	0.0001	mg/L	-	-	-	< 0.001
Anthracene	0.0001	mg/L	-	-	-	< 0.001
Benz(a)anthracene	0.0001	mg/L	-	-	-	< 0.001
Benzo(a)pyrene	0.0001	mg/L	-	-	-	< 0.001
Benzo(b)fluoranthene	0.0001	mg/L	-	-	-	< 0.001
Benzo(g.h.i)perylene	0.0001	mg/L	-	-	-	< 0.001
Benzo(k)fluoranthene	0.0001	mg/L	-	-	-	< 0.001
Chrysene	0.0001	mg/L	-	-	-	< 0.001
Dibenz(a.h)anthracene	0.0001	mg/L	-	-	-	< 0.001
Fluoranthene	0.0001	mg/L	-	-	-	< 0.001
Fluorene	0.0001	mg/L	-	-	-	< 0.001
Indeno(1.2.3-cd)pyrene	0.0001	mg/L	-	-	-	< 0.001
Naphthalene	0.0001	mg/L	-	-	-	< 0.001
Phenanthrene	0.0001	mg/L	-	-	-	< 0.001
Pyrene	0.0001	mg/L	-	-	-	< 0.001
Total PAH	0.0001	mg/L	-	-	-	< 0.001
Chrysene-d12 (surr.)	1	%	-	-	-	82
2-Fluorobiphenyl (surr.)	1	%	-	-	-	100

COMMENTS:

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GHD Pty Ltd VIC	Client Sample ID		GW9	GW10	GW11
Level 8, 180 Lonsdale St	Lab Number		08-JL11896	08-JL11897	08-JL11898
Melbourne	Matrix		Groundwater	Groundwater	Water
Victoria 3000	Sample Date		Jul 29, 2008	Jul 29, 2008	Jul 29, 2008
Analysis Type	**LOR**	**Units**			
Total Recoverable Hydrocarbons					
TRH C6-C9 Fraction by GC	0.02	mg/L	< 0.02	< 0.02	< 0.02
TRH C10-C14 Fraction by GC	0.05	mg/L	< 0.05	< 0.05	< 0.05
TRH C15-C28 Fraction by GC	0.1	mg/L	< 0.1	< 0.1	< 0.1
TRH C29-C36 Fraction by GC	0.1	mg/L	< 0.1	< 0.1	< 0.1
Monocyclic Aromatic Hydrocarbons					
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Xylenes(ortho.meta and para)	0.001	mg/L	< 0.001	< 0.001	< 0.001
Fluorobenzene (surr.)	1	%	92	93	92
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Anthracene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(b)fluoranthene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Chrysene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Fluoranthene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Fluorene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Naphthalene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Phenanthrene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Pyrene	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Total PAH	0.0001	mg/L	< 0.001	< 0.001	< 0.001
Chrysene-d12 (surr.)	1	%	111	62	132
2-Fluorobiphenyl (surr.)	1	%	139	72	127

COMMENTS:

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GHD Pty Ltd VIC	Client Sample ID	BT1	BT1	RPD	SPIKE	Method blank
Level 8, 180 Lonsdale St	Lab Number	08-JL11882	08-JL11882	08-JL11882	08-JL11882	Batch
Melbourne	QA Description		Duplicate	Duplicate % RPD	Spike % Recovery	
Victoria 3000	Matrix	Oil	Oil	Oil	Oil	Oil
	Sample Date	Jul 21, 2008	Jul 21, 2008	Jul 21, 2008	Jul 21, 2008	Jul 21, 2008
Analysis Type	Units			% RPD	% Recovery	mg/L
Polychlorinated Biphenyls in Oils & Greases						
Aroclor-1016		< 2	< 2	< 1	-	< 2
Aroclor-1221		< 2	< 2	< 1	-	< 2
Aroclor-1232		< 2	< 2	< 1	-	< 2
Aroclor-1242		< 2	< 2	< 1	-	< 2
Aroclor-1248		< 2	< 2	< 1	-	< 2
Aroclor-1254		< 2	< 2	< 1	-	< 2
Aroclor-1260		< 2	< 2	< 1	129	< 2
Total PCB		< 2	< 2	< 1	129	< 2

COMMENTS:

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GHD Pty Ltd VIC Level 8, 180 Lonsdale St Melbourne Victoria 3000	Client Sample ID	RPD	SPIKE	Method blank
	Lab Number	Batch	Batch	Batch
	QA Description		Spike % Recovery	
	Matrix	Groundwater	Groundwater	Groundwater
	Sample Date	Jul 26, 2008	Jul 26, 2008	Jul 26, 2008
Analysis Type	Units		% Recovery	mg/L
Monocyclic Aromatic Hydrocarbons				
Benzene		< 1	118	< 0.001
Toluene		< 1	99	< 0.001
Ethylbenzene		< 1	92	< 0.001
Xylenes(ortho.meta and para)		< 1	118	< 0.001

