Solid Waste Management

Guideline

for

Pitcairn Island

June 2016

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1. Overview

Pitcairn Island is doing very well in its solid waste management (SWM) system given the size of the community, the remoteness, and the situation generally found in Pacific Islands of this size. As all Pacific Island communities have experienced over the last thirty years, the quantities of wastes today are far greater than in days gone by, and the need for more organisation to keep the wastes under control and properly managed is widely recognised, for both improved public health and environmental protection. This Guideline is for use by Pitcairn Islanders to help their ongoing efforts to improve waste management on the island, and provide practical steps that follow the aim of the current Strategic Development Plan. These steps can be implemented over time, as capacity and resources allow; there is no requirement in this guideline for any formal ordinance to be made, unless the community decides to do so, as community agreement should be sufficient to implement the recommended steps.

AIM

Improve solid waste management on Pitcairn to protect the island and its people.

OUTCOME

Good operating practises for both collection and landfilling of the island's wastes, and better management, or export, of hazardous wastes where possible.

1.1 Guiding Principals

Improvement

Development of existing collection and dumpsite system to follow the existing strategy and culture: ***Build on Existing Foundations****;*

Reuse

Useful materials in the waste stream are recovered and made available for anyone who can find a use for them: ***Use Existing Resources;***

Reduce

Less waste that needs to be collected and landfilled, and the waste that is landfilled squeezed into a smaller space than before: ***Improved Compaction at Landfill;***

Recycle

Anything that can be realistically exported for industrial processing for recycling into new products should be diverted from Pitcairn Dumpsite: ***Better Sustainability;***

Divert

Green waste, scrap metal, and materials suitable for local fuel are not ending up in landfill: ***No waste of resources;***

Public Health

Potentially toxic items and practises are minimised to reduce harm to the community, especially the children, and hazardous materials that can feasibly be exported from Pitcairn are removed from the island: ***Reduce Potential Public Health Hazard;***

Ease of Operation

Less effort, cost and cleaner to collect the household waste, and less effort, cost and cleaner to manage the landfill, plus improved safety of operations: ***Clean and Efficient System.***

2. Reuse, Reduce and Recycle

These Three Rs - Reuse, Reduce, Recycle - are the main approaches to improving waste management on Pitcairn. As Pitcairn has such a strong local tradition of re-using anything possible (one man's trash is another man's treasure!) the normal order of the Three Rs is changed to put Reuse at the top of the list of actions[1].

2.1 Reuse

Reuse is Number One on Pitcairn as the island has a strong culture of using anything that may possibly be useful, and that island way of life can be enhanced if potentially useful materials are easily available to anyone who might have a use for them. Things that might have been thrown away in other places are kept in back sheds as they may have a potential use. However, the person who saves a particular resource is not always the person who actually needs that resource; a 'Pick-A-Part' system where excess materials could be stockpiled - for example old building materials or dead Quad bikes - would improve community access to all available resources.

This reuse approach could done by having stockpiles set up around the dumpsite area, where excess materials are put, so others can go and look for things they need. For example, if someone has four dead Quad bikes in their backyard, they may feel they have more parts than they are likely to need, and might take two of the wrecks up to the Quad bike dump area, and free up some space in their back yards. They still have access to those parts, but others now also have access, without having to go and ask around. This system could also work for old building timbers, roofing iron, scrap metals, dead washing machines and fridges, etc.

Separate reuse sites are best defined (and protected) from encroachment by the surrounding bush by old oil drums set around in a stockade, with a clearing cut initially, and then some sort of matting put down to discourage weed growth. This matting could be broken one-tonne bags, torn tarps, mulch or whatever comes to hand; this will prevent the stockpile becoming buried under vines, which results in loosing valuable resources as one can no longer see what is in the stockpile.

Where stockpiles of things such as old Quad bike frames and building materials get excessive, these materials can often be used for infill areas to help stabilise low banks and fill until vegetation has a chance to grow and the soil a chance to settle[2].

2.2 Reduce

The dump pit (as of May 2016) is around 200 cubic metres (m^3) in volume, and is expected to last two years from first filling to completion[3]. This means that Pitcairn currently uses around 100m^3 per year of dump space. The waste is burnt regularly to reduce the amount, so more waste can fit in the pit.

The amount of waste that the collectors pick up is around 75kg per week. If another 75kg is thrown into the pit by private visits to the dump, then around 150kg per week might be dumped, or around 8 tonnes per year. In a normal small landfill, where a

[1] 'Reduce' would usually come first, but actual waste production per capita is already low at around 0.4 to 0.5kg/person/day (using a generous measure of production) and is probably nearer 0.3kg/p/d. This is significantly less than a typical New Zealander, for example, who would be expected to make 1kg or more per day.

[2] If engine blocks are reused for this type of application they should be drained of residual oils first.

[3] Currently about half full.

heavy machine drives around regularly over the waste to compact it, it is easy to get 500kg of waste into each cubic metre. So, in a normal small landfill, that 8 tonnes of waste should easily go into 16 to $20m^3$ of landfill space per year. If the existing pit was achieving normal compaction rates for a small landfill, it would be expected to last something like ten years. So even with the current burning of waste, actual compaction is very low. The result is increased effort to dig holes (about ten times as much digging as ought to be required) and spreading the polluting effect of dumpsite holes over a much large part of the island as the years go by.

2.3 Recycle

Due to the remoteness of Pitcairn and the small quantities of waste produced, the potential to export recyclables is very small. However, an occasional mixed shipping container - perhaps one each year - could be exported to New Zealand. This might contain aluminium cans crushed into small blocks, old lead-acid batteries, some electronic wastes -such as dead laptops and routers, plus maybe even crushed PET bottles. The possibility of export will be entirely dependant on the agreement of the New Zealand government to provide a Basel Permit for any hazardous materials, and a New Zealand recycling company who is prepared to take such small quantities of waste.

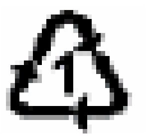
The value of the recyclable materials exported might be similar to the cost for a recycler to collect them with a truck from the Shuttle Express depot in Auckland, given that some materials have some market value (aluminium cans and lead-acid batteries), whilst others have very little (PET and electronics). But by making up a mixed shipment, there may be enough value in the whole shipment to be of interest to a recycling company in NZ[4].

