Compost Loo

Design no. 4 for Diploma in Applied Permaculture

by Nenya Milne

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This design uses the

Simplest Design Process (J. Chapman)*:

Design question: What is the best possible solution for all those involved?

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* https://nonstuff.co.uk/permaculture-3/the-simplest-design-process-e-book/

Brief:

Take a plunge (not literally ☺) with a compost toilet!

We have been meaning to for years but were not sure how to approach the task; James Chapman's compost loo (itself based on Jo Jenkins' *Humanure Handbook*) was an inspiration and the catalyst.

This project is about trying out the process for ourselves and seeing how we can tackle our own 'produce'.

We also need a second toilet (often a bottleneck in a household of 3) – and hopefully this will be the 1st choice of toilet for the family, so it needs to be comfy and pleasant to use, warm (= indoors) and not too laborious to maintain.

The compost loo is not replacing the mains plumbed toilet but will hopefully supersede it.

Budget: no strict limits; but wouldn't want to be too profligate without a good cause.

Broader considerations include the ethic of Earth Care and breaking the spiral of erosion leading to nutrient loss from soils and avoidable wasting of fossil fuels (see next slide).

Survey: A Spiral of Erosion

Before the project:

Flush away ‘waste’ and deprive soil of perfectly good nutrients

Buy compost and manure (= someone else’s poo!) to grow food

Lots of water is wasted on flushing;
Energy is wasted on transport and water purification;
Money is wasted on compost / manure which we could produce ourselves;
Soil fertility suffers (elsewhere as well as in the garden).

This is a prime example of Mollison’s dictum ‘**Waste is an unused resource**’.

Survey: Boundaries

Retrofitting the compost loo in a small house means we can have a ‘compost toilet’, where collecting the stuff happens separately from composting, but not an all-in-one ‘composting toilet’ with a composting chamber under the loo, which tends to be lower maintenance.

Separate design is required for:

(1) the collecting stage (the **loo** itself); and
(2) the **composting** stage.

(1) Possible **loo** locations:

- in the existing bathroom next to flushing loo: warm, but means still only one person can use the bathroom at a time, and it’s a trek downstairs with the full receptacles; or

- in a storage cupboard under the stairs: just about indoors (but cold in winter), next to the door leading into the back garden with its composting area; but the cupboard needs to be adapted (requiring some time and DIY).

(2) Limited space for **composting** in the garden: the garden was not designed with a view to composting large volumes, and with the existing layout there is no room for 2 or 3 DIY 1.5m^3 bins. But several smaller composters could be fitted in.

Ideas / research: Loo options

High tech (Biolan, Separett etc.):

Positives	Negatives
Sanitised look	Very expensive – upwards of £600
Low maintenance	Need plumbing for urine diversion or energy to evaporate urine or freeze poo

Low tech prefab (such as toilets marketed for narrowboats, caravans etc.)

Positives	Negatives
Compact	Expensive – upwards of £300
Look great	High maintenance (daily for urine compartment and weekly for poo)

DIY: separating

Positives	Negatives
Cheaper than prefab	Same issues with urine: daily emptying or plumbing

DIY: Jo Jenkins' non-separating 'lovable loos'

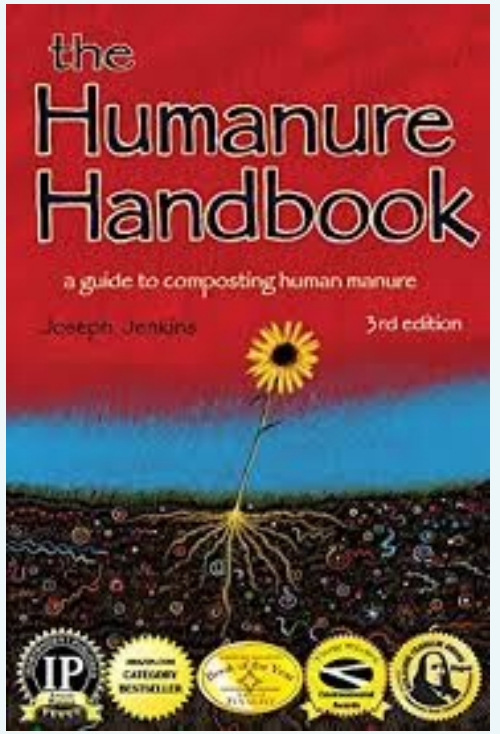
Positives	Negatives
Cheap to make	High maintenance but can be optimised with multiple buckets