COMMENTS:

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Telephone: (03) 9564 7055
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Email: mgt@mgtenv.com.au

GHD Pty Ltd VIC	Client Sample ID	GW9	GW9	RPD	SPIKE	Method blank
Level 8, 180 Lonsdale St	Lab Number	08-JL11896	08-JL11896	08-JL11896	08-JL11896	Batch
Melbourne	QA Description		Duplicate	Duplicate % RPD	Spike % Recovery	
Victoria 3000	Matrix	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
	Sample Date	Jul 29, 2008	Jul 29, 2008	Jul 29, 2008	Jul 29, 2008	Jul 29, 2008
Analysis Type	Units			% RPD	% Recovery	mg/L
Total Recoverable Hydrocarbons						
TRH C6-C9 Fraction by GC		-	-	< 1	109	< 0.02
TRH C10-C14 Fraction by GC		< 0.05	< 0.05	< 1	99	< 0.05
TRH C15-C28 Fraction by GC		< 0.1	< 0.1	< 1	-	< 0.1
TRH C29-C36 Fraction by GC		< 0.1	< 0.1	< 1	-	< 0.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene		< 0.001	< 0.001	< 1	77	< 0.0001
Acenaphthylene		< 0.001	< 0.001	< 1	78	< 0.0001
Anthracene		< 0.001	< 0.001	< 1	82	< 0.0001
Benz(a)anthracene		< 0.001	< 0.001	< 1	99	< 0.0001
Benzo(a)pyrene		< 0.001	< 0.001	< 1	78	< 0.0001
Benzo(b)fluoranthene		< 0.001	< 0.001	< 1	82	< 0.0001
Benzo(g.h.i)perylene		< 0.001	< 0.001	< 1	86	< 0.0001
Benzo(k)fluoranthene		< 0.001	< 0.001	< 1	84	< 0.0001
Chrysene		< 0.001	< 0.001	< 1	86	< 0.0001
Dibenz(a.h)anthracene		< 0.001	< 0.001	< 1	104	< 0.0001
Fluoranthene		< 0.001	< 0.001	< 1	88	< 0.0001
Fluorene		< 0.001	< 0.001	< 1	86	< 0.0001
Indeno(1.2.3-cd)pyrene		< 0.001	< 0.001	< 1	90	< 0.0001
Naphthalene		< 0.001	< 0.001	< 1	87	< 0.0001
Phenanthrene		< 0.001	< 0.001	< 1	93	< 0.0001
Pyrene		< 0.001	< 0.001	< 1	87	< 0.0001

COMMENTS:

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19 August 2008

Mr Farran Redfern
Ministry of Environment, Lands and Agricultural Development
PO Box 234
TARAWA Kiribati

Our ref: 31/23191/154513
Your ref:

Dear Farran,

Banaba Island PCB Reconnaissance Mission
ANNEX 9 TO REPORT

1 Introduction

Section 5 of the report *Kiribati Chemical and Waste Management Advice and Banaba Reconnaissance Mission* described the location and quantity of transformers identified associated with the old phosphate mine developments and the township on Banaba Island.

The report indicates that 49 transformers were identified and all but 4 were found to be empty. The transformers that contained oil were sampled. Oil from two soft starters used in the old rotary drying shed was also sampled.

This letter presents the data obtained from the analysis of these oil samples for PCBs.

2 Location of Transformers

The locations of the transformers are shown in Annex 7. All transformers sampled were marked with spray paint to ensure easy identification.

3 Test Results

The MGT analytical data is attached to this letter and the results are summarised in the table below. All samples were analysed for PCBs.

Sample identification	Collection location	Collected from	Analysis: Total PCB (mg/Kg)
BT1	Phosphate crushing station	Transformer, General Electric, 60 KVA	<2
BT2	Phosphate drying shed	Transformer, General Electric, 60 KVA	7.2
BT3	Phosphate drying shed	Soft starter, Allen West.	<2
BT4	Phosphate drying shed	Soft starter x 2, Allen West	<2
BT5	Uma Village (west side)	Transformer located up a power pole, approximately 7m high	<2
BT6	Uma Village (east side)	Transformer located up a power pole, approximately 7m high	<2

4 Guidelines

The PCB concentrations requiring regulation in most developed countries [1] is 50 mg/Kg[1]. The Basel and Stockholm Conventions identify 50 mg/Kg PCB as the notifiable limit [2]. Under the Basel Convention, PCB contaminated oil is classified as hazardous waste only if the concentration exceeds 50 mg/Kg. Legislative arrangements have been created in many countries which seek to define the concentration of PCB in waste oil below which minimal concern is required and 50 mg/Kg is well established in this context [3].