Aluminium Cans

These soft drink and beer cans could be collected by a twice monthly household recycle collection which would operate along with the regular bag collection. Around 200kg of aluminium cans are potentially available per year; these will require about one half hour per month to crush, if a baler such as the mini-baler (see Appendix II) is used.

PET Bottles

These are the soft drink and juice bottles marked with a Number 1 symbol on the bottom as thus:



These bottles make a 'crack' sound when squeezed and let go. The tops are made of a different plastic, and should be thrown away (into the landfill waste stream) and the bottles can be crushed using the can baler. (The baler will need cycling several times if used for bottles, and a few added on each cycle to maximise compaction.) They are hard to squash well - they tend to spring back over time - but exporting them will save quite a lot of landfill space over the years because of this property. There will only be about 80 - 100 kg of PET on Pitcairn each year (around 2,500 bottles), and as PET is made from oil this quantity has very low value with 2016 oil prices, of perhaps $20/year.

[4] These possibilities are currently being investigated.

Lead-Acid Batteries

These are the batteries that are used in Quad bikes, the tractors and other heavy machines, as well as the 12 Volt batteries that run household light systems for when the generator is off. These batteries have lead plates that are flooded by sulphuric acid. Batteries that are no longer any use are called Used Lead-Acid Batteries (ULAB); and these are will be the largest single toxic waste on the island. Lead is a neurotoxin that causes brain damage, particularly to young, growing bodies, so it is really important to keep lead away from the children. Lead was removed from petrol in the 1980s because it had become very clear that entire generations of children growing up in cities were being poisoned every day by breathing in lead from the air. (See also Appendix I.)

Fortunately, ULABs are easy to recycle (usually in the same plants that make new batteries) and have a reasonable value - a typical car battery in Auckland would make $10 at a scrap yard. If ULABs are collected from Pitcairn two important things can be achieved: getting rid of a toxic pollutant, and adding enough value to a shipment of recyclables that it is worth a recycling company taking a truck to Shuttle Express to unload the container and take the recyclables away.

There are probably around thirty ULABs generated each year on Pitcairn. But if we assume that this is the rate for the last ten years, then there may already be 2-300 ULAB lying around the island[5] that could be recovered without too much effort.

Appendix III provides some information about lead-acid batteries that may help people get more life from the batteries, so reducing waste. It would be better if batteries bought onto Pitcairn were sealed type batteries (NOT 'low-maintenance' type) as these are cleaner to handle than wet cell batteries, but wet-cell batteries can be longest lived batteries if well used and well cared for.

Electronics

Waste electronic equipment is called e-waste and can contain toxic chemicals bound up in circuit boards and electrical components. Items such as desktop computers, laptops, routers, chargers, power supplies and even flat screens can be exported from Pitcairn as part of a mixed load of recyclable materials for processing overseas. These may be partially dismantled, and then put through industrial shredders in factories in Asia, and the precious metals recovered and fed straight back into the Asian electronics factories. Quantities on Pitcairn will be very small, but if e-waste is thrown into the dump, it will slowly degrade and release some toxic chemicals into the environment, toxics Pitcairn could comfortably do without. Recycling electronics also decreases the demands for mining, which can be very destructive to small communities around the world as such mining usually takes place in remote places.

Glass Bottles

Glass is made from sand, and so quite inert and non-toxic. Its market value is very low, and it is heavy and difficult to handle, and there is no point in trying to export it for industrial recycling. It is very useful stuff, and has lots of re-use potential on Pitcairn, from the high-grade use as a material for fine craftwork through melting glass for jewellery and glass blowing, through use for wall building and concrete supplement, to simply crushing the bottles and using them as road metal substitute.

[5] As a comparison, when Kosrae Island in the Federated States of Micronesia started paying $3 for a ULAB, 2,200 ULAB were collected in two weeks from households: around 1,000 people, with the number of vehicles per head be at least one tenth of that on Pitcairn had a ULAB rate of 2.2 per household - and that was just what showed up in the first two weeks of the project!

The glass can be piled up in one spot, contained within a stockade of old oil drums (measures taken as described above to keep the weeds down) so that those artists who might want particular bottles and colours can pick through the pile and get what they need; those who want to build walls can sort out bottles of similar sizes to assist construction; and where an excess builds up, the reject bottles can be spread onto boggy parts of the dumpsite roads, crushed with a bulldozer or loader, and used to firm up the road surfaces very effectively, a common practise in landfills around the region.

3. Garbage Collection System

The Rubbish Collection on Pitcairn is weekly, which is very good. Household size is generally small, so most households probably produce a bag of rubbish every two weeks or so. The Quad bike and trailer used currently are just about big enough to handle a normal week (typically 12-15 bags), but a big week of around 20 bags requires several bags to be stacked up on the quad bike towing the trailer. Also, due to difficulty turning around with a trailer, the collector must bring bags to a central point before loading the trailer and heading to dumpsite, collecting other bags along the way. This consolidation process adds time and distance to the collection system - admittedly small on a weekly basis, but significant over the year.

A larger ATV with a carry deck of about $2m^2$ and removable wire cage sides would be able to carry 20 bags easily, and so leave the driver freer to drive and pick-up bags (see Appendix II). Such an ATV could also be used to haul excess building materials, old Quad bike wrecks, roofing iron etc. to the Pitcairn Pick-A-Part area of reusable materials.

Some households put out waste in drums, which requires the collector to tip the household drum into a drum that is carried on the Quad trailer. As drums are awkward to handle, can be heavy, and require the collection vehicle to carry an extra drum simply to meet certain households' practise, it would be preferable if all households would use a garbage bag system. This make the collectors job physically much easier, is much cleaner for the collector, and the households who wish to continue using a drum can simply put a bag inside their drums as a liner, so that the collector simply needs to lift the bag out of the drum.

The current allowance of 10 hours per month for collection time is consistent with the time required to collect and dump the waste monthly if the Collector did not have to consolidate bags of rubbish in Adamstown before heading up the hill.

4. Materials Recovery Facility and Landfill Site

The Pitcairn Islands Strategic Development Plan[6] calls for a building to facilitate waste management. This would provide the centrepiece of a Materials Recovery Facility (an MRF - commonly called a 'Murf') and be central to continuing the Islands' longstanding culture of reusing any available resources from the waste stream.

[6] Goal Three: Environmental Management; Strategy 2: Waste Management

The existing pit dumpsite can be converted to a Controlled Dumpsite system which applies landfill techniques to the operation; this improved version will be described as 'landfill' from now on[7], using the term 'dumpsite' for the old burn-and-bury approach. The MRF building, stockpiles of reusable materials, and the landfill pit can be placed in the same area of White Cow Pen in Aute Valley. This arrangement would put all the SWM facilities in the same area, and ensure that when recyclable and reusable materials are bought into the MRF area, any parts that are only suitable for landfilling can be immediately dumped rather than creating an additional - if perhaps unintentional - dumping area.

The creation of a MRF alongside a landfill area would give Pitcairn a 'best practise' approach to its waste management, and something that would provide a valuable case study for small Pacific Island communities in the future.

4.1 Existing Dumpsite

Current practise is to dump waste into a pit, and the islanders have access to the dumpsite to throw anything in at anytime. The pit is deep, and whilst the edge protection is sufficient to stop a Quad bike rolling in, it would be fairly easy for a person to fall in. The waste is burnt, generally weekly: the purpose of burning the waste is to decrease the quantity of waste, so that the pit takes longer to fill up, and so less effort is expended on constantly having to dig new pits. What is thrown into the pit is uncontrolled, and sometimes explosive materials find their way in[8]. These factors mean that the current dumpsite is termed an 'Uncontrolled Dumpsite'. It would be fairly easy to lift the standards of operation to a level consistent with a 'Controlled Dumpsite', which would be appropriate for a community of this size. This would make the dumpsite safer for collectors and the public, and significantly reduce the pollution and public health impacts of the existing system.

Compaction at the Dumpsite

Observation and calculation indicate that the effective compaction rate achieved by the current method is 7 - 8 tonnes per year into around 100 cubic meters (m^3), or a rate of around 140kg/m^3; this is largely because of voids that exist within the pit caused by bulky waste items such as scrap metals, consumer goods, and un-burnt green waste materials significantly decreasing density.

Pitcairn is fortunate in having access to heavy machines eminently suitable for compaction of a small dumpsite, primarily a wheel loader and tracked bulldozer. A small bulldozer can achieve a reasonable level of compaction, but as it is designed to spread its weight, struggles to get much more than 500kg/m^3 (that is, one tonne of waste to two cubic metres of landfill space). A wheel loader can get over 600kg/m^3 without too much effort, but the waste must be clear of scrap metals unless the loader has Rock Tyres, or foam-filled tyres, that will not puncture. To achieve these figures (which would mean the existing pit would last over ten years instead of two), the landfill needs to be large and shallow, no more than 2.5 metres or so deep. The machine needs to be able to drive into the pit easily, spread the waste around into a thin layer, and drive around and around on the waste to compact it. A landfill area of 15 m x 15m x 2.5m deep would contain 550m^3 of space, which at 8 tonnes per year, and 500kg/m^3, would provide enough landfill space for over 30 years. Whilst it is not possible - or advisable - to predict waste generation on the island in 20 or 30 years

[7] Technically, a 'Sanitary Landfill' is the name for a fully controlled, lined operation that is treating water and leachate to a high standard, such as typical in New Zealand.
[8] With dramatic results: Pers.Comm. Turi Griffiths, waste collector.

time, the point is that one small landfill facility could be sufficient for many years of waste dumping. The existing pit has a surface are of $35m^2$, and a 15m x 15m landfill would have a surface area of $225m^2$, taking up only six and half times more land area. The big differenced is that a heavy machine cannot work a small pit to keep compacting the waste, but a larger shallower pit could have machine access, and allow regular compaction runs (once a month would probably do fine) where the machine spreads the dumped waste and then drives around over the waste, to pack it down solidly.

Compaction is greatly assisted by the use of cover material; this helps to provide stability to the waste, working its way into the gaps in the waste, but it also acts to prevent light waste blowing out of the dumpsite. As Pitcairn has virtually no food waste going to dumpsite, cover can be applied less frequently; cover material can be taken from the piles of earth around the pit which are acting as bund walls: spreading some earth around over the waste from a loader bucket can be very effective in providing a nice compaction surface. This also can help firm up areas if an internal road-way needs it for some reason. After the dump is finally full, a layer of about 300mm (1 foot) of earth can be spread over the top and compacted down, to give a gently domed effect, encouraging rainwater to run off rather than into the waste below.

4.2 New Landfill Design

The landfill needs to fill several parameters, but if those are met, then the actual shape, size and location of the landfill can best be decided by Pitcairn Operations Division as the available machinery capacity will be a significant design input. The parameters that need to be met are:

- The site should be on a gently sloping grade, so that water coming down hill from above can be diverted around the dump, and access is easier on the downhill side;
- The surface area must be large enough that the machines to be used can move around on top of the waste easily without too much awkward manoeuvring;
- The depth is deep enough to create a sizable volume, but not so deep as to make entry and exit steep for machinery;
- The 'overburden' material to be dug out can be easily placed around the edges of the pit to provide bund walls to keep water out;
- The uphill side of the pit can be rounded in an arc to make it easier to direct external water around the pit head;
- The walls should be 'battered' back from the floor, so that vertical walls are minimised to prevent walls collapsing into the pit;
- Access roading is not through a wet area if possible (as this will require extra works to firm up the road);
- Gardens, or fruit crops, should not be planted downhill of the dumpsite;
- Existing trees should be left where possible so as to provide shelter to the side and prevent a windblown rubbish problem.

If the local trees cannot provide sufficient shelter and windblown rubbish is found to be a problem from a shallower site, a low chain link fence - or similar - will be sufficient to catch rubbish that blows out of the pit. Figure 1 provides a schematic plan view of the landfill; actual shape will be determined by the local topology and surrounding trees.