5 Data Analysis

Transformer BT2 contained PCBs above the laboratory detection limit. In this transformer, Aroclor-1260 was detected at the low concentration of 7.2 mg/kg. The other transformers all tested below the laboratory detection limit.

The PCBs identified in transformed BT2 on Banaba Island do not present an environmental or human health risk.

6 Recommendations

The transformer and soft starter oils identified on Banaba do not contain significant concentrations of PCBs. Therefore no further action is required to remove the oil from the transformers on Banaba Island and there is no need for them to be removed under the POPs in PICs Project.

It should be noted that waste oil, although not a POP, is organic and can contaminate the environment. As such care should be taken to ensure the waste oil is not released into the receiving environment. Waste oil should be drained from the soft starters and transformers and stored in drums with other waste oil in Banaba, for transport to Tarawa to Kiribati Oil, and eventual disposal in Australia.

7 References

UNEP (1999) Guidelines for the Identification of PCBs and materials containing PCBs.

http://www.chem.unep.ch/pops/pdf/PCBident/pcbid1.pdf

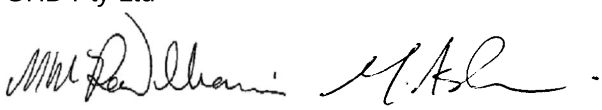
UNEP POPs Disposal under the Stockholm Convention

crsbasilea.inti.gov.ar/workshop/11Basel_Stockholm_links1.ppt

Technical Guidelines on Hazardous Waste: Waste Oils from Petroleum Origins and Sources.

http://www.upme.gov.co/guia_ambiental/basilea/CONVENIO/Guia%20tecnica%20de%20desechos%20de%20petroleo%20(Y8).pdf

Yours faithfully
GHD Pty Ltd



Mike McRae-Williams and Melanie Ashton

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26 August 2008

Mr Farran Redfern
Ministry of Environment, Lands and Agricultural Development
PO Box 234
TARAWA Kiribati

Our ref: 31/23191/154886
Your ref:

Dear Farran

Betio Power Station
Annex 10 to Report

1 Introduction

Section 8.3 of the report *Kiribati Chemical and Waste Management Advice and Banaba Reconnaissance Mission* described the background that led to the sampling of the groundwater at the Betio Power Station. In summary, anecdotal evidence from residents living to the north and south of the site indicated at least two wells had been backfilled, after residents realised they were contaminated with diesel. MELAD was concerned about contamination of groundwater surrounding this site and as a consequence three water samples were taken to provide background information.

2 Sample Locations

The sample locations are shown on the attached photograph. The following samples were collected from residential wells.

- GW 5 was collected from a well adjacent and to the south west of the power station building.
- GW 6 was collected from a well in a residential property across the road to the east of the site
- GW 7 was collected from a well in a residential property 50 meters south of the power station.

3 Test Results

Observations made at the time of sampling are shown in Table 1.

Table 1 Sample Point Observations

Sample ID	Collected from	Odour	Colour	Sheen	Depth to gw (m)	Other comments
GW 5	Domestic well	Organic odour	clear	none	1.0	Well in yard of power station
GW 6	Domestic well	Organic odour	clear	none	2.0	Approx – 2mm separate phase.
GW 7	Domestic well	Organic odour	clear	none	1.2	Residents no longer using the well

Table 2 shows the results of analysis of the water samples. Laboratory reports are attached at the end of this letter. All water samples showed levels of hydrocarbon contamination above the detection limit. The samples showed low levels of contamination in the C10 – C36 range suggesting previous spills of diesel or lubricating oils.

Table 2: Analytical Results for Water Samples Collected from the Betio Site

Sample No.	Test	Result (mg/L)	Bore Type
GW5	TRH C10-C14 Fraction by GC	0.2	House well
GW5	TRH C15-C28 Fraction by GC	0.5	
GW5	TRH C29-C36 Fraction by GC	0.5	
GW5	TRH C6-C9 Fraction by GC	0.02	
GW6	TRH C10-C14 Fraction by GC	0.2	House well
GW6	TRH C15-C28 Fraction by GC	0.5	
GW6	TRH C29-C36 Fraction by GC	0.5	
GW6	TRH C6-C9 Fraction by GC	0.02	
GW7	TRH C10-C14 Fraction by GC	0.2	House well
GW7	TRH C15-C28 Fraction by GC	0.5	
GW7	TRH C29-C36 Fraction by GC	0.5	
GW7	TRH C6-C9 Fraction by GC	0.02	

4 Discussion

The data collected shows that contamination of the ground water by hydrocarbons has occurred at the Betio Power Station. This confirms anecdotal information that suggests a major diesel spill occurred at the Power Plant previously. The levels of contamination are sufficient to affect the quality of the groundwater to such an extent that it is now unsuitable for use as drinking water.