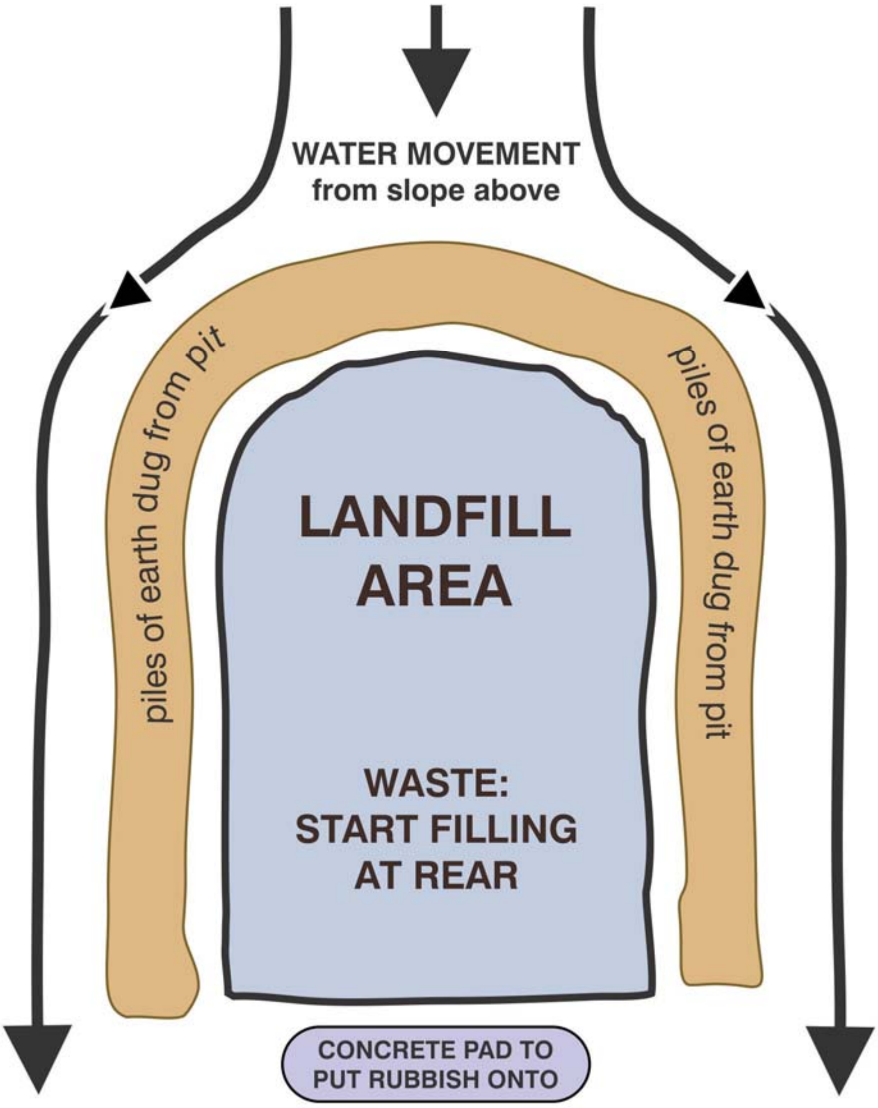


Figure 1: Landfill schematic showing key design points and surface water diversion.

Access to the Landfill

An ideal approach would be to build a concrete pad at the top of the landfill entranceway, so that rubbish can be dumped onto the pad. This will make it easy for the community to take wastes to the landfill at any time, but avoid any possibility of damaging Quad bikes by driving them into the landfill and across the waste (highly likely to cause punctures if this is done); this also avoids the collectors having to enter the landfill to dump bags of collected waste. The waste dumped onto the concrete pad can then be easily scooped up by the loader bucket, or pushed by the bulldozer, into the area of the landfill that is currently being worked, called the tipping face. This approach also allows some control of wastes going into the landfill proper, so that if scrap metal - or other items that are best kept out such as old oil drums and televisions - are dumped, the machine operator has a chance to pull them out before they get in the landfill, cause damage to the machine, and cause much extra time and effort to sort out. This also means that if someone is unsure where some item of waste is meant to best go, they can put it on the pad, and the waste collector and/or machine operator can decide what to do about it. A concrete pad is not essential; a good spread of road metal would probably do, but if left just as earth this area may end up getting boggy, encouraging wastes to be dumped further away from the dump.

Burning Waste

Burning dumpsites to reduce volume is very common in the Pacific Islands[9], but is no longer considered an acceptable practise from a public health and safety standpoint (see also Appendix I). The New Zealand Ministry of Environment has a Guidebook to fires on landfills[10] and it gives some detail about the public health problems caused from the toxic chemicals that result from burning landfill; it states:

Where fires burn quantities of flammable organic materials, such as tyres or plastics, temperatures may be very high in the burning zone. Combustion of the volatiles will not be complete, however, because of insufficient oxygen. High temperatures can break down volatile compounds, resulting in ***the emission of dense black smoke****. Contaminants released are likely to include* ***carcinogens*** *such as polyaromatic hydrocarbons (PAHs),* ***dioxins, furans and volatilised heavy metals.*** *If plastics containing chlorine, such as PVC, are involved,* ***acidic hydrogen chloride*** *will also be discharged.*(Emphasis added.)

Burning landfills to reduce waste is illegal in New Zealand, and, as demonstrated above, does not achieve the primary aim of waste reduction that can be achieved safely through compaction with a heavy machine. It is particularly unsafe for those who must continually deal with the waste, such as collectors. (Burning plastics in household fires can produce similar toxic chemicals.)

4.3 Water Control and Drainage around the Landfill

Leachate is the blackish 'soup' that can often be found dribbling out of dumpsites; it is caused by water running through the waste, and carrying away pollution into the wider environment. Control of rain water run-off is a key concern to stop dumpsite leachate taking pollutants away from the dump and into local water systems.

With the landfill design outlined above, and shown in schematic at Figure 1, the aim is to get surface water that runs down the hillside to run **around** the dump rather than **through** it. This can be achieved by care in choosing a site for the landfill pit, by putting it on a gently sloping area that naturally drains off to a steeper slope, and then building up the earth extracted from digging the landfill to form bund 'walls' around the pit, that will divert the water coming from higher up the slope around the landfill pit. By keeping the landfill away from gully areas, water running into the site from above is minimised.

Rain that falls directly into the landfill cannot be kept out; the main thing in this case is to ensure that no gardens or fruit trees are planted 'downstream' so that any water draining out of the site will not contaminate food. The existing dumpsite pit on Pitcairn was observed to be well drained even after a day of heavy rain, indicating that soil in the dumpsite area drains well, even at a depth much greater than that required for the landfill design above.

The area where a new landfill might be put can be seen on the aerial photo below - Figure 2 - perhaps fifty metres or so uphill from the current pit:

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[9] As it was also in rural NZ dumpsites, until made illegal.

[10] Landfill Guidelines: Hazards of Burning at Landfills, 1997, NZ Ministry of Environment

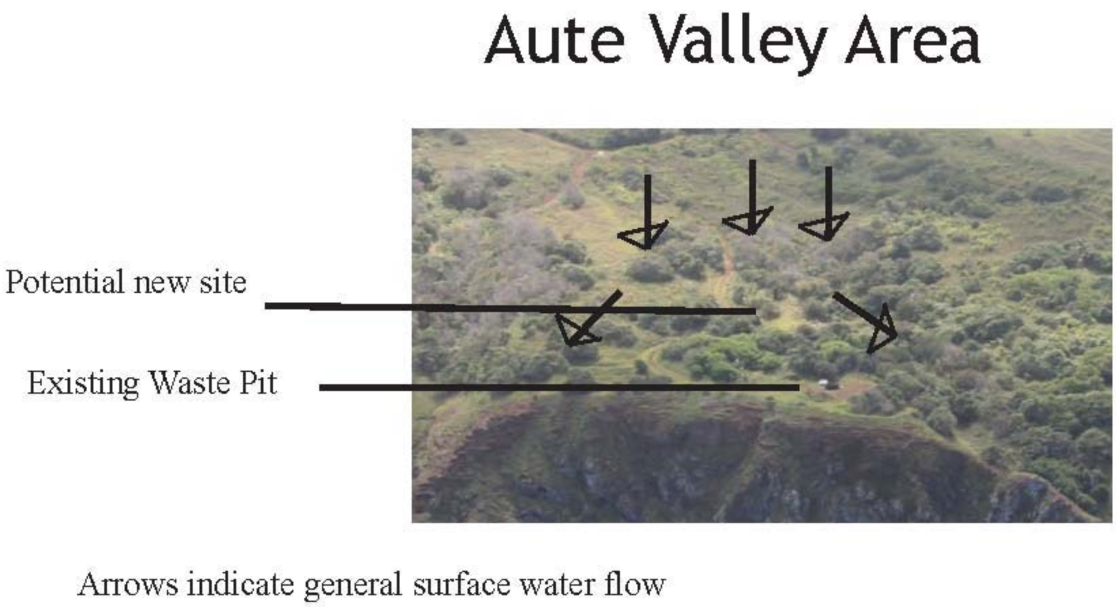


Figure 2: Aerial view of Aute Valley and the White Cow Pen locality, showing light slope and side gullies and indicating suitable area for the new landfill.

Actual siting of the dump must be decided by the PIC and the Operations Division through observation of the on-site local conditions; this figure simply indicates a likely general area in which to look for the best site.

Landfill Monitoring
If the volume of airspace above the waste in the landfill is estimated once a year, this will give a useful measure of how well waste is being compacted, as well as some indication of when a new landfill pit will be required. This estimate can be crudely made, but will still be very useful, not only for Pitcairn Island Council planning purposes, but also to provide a case study for use by similar remote, small communities around the Pacific islands.

4.4 Materials Recovery Facility & Building

Having a building for the MRF - or 'Murf' - at the dumpsite provides a place for a small baling machine for cans and PET bottles, a place to store ULABs (batteries), any electronics stockpiled for spares or awaiting export, and any site equipment that needs shelter.

The PIC Strategic Development Plan includes provision for a steel pre-fabricated building, and this would be an excellent approach. Use of colour-bond (powder coated) materials will greatly add to life expectancy of such a shed in an exposed location such as Aute Valley, and will be well worth the extra initial cost. The shed can also be of a style that has some open bays, so that useful materials for reuse can be stored undercover, and so greatly prolong their useful life: for example old building timbers, roof iron, dead Quad bikes still with engines and many parts, white-goods with spare parts still intact, and perhaps building demolition materials such as window frames and doors.

A kit-set building of perhaps five bays that can combine some open bays with some closed with roller-doors (perhaps three closed and two open) could provide a simple option for procurement. Design can be to individual specification; in addition, a well chosen kit will allow additional lean-to sections to be built onto the side of the building

- possibly out of reusable materials from the stockpiles - to provide more cover for materials that need shelter to maximise their potential for reuse.

Electric power for a 1.5 kW baler and power tools can be supplied from one of several portable gensets that are on-island under the control of the Operations Division. A unit around 5 - 6 kVA will provide sufficient power for the baler example, as shown in Appendix II, and this can be based in the MRF shed.

Shelving inside the MRF shed - or even a mezzanine floor - can greatly increase the capacity of such a shed to hold items from the waste stream that may find a home - or be a source of spare parts - in the future. Electrical items and commonly used Quad bike parts can possibly be stripped out of wrecked items and stored in the MRF shed.

4.5 Handling and Storing Recyclable and Other Wastes

Pitcairn has at least fifty 1,000 litre plastic fuel tanks (inside metal frames) on-island that are no longer used for diesel fuel transfer from the supply ship. These can be used to hold recyclable materials to be shipped off, or store any hazardous waste materials prior to disposal in a hazardous waste cell (see below). The plastic top should be cut open to allow easy access, and then materials placed inside. The entire unit is easy to handle with a forklift.

These 1,000 litre containers will be excellent for packing and shipping ULABs, with cardboard placed into the floor of the container, and then at least three layers of thick cardboard placed between each layer of batteries. A maximum of sixty ULAB should be placed into a container, so as to keep the weight under one tonne. These containers can also be used for crushed aluminium can blocks, PET bales, and electronic equipment that is to be exported. These containers should be kept under cover while awaiting export so as to avoid filling with rain water. It is essential that no plant material - or insects, lizards etc. - get into the containers and take up residence or else there will be great difficulties, and expense, at the New Zealand end when the NZ Quarantine Officers check the shipment.

4.6 Hazardous Wastes at the Landfill

Hazardous wastes are always a challenge, but the positive side of the Pitcairn situation is that they can be expected to be few. Lead-acid batteries are the most common hazardous waste, and have been dealt with above. Liquid chemicals are usually all used by the original purchaser, so it is empty containers that may need a little care (just as when new and full). Pesticides are the most common liquid hazardous waste, and the ideal on a small island such as Pitcairn is to avoid importing them altogether if possible.

Cathode Ray Tubes and CFL lamps

Old televisions and computer monitors of the cathode ray tube (CRT) type pose a potential hazard if they are present, but the best option is to avoid breaking them if possible, after stripping the glass tube out of the rest of the unit. This glass tube would then be buried - as described below - as exporting it will not likely be feasible. CFL (energy saving) and florescent strip lamps contain small amounts of mercury vapour, and these lamps should be placed into the same hazardous waste cell as the CRTs. The lamps found in scanners and photocopiers also contain mercury valour, and ideally, the lamps should be stripped out of the units and the lamp only dumped, although this may not be feasible. It may be that these lamps can be exported as part of a recycling shipment to New Zealand along with waste electronics.