5 Recommendations

Several recommendations have been made in Section 7 of the Mission report. In addition to these recommendations the following recommendation is made:

» MELAD should include tests for Monocyclic aromatic hydrocarbons (BTEX) and polycyclic aromatic hydrocarbons (PAH) in their monitoring program.

Yours sincerely,
GHD Pty Ltd

Mike McRae-Williams and Melanie Ashton

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26 August 2008

Mr Farran Redfern
Ministry of Environment, Lands and Agricultural Development
PO Box 234
TARAWA Kiribati

Our ref: 31/23191/154883
Your ref:

Dear Farran

Kiribati Oil: Depot Tank Farm
Annex 10 to Report

1 Introduction

Section 7 of the report *Kiribati Chemical and Waste Management Advice and Banaba Reconnaissance Mission* described the background that led to the sampling of the groundwater at the Kiribati Oil Depot (KOIL). In summary, KOIL has recently assumed control of the fuel depot previously owned by Mobil. Background data on groundwater quality was not available to MELAD. Consequently, as a part of the Kiribati Chemical and Waste Management mission, four groundwater samples were taken from around the depot to provide MELAD with baseline water quality data.

2 Sample Locations

The sample locations are indicated in Annex 10 to the Mission report. The four samples were collected from three remediation bores and from a residential well.

- GW 1 was collected from remediation bore south of the main access gate adjacent to a service station.
- GW 2 was collected from remediation bore Number 4 to the north of the tank farm.
- GW 3 was collected from a groundwater in a house well east of the tank farm.
- GW 4 was collected from remediation bore number 10 in the North West corner of the depot site.

3 Test Results

Observations made at the time of sampling are shown in Table 1. Samples GW 1, 2 and 3 all exhibited a strong hydrocarbon odour. GW 2 showed a thin free phase layer. The odour and taste of the well water sampled in GW 3 had, at the time of sampling, resulted in its disuse.

Table 1 Sample Point Observations

Sample ID	Collected from	Odour	Colour	Sheen	Depth to gw (m)	Other comments
GW 1	Remediation bore	Strong petroleum odour	Yellowish	Slight	2.0	Small diameter hole (5cm)

Sample ID	Collected from	Odour	Colour	Sheen	Depth to gw (m)	Other comments
GW 2	Remediation bore	Very strong odour	Fawn	Thin surface film	2.0	Approx – 2mm separate phase.
GW 3	Household well	Strong oily odour	Slightly yellowish	Oil sheen	1.2m	Residents no longer using the well
GW 4	Remediation bore	None	Clear	Slight sheen	2.0m	

Table 2 shows the results of analysis of the water samples. Laboratory reports are attached at the end of this letter. All water samples showed levels of hydrocarbon contamination above the detection limit. Sample GW 2 shows a combined hydrocarbon content of 60.5 mg/L with kerosene (C10-C18) and diesel (C12-C18) being the dominant fractions present. The other samples taken showed substantially lower levels of contamination with GW 1 exhibiting a similar fraction distribution. Samples GW 3 and GW 4 showed a higher percentage of contamination in the heavier fractions possibly representing contamination of lubricating oils (>C18).

Table 2: Analytical Results for Water Samples Collected from the KOIL Site

Sample No.	Test	Result (mg/L)	Bore Type
GW1	TRH C10-C14 Fraction by GC	2.3	Remediation
GW1	TRH C15-C28 Fraction by GC	2.4	
GW1	TRH C29-C36 Fraction by GC	0.5	
GW1	TRH C6-C9 Fraction by GC	0.19	
GW2	TRH C10-C14 Fraction by GC	26	Remediation
GW2	TRH C15-C28 Fraction by GC	31	
GW2	TRH C29-C36 Fraction by GC	2.1	
GW2	TRH C6-C9 Fraction by GC	1.4	
GW3	TRH C10-C14 Fraction by GC	0.08	House well (abandoned)
GW3	TRH C15-C28 Fraction by GC	0.6	
GW3	TRH C29-C36 Fraction by GC	0.5	
GW3	TRH C6-C9 Fraction by GC	0.02	
GW4	TRH C10-C14 Fraction by GC	0.06	Remediation
GW4	TRH C15-C28 Fraction by GC	0.8	
GW4	TRH C29-C36 Fraction by GC	0.5	
GW4	TRH C6-C9 Fraction by GC	0.02	

4 Discussion

The data collected shows that contamination of the groundwater by hydrocarbons has occurred at the KOIL depot site. High levels of contamination are confined to the area immediately adjacent to the tank farm and are likely to have resulted from leakages from pipelines or pumps or overflow of tanks. This contamination is not surprising as the tank farm while bunded has a porous coral floor.

The levels of contamination further from the tank farm, while lower, are sufficient to affect the quality of the ground water to such an extent that it is now unsuitable for domestic use for either wash water or drinking water.