Waste Oil

Waste oil on Pitcairn is currently all used, for lighting fires or other uses. It may be that over time, an excess builds up. This should be kept in one of the 1,000 litre contains - as currently - and this may be able to be exported as part of a recyclables shipment on occasion. Waste oil can be used to treat old building timbers, such as used for simple sheds, but care must be taken when doing this to use gloves, and it should not be used for houses where spaces are confined and the vapour breathed constantly.

Hazardous Waste Cell

It is best to dedicate a single small cell at the dumpsite to hazardous wastes, and place this cell in a position such that it is in a very well drained position, protected from surface water, and not subject to run-off or possible leaching into nearby water systems. Position needs to be determined on site, but could be at the 'up-stream' end of the landfill, so that any leachate from the hazardous waste cell was actually running out into the main dumpsite area. Such a cell would hold things such as old medicines, old chemical containers and CRT TV tubes. This cell could be a simple pit that is perhaps 3m x 3m but 5 or 6m deep (as geology allows) and fenced off so that the public is clearly kept out of the cell. Regular cover with soil is advisable. Hazardous materials suitable for this cell could be stored in the MRF shed and then placed into the cell in a group and covered, for example once every three months.

5. Green Wastes

No green waste should be taken to the dumpsite and placed with inorganic (man-made) wastes if at all possible. If a greenwaste dumping area is desired (in that people are unable to deal with this near their own houses), then this should be separate from the dumping of other wastes. Greenwaste is a valuable resource, and if gardens and surrounds do not allow sufficient space for nature to do its work, then any chipping of greenwaste should be done separate to inorganic (landfill) waste. If greenwaste is added to the dumpsite, during the decomposition this tends to encourage acidic leachate which is not helpful in containing potential contaminants. Acidic leachates tend to help mobilise heavy metals into the surrounding environmental waters.

A green waste site might be better located nearer to the gardens where the chipped material can be used: it makes little sense to carry green waste over hill to Aute Valley to chip it, only to carry it all the way back again later.

6. Recommendations

From the above plan, the following simple recommendations result:

- Collect household waste in bags; if drums are used, put a bag in the drum for ease of emptying;
- Procure an ATV with a flat bed of around $2m^2$ that can carry 20 garbage bags of waste with ease to avoid having to consolidate bags in one place, and put removable mesh side on the ATV to give capacity to carry smaller scrap metals and building materials;
- Twice monthly recycling collection of Used Lead-Acid Batteries (ULABs), glass bottles, aluminium cans, and PET bottles (if export proves feasible);
- Procure a baler to crush aluminium cans and PET bottles for export;
- Pack ULABs and old electronics into modified 1,000 litre containers for export if feasible;
- Dig a new, shallower but larger, landfill pit as described, with bunds to keep surface water out;
- Build a concrete slab at the entrance to the pit for rubbish to be dumped on;
- Only the loader or bulldozer pushes waste into the landfill;
- Compact the landfill at least monthly with the loader or bulldozer;
- Cover landfill wastes with soil occasionally to firm up ground and cut down windblown litter;
- Cease burning of landfill waste;
- Set up an MRF area with a shed and stockades of useful materials;
- Pile up glass bottles in a stockade of old oil drums, for artisanal use, building projects, or to be crushed for road metal substitute;
- Build a shed with closed areas for equipment, and storage of ULABS, e-waste, and other recyclables, plus open covered areas for reusable building materials, vehicle parts and white goods spare parts - the 'Pitcairn Pick-A-Part';
- Waste Oil should continue to be stored in the 1,000 litre containers, and if an excess builds up this could possibly be exported to New Zealand;
- Exports of ULAB, e-waste and waste oils will require a Basel permit, and this would best be done if PIO was to act as both exporter from Pitcairn and importer into NZ.

Appendix I: Details of Toxic Hazards **That may be found on Pitcairn Island from wastes**

1. Lead-Acid Batteries

Lead-acid batteries contain sulphuric acid and large amounts of lead. The acid is extremely corrosive and also a good carrier for soluble lead and lead metal as metal particles. If the acid leaks onto the ground, it may contaminate the soil which will become a source of lead dust as it dries out and the lead becomes incorporated into soil particles that may be blown by wind or into nearby waters. Lead is a highly toxic metal that produces a range of adverse health effects, particularly in young children. Exposure to excessive levels of lead can cause brain damage; affect a child's growth; damage kidneys; impair hearing; cause vomiting, headaches, and appetite loss; and cause learning and behavioural problems. In adults, elevated lead levels can increase blood pressure and can cause digestive problems, kidney damage, nerve disorders, sleep problems, muscle and joint pains. Unborn children, infants, and growing children are especially vulnerable to lead exposure compared with adults, since lead is more easily absorbed into growing bodies. Also, the tissues of small children are more sensitive to the damaging effects of lead.

Lead recovery is practiced at a domestic level in some Pacific Island Countries. for making fishing sinkers and weights for diving belts. However, this practice is likely to be extremely harmful both to the people who do it and their families and children close by, and anyone who does this should be made aware they are likely to be slowly poisoning both themselves, their families, and the local environment, and they should refrain from this activity for personal and public health reasons.

2. Landfill Burning

Main pollutants of concern:
Although there are many harmful pollutants produced in a landfill fire[11] the pollutants of most concern are:

- particulates;
- carbon monoxide;
- acrolein; and
- formaldehyde.

Particulates
Smoke consists of the products of the incomplete combustion of the fuel source. All particles exist in either an aerosol or solid form at normal temperatures. The characteristics of smoke particles are influenced by the fuel being burned, and the characteristics of the fire. It is often difficult to separate the effects of particles from gases that may also be present. Exposure to smoke particles can, however, reduce the ability to breathe, and reduce resistance to disease. Existing respiratory conditions may also be aggravated. Those with a greater pulmonary sensitivity, for example asthmatics, may show a much greater reduction in lung function than others.

Other pollutants
The following pollutants may also be present in emissions from burning:

- ammonia;
- benzo-pyrene;

[11] The information in this section is extracted from: Landfill Guidelines: Hazards of Burning at Landfills, 1997, NZ Ministry of Environment

- hydrogen bromide;
- hydrogen chloride;
- hydrogen cyanide;
- hydrogen fluoride;
- isocyanates;
- nitrogen oxides;
- phenol; and
- sulphur dioxide.

These are all toxic to humans in some way, depending on the concentration and exposure. They can result in irritation to the eyes, nose and throat, and skin, respiratory problems, and some are cancer causing (carcinogenic).

Health Effects
The toxicity of the products of refuse combustion is far more complex than the effects of exposure to a single chemical. It is difficult to assess the relative concentrations of different pollutants that are likely to be present in the emissions from a landfill fire, and there is also a possibility that the effects of some pollutants will increase the effects of others.

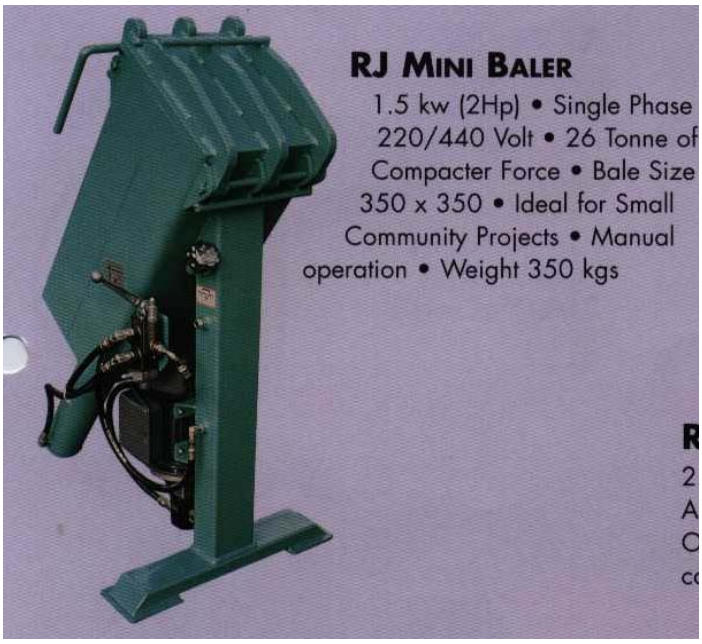
Toxic and Hazardous Wastes
In addition to the exposure to the products of incomplete combustion already discussed, other more toxic compounds may be present in the smoke plume. This can occur when hazardous or toxic substances are disposed of in the general landfill area. In the case of liquids, although the fire will burn some of the material, a proportion may be volatilised (evaporated) by the heat of the fire, and people downwind will be exposed. Such compounds can include pesticides, herbicides, or solvents. Similarly, any toxic solids, such as pesticides or herbicides in the form of powders will be carried into the plume by the action of the rising fire gases resulting in potential exposure of people downwind. Other potential adverse effects may arise from timber which has been treated with pentachlorophenol (used as a preservative until a few years ago). This can produce cancer causing (carcinogenic) dioxins when burned on an open fire. If the wood has come from an older house, which may have been painted with lead-based paints, some of the lead in the paint can vaporise and be present in the smoke. Those inhaling the smoke may absorb additional lead into their bodies.

Re-constituted wood products such as particle board, chip board, medium density fibreboard, and strand board will emit higher than normal quantities of formaldehyde, adding to the irritant effects discussed above. The practice of co-disposal of toxic and hazardous materials with other refuse increases the likelihood of exposure to toxic and hazardous compounds during a landfill fire. Even more inert material can cause potentially hazardous exposures. For example, asbestos is usually disposed of in specially marked plastic bags. If these bags are burned in a fire, asbestos fibre may become airborne and anyone exposed to the smoke plume may inhale the potentially carcinogenic fibres. Similarly, linoleum removed from old houses often contains asbestos, and creates the same potential hazard if burned. The products of incomplete combustion will include dioxins, furans and other potentially carcinogenic organic compounds. Although some of these compounds will be carried off into the atmosphere with the smoke plume, some will remain in the ash left behind after the fire has been extinguished or allowed to go out. These compounds may then find their way into ground water or other water courses, depending on how well leaching effects are minimised at the landfill.

Appendix II: Equipment Suitable for use on Pitcairn as part of Waste Collections

Small 4WD truck
(dog not included or essential).

Quad bike style option flatbed



Baling press suitable for crushing aluminium cans,
low power consumption: manufactured by Alert Engineering, Auckland.

Appendix III: Information regarding extending the life of lead-acid batteries

These notes are provided to assist Pitcairn Islanders to get the most life out of their back-up power system batteries.

A. Identifying batteries that may be able to be re-used

If the battery case looks good, and it still has acid in it, it may be possible to use that battery in small solar system or some similar application. A battery that may no longer start a car or truck may well be OK for a small outer island solar system to run a couple of lights and charge a cell phone when used with a solar panel. These batteries can be sold on again, and are worth looking out for.

If a battery looks good, and still has good levels of acid inside, then test it with a voltmeter. A 12 Volt lead acid battery in good condition would be expected to have a voltage of 12.8 to 12.5 when disconnected for a week or so. If it is above 12.5V, it is likely to be in very good shape. If it is much below 12.5V – say down to 12.1V or so, it may well just need topping up with distilled water and putting on a charger for a day or so to get more use out of it. If it shows a reading above 12V, then it is very probably still useful to someone, and it should be topped up with distilled water, charged and checked for use in a solar system.

If the voltage is between 11V and 12V, then put it on a charger for a day or so and then check the voltage to see if it is at 12.5V or above, and while it may not be useful for starting an engine, but may well be good enough for a solar system.

If it is between 10V and 11V when it comes in, then do the same, but it will almost certainly be only any good for a solar system. Below 10V and it probably will be not much use and only fit for recycling. Single 24V batteries are unusual as they are so big, 24V truck systems made up with 12V batteries. Solar batteries are often 6V, and so the figures are then half of those for a 12V battery. Some very large solar system batteries are 2V each, and it may be that in a set only some cells are bad. It may be possible to make a 12V set for solar out of a 24V set, for example. The table below gives some guide, but values will never be precise and will depend on the particular battery.