The KOIL facility location in the Port District is close to the sea and groundwater movements will be effected by tidal changes and input rainfall. Movement of groundwater from the area of the tank farm has the potential to expand contaminating domestic wells and the marine environment.

5 Recommendations

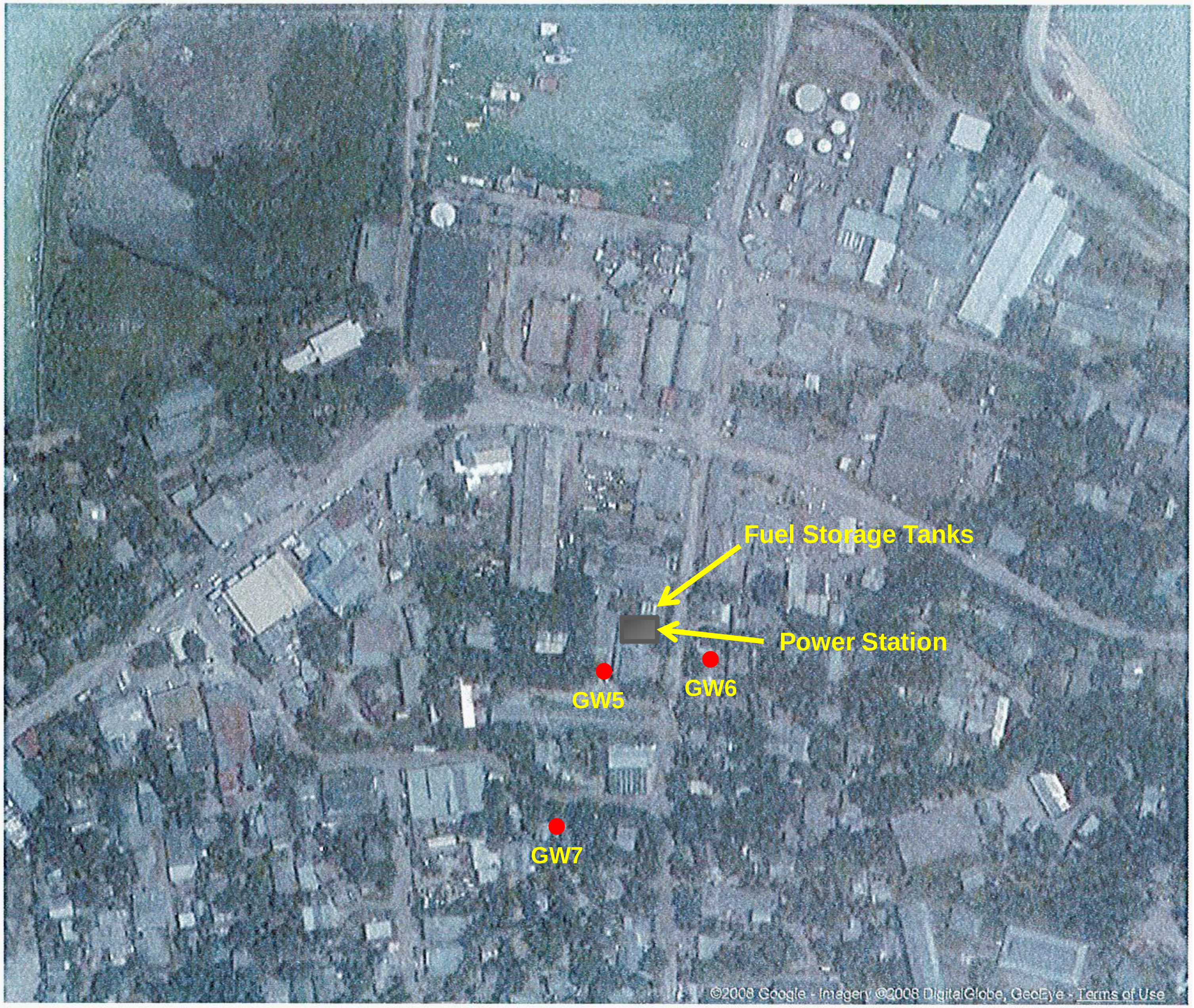
Several recommendations have been made in Section 7 of the Mission report. In addition to these recommendations the following recommendation is made:

» MELAD should include tests for Monocyclic aromatic hydrocarbons (BTEX) and polycyclic aromatic hydrocarbons (PAH) in their monitoring program.

Yours sincerely
GHD Pty Ltd

Mike McRae-Williams and Melanie Ashton

Betio Power Station – Sample Locations



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21 August 2008

Mr Farran Redfern
Ministry of Environment, Lands and Agricultural Development
PO Box 234
TARAWA Kiribati

Our ref: 31/23191/154631
Your ref:

Dear Farran

Tarawa Airstrip Site: Bitumen contamination of groundwater, coral sand area, shore platform and intertidal zone
Annex 11 to Report

1 Introduction

Section 4 of the report *Kiribati Chemical and Waste Management Advice and Banaba Reconnaissance Mission* described the background that led to the sampling of the groundwater at the Tarawa Airstrip site. In summary, bitumen contained in drums and machinery remained after re-surfacing of the airport runway in the 1980s. The bitumen containers have all rusted away. This has allowed the bitumen to flow and spread over a considerable area.