Typical Battery Voltages and Indication of Condition for Reuse or Recycling

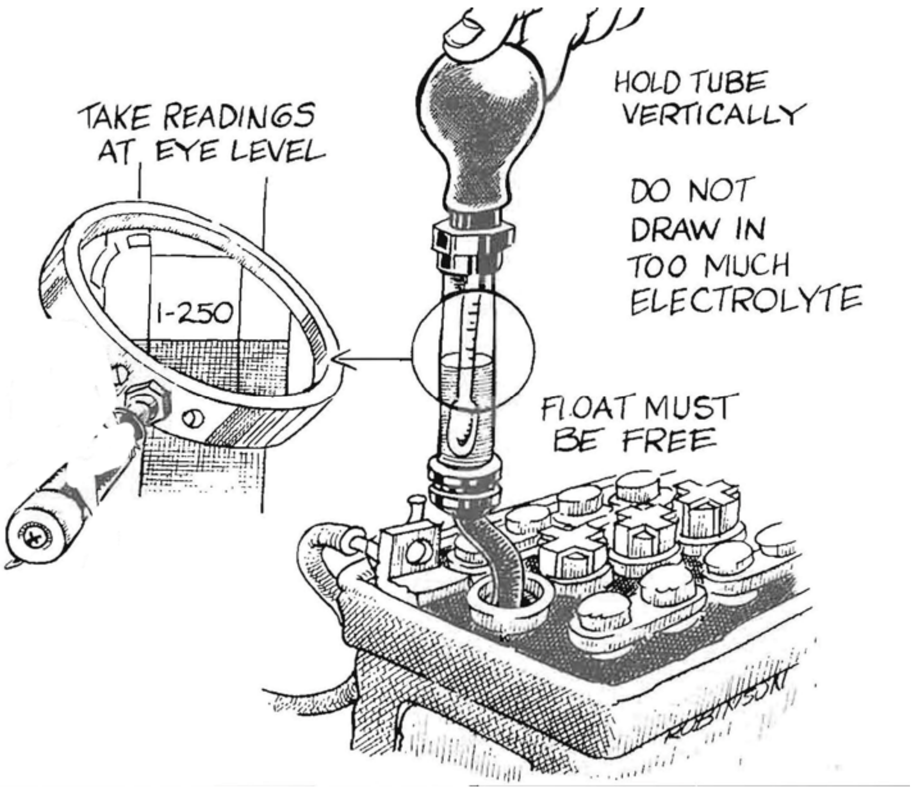
Nominal Battery Voltage	Good and healthy	Flat but still should be good with a recharge	Worth trying to recover with a good charge and use on a small solar system	Only likely fit for recycling
12 V	12.4 – 13V	11 – 12V	Around 10V	Under 10V
6 V	6.2 -6.6V	5.5 – 6V	Around 5V	Under 4.5V
2V	2.1 – 2.2V	1.85 – 2V	Around 1.6 - 1.8V	Under 1.5V

B. Testing a battery with a hydrometer

A test of the battery can also be made using battery Hydrometer. This is a glass tube with a float inside, and it measures the Specific Gravity (S.G.) or density of the battery acid. Less dense means that the acid is weak, and that much of the sulphate is attached to the plates, and this indicates a damaged battery. Batteries that are 'dead' are often called 'sulphated' which means that the sulphate part of the acid cannot go into solution in the acid and make the battery work. Higher densities of acid indicate that a battery is recoverable. See picture below of how to take a hydrometer reading.

A 'dead' and probably useless battery will show a Specific Gravity reading of 1.14 or lower. If it is showing 1.20 or so it is well worth trying to recharge it.

If a battery looks like it might be reusable, then put it onto a charger as soon as you can – see below. If a battery shows clear bulging of the case at the sides, it is probably not useable, unless it is a very big 2V cell.



How to take hydrometer readings of a battery

C. Battery recovery for re-use

Batteries that have a voltage of nearly 12V or above can be put straight on a charger and given 12 to 24 hours steady charge and then sold on for use in solar systems.

If a battery looks like it is down on its voltage reading (say 11V or lower, but above 10V) and the Specific Gravity (S.G.) is reading 1.15 or higher, then the battery may well have some use in a small household solar PV system. But 'flat' batteries (that is rundown and discharged) need to be carefully charged using a small current for quite a while if they are to come back to life and be useable. Use a battery charger that has a low output (under 3 A) to do this, and leave the battery on the charger for several days. A small solar panel (around 30W or less) connected directly to the battery can be useful for this too. This is called ‘trickle charging’ and it is much more likely to make an old battery re-usable than putting it on a big charger and pumping a lot of power into the battery for a few hours, when the battery will most likely get hot and die completely. Check the battery water regularly when the battery is on a charger as water will be used up faster than in normal use. Top up the battery with distilled water only – rain water can be used, but make sure it is clean and filtered from dust and insects, but distilled or de-ionised water is better as rain water is slightly acidic usually. Water needs to cover the plates well, but not right to the top of the battery case, always leave at least an inch (25mm) below the top.

Batteries should be filled with water so that at a minimum the plates are covered with liquid, and at a maximum to the **bottom** of the tubes that often stick down into the battery when the caps are removed. Never fill the battery right to the top, there should be water to about half the distance between the top of the plates and the top of the battery, unless there are marks to indicate otherwise, which should then be followed.

D. Notes on Charging Batteries

It is generally better to give batteries a longer time at a small charge than try and give them a big charge in a short time. An old battery is much more likely to come back to life after several days or a week or more of light charging than 6 hours of fast charging, in fact the big short charge may well completely kill it dead. Loosen battery caps right off (but leave sitting loose in their holes to keep dust out and spillages down) when charging so that gas build-up cannot cause the battery to explode.

Take care that batteries are charged in a well ventilated area, and that no smoking, open flames or sparks are allowed in the area. Never connect or disconnect a battery when the charger is switched on, as sparks that happen when the clamps go onto the terminals can ignite explosive gas from the batteries and cause explosions (it happens, and not that unusual!!). This results in acid exploding everywhere to add to the danger, with a great risk to both people and property. So:

- Connect up the charger to the battery, THEN
- Turn on at the switch or plug into the main AC socket.

Similarly,

- TURN OFF or unplug the charger at the main AC socket and THEN
- Disconnect from the battery.

Do not allow the battery to get hot when charging. If the battery becomes more than warm to touch, then disconnect the charger and let it cool for a few hours. Do not fill batteries right up to the top with water prior to charging, just make sure that there is plenty of coverage of plates inside, but still plenty of room below the top. Too much water often causes acid to spill out of the caps during charging as the acid bubbles. This is not only dangerous, but will also damage your charger leads and the battery terminals.