The bitumen occurs in two areas; to the north of the runway and to the south of the runway (Plate 1). In 2006, the bitumen south of the runway was observed flowing into an old well (Figure 1) and concern was raised that this may be contaminating the groundwater. Since the groundwater is accessed by local households through wells for drinking water, the worry is that a potential health issue existed. Consequently, MELAD commissioned a further site assessment including sampling those residents wells in close proximity to the bitumen contaminated area.

On visiting the site it was discovered that much of the bitumen south of the runway had been removed to make way for a new house (Plate 2) and been deposited on the shore platform in the intertidal zone and in a depression containing ground water located adjacent to the dwellings (Figure 1).

2 Sample Locations

The sample locations are indicated in Figure 1. The following samples were collected from three household wells and from the surface water depression:

- GW 8 was collected from Tataake residential well.
- GW 9 was collected from Mikaerae residential well.
- GW 10 was collected from a groundwater depression (see Figure 1).
- GW 11 was collected from Maata Riutere residential well.

3 Test Results

Observations made at the time of sampling are shown in Table 1. The samples from the western most wells (GW 8, GW 9) were clear and without odour. Sample GW 10 taken from the depression between the dwellings showed clear evidence of a hydrocarbon film and organic odour. Sample GW 11 was slightly discoloured and also had a discernable organic odour.

Table 1: Sample Point Observations

Sample	Oservations	Water Source
GW 8	Clear water, No odour	Well
GW 9	Clear water, No odour	Well
GW 10	Hydrocarbon scum observable, organic odour	Surface water depression
GW 11	Slightly discoloured water, organic odour	well

Table 2 shows the results of analysis of the water samples. Laboratory reports are attached at the end of this letter. The analytical data shows no measurable contamination for Monocyclic Aromatic Hydrocarbons (MAHs) or Polycyclic Aromatic Hydrocarbons (PAHs) or Total Recoverable Hydrocarbons (TRHs) in any of the samples.

Table 2: Analytical Results for Water Samples Collected at Tarawa Air Strip

Analysis	GW8	GW9	GW10	GW11
Monocyclic Aromatic Hydrocarbons				
Benzene	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes(ortho.meta and para)	< 0.001	< 0.001	< 0.001	< 0.001
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b)fluoranthene	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	< 0.001	< 0.001	< 0.001	< 0.001
Total PAH	< 0.001	< 0.001	< 0.001	< 0.001
Total Recoverable Hydrocarbons				
TRH C10-C14 Fraction by GC	< 0.05	< 0.05	< 0.05	< 0.05
TRH C15-C28 Fraction by GC	< 0.1	< 0.1	< 0.1	< 0.1
TRH C29-C36 Fraction by GC	< 0.1	< 0.1	< 0.1	< 0.1
TRH C6-C9 Fraction by GC	< 0.02	< 0.02	< 0.02	< 0.02

4 Discussion

The lack of measurable contamination for PAHs in the dwelling wells and groundwater depression indicates that these wells are not contaminated at present. However, this does not indicate that contamination of the groundwater table is not occurring. Rather it indicated that the contamination has not moved into the areas utilised by the wells, as yet. The initial location of the bitumen contamination, the direction of movement of the ground water and the solubility characteristics of the bitumen have all combined to result in the dwelling wells remaining uncontaminated as of July 2008.

The original contamination by the bitumen was via an old well that was located approximately 40 metres north east of the original dwellings and 15 metres north of the existing depression (Figure 1). This well was then disused by the local people. This well could not be sampled in July 2008, as it has been back-filled. Anecdotal evidence collected through discussions with residents indicates this well was back-filled with bitumen waste.

Contamination entering the water table in this location considering the most likely movement direction of the groundwater (east and north east) would have migrated away from the existing leaf houses and the wells now being used (Figure 1).

Fortunately PAHs do not dissolve easily from bitumen. While limited data is available for estimating the potential for PAH release to water from these materials, there are reports that concentrations can reach 10 ppb with optimum leaching conditions[1]. Maximum Contaminant Level Goals based solely on possible health risks and exposure, has been set at 0.2 ppb for public water systems by the USEPA.

The recent construction of a new cement block house and the pushing of the bitumen into the sea and the groundwater depression may have the effect of increasing the potential for contamination of the groundwater in a location, which could affect at least one of the village house wells as the depression is directly east of this house (Figure 1).

PAHs are moderately persistent in the environment and if released to water will adsorb very strongly onto sediments and particulate matter. The organic content of the water in the depression and the filtering potential of the coral sand surrounding the wells are likely to result in a remediation effect on any PAH contamination of the dwelling wells in the short term. However, if the source of the contamination, the bitumen, remains then eventually the remediation effects will diminish, through saturation of the organic content and the coral sand, and contamination of the wells is likely to occur. The chronic health effects of long-term exposure to low concentrations of PAHs are not well understood but in high concentrations they are carcinogenic.

Some PAHs bio-accumulate in the aquatic food chain and have been reported in plankton, oysters and some fish. The recent pushing of much of the bitumen into the sea has resulted in an additional environmental risk of contamination of the aquatic food chain, a resource of particular importance to Kiribati.

5 Recommendations

The potential health implications of the bitumen spill, the contamination of the water table and the near shore zone of the sea cannot be quantified but a precautionary approach should be applied and the source of the contamination should be contained and managed.

Eliminating the potential source of contamination can be done effectively and cheaply to minimize the risk of environmental damage and potential impacts on human health. A method for this risk minimization has been detailed in Section 4 of the report.

6 References

USEPA Consumer fact sheet on: Benzo(a)pyrene

http://www.epa.gov/OGWDW/contaminants/dw_contamfs/benzopyr.html

Yours sincerely
GHD Pty Ltd

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Tarawa Airstrip Site: Water Sample Locations and Site Detail

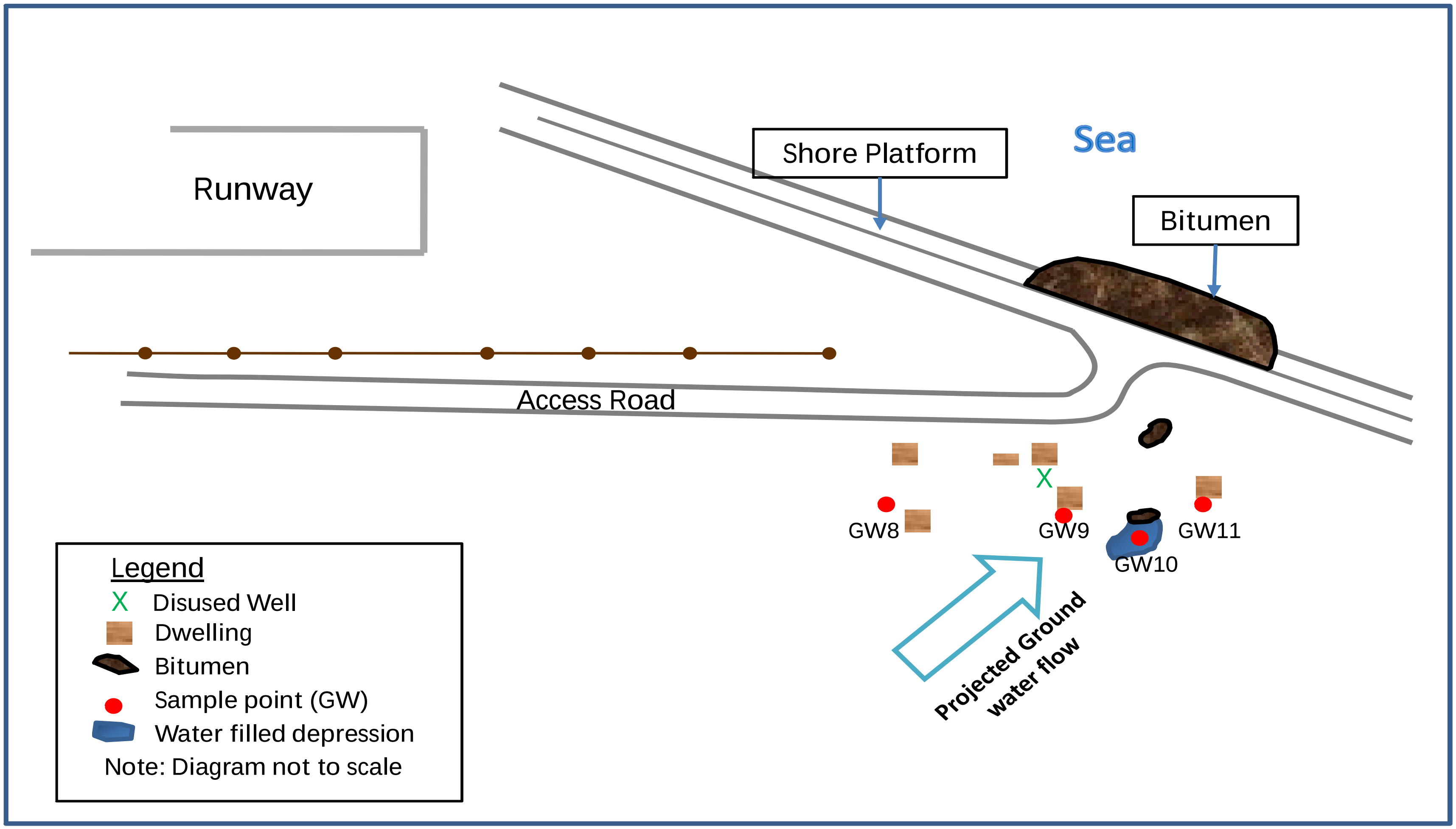


Figure 1: Tarawa Airstrip Bitumen and Community Infrastructure Location

Plate 1: Location of Bitumen 2006 - Tarawa Airstrip

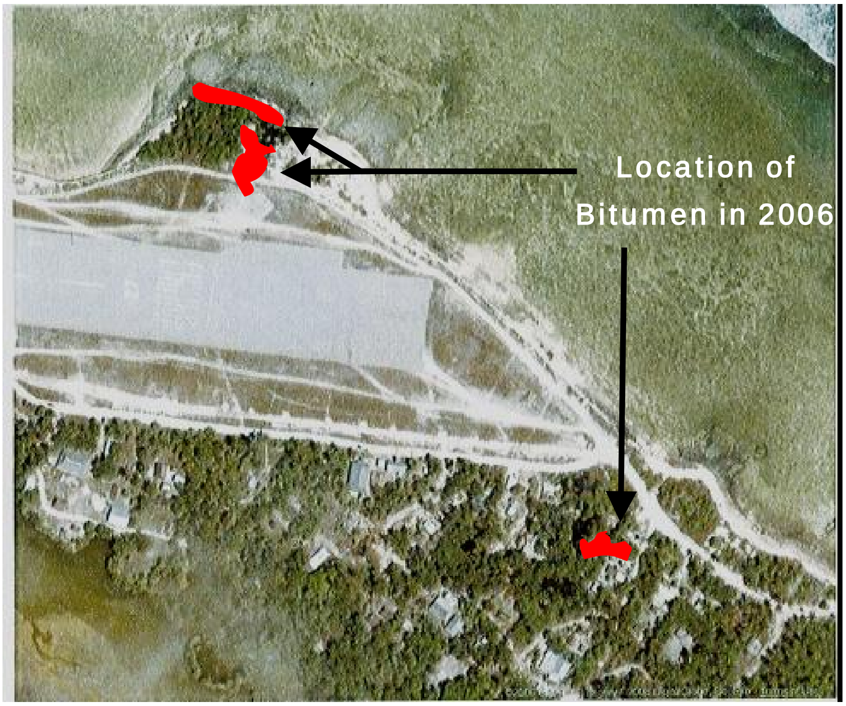
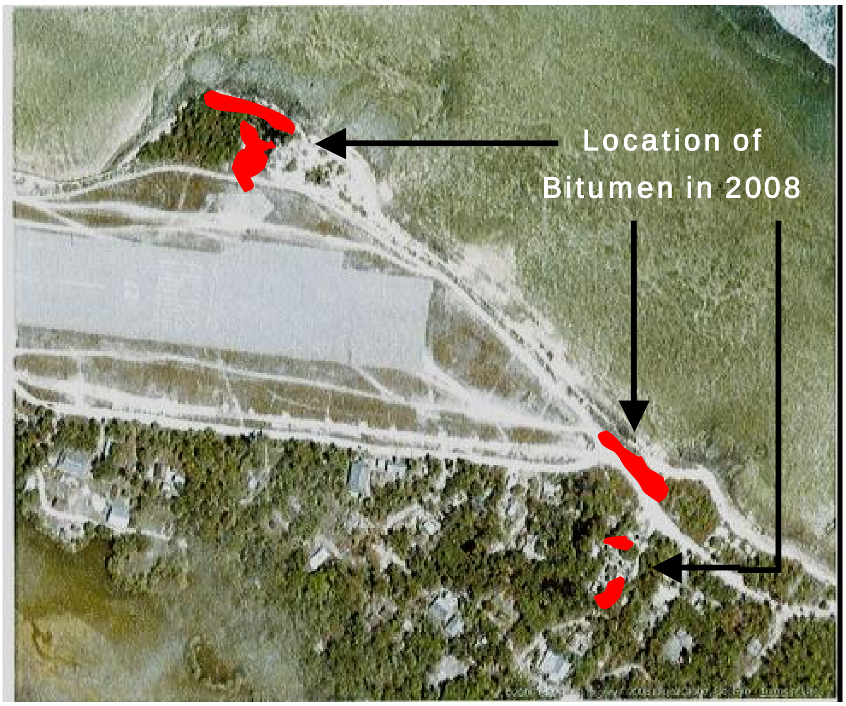


Plate 2: Location of Bitumen 2008 - Tarawa Airstrip



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