Survey: Loo – Further Boundaries

We didn't want to have to use energy on the compost loo, so this ruled out some high-tech solutions that rely on ventilators for evaporating liquids, or on freezing the contents.

Most high-tech models and prefab low-tech loos are separating, and either plumb urine away or have a separate urine receptacle (5-6 l) – but we can't easily plumb anything from either the bathroom (no space for an extra loo by the external wall) or the understairs cupboard (which sits below the soil level), and we didn't fancy carting around large bottles of urine.

This leaves Jo Jenkins' system where pee and poo goes into a single bucket, dusted with sawdust or other C-rich absorbent cover material or 'soak', before being emptied into a composter.



These are normally DIY: the only non-separating prefab toilet is marketed by Good Gardeners Intl., and it's unclear how it's meant to be maintained (and it's also pricey for a bucket with a seat).

Our DIY skills are limited but could probably stretch to a box with a seat and a bucket, especially a square seat that requires no jigsawing. We don't have ready access to sawdust but having looked at other people's experiences, materials such as fine woodchip, shredded dry leaves etc. work well too.

Ideas / research: Composting

Hot composting is desirable for getting rid of any potential intestinal parasites in the finished compost. With cold composting, time can substitute for T – the cooler the process, the longer it takes to render humanure compost safe (see Jenkins' *Humanure Handbook*).

Jenkins' system involves a 2-bay 1.5m^3 DIY composter, insulated by something like straw, sitting over a mulch basin (filled with woodchip or saw dust) to catch any leachate. The new additions are placed into the middle of the pile and covered up with straw to stop smells and flies. The new material heats up the heart of the pile, and T tails off towards the edges.

There are commercial hot composters such as Hotbin and Aerobin, which are fully enclosed and promote aerobic hot composting. Their footprint is much smaller (60 cm^2) but the cost is quite high, upwards of £200 for a single bin.

After the hot composting, the compost needs to undergo a cool 'curing phase' to make it useable in the garden (to allow nitrifying bacteria to convert ammonium to nitrate).

Vermicomposting is often used for integrated composting toilets. Earthworms of different species (inc. brandling/tiger worms *Eisenia foetida*) have a selective action on microorganisms they ingest or simply come into contact with: their mucilage kills off pathogens (inc. *E. coli*) and even human parasites, but does not harm beneficial bacteria, fungi, protozoa etc. (Ingham and Rollins, *Adding Biology in Soil and Hydroponic Systems*, 2006, pp. 64-65)

Design: Loo and Composting

Since the whole compost loo business was so new for us, I decided to go with **Phased Implementation** as the design tool, to avoid putting a lot of effort and money into a project which might not succeed.

Phase 1: Test - see how the family takes to the practical side of using a compost toilet.

Loo: Camping compost loo, which can be used outside the project too (£16).
Cover material: hand-shredded garden waste that would otherwise be composted (free).
Composting: Hotbin (£200; will be useful whether or not the design project is successful).

Design: Phase 2

Since the 1.5-month trial went well, the 2nd phase was to design a more permanent solution:

Loo: A more robust custom-made non-separating 'loveable loo' using reclaimed wood, council food waste buckets (free, robust and with tightly sealable lids), old paint samples, and a square loo seat to accommodate limited DIY skills (£12).
Cover material: shredded garden waste (using a free 2nd-hand shredder, at the cost of £20 taxi fare home, solar-powered via PV).
Composting: 2 more Hotbins (£370), and one additional cool phase composter (£130).

Design: practical aspects

With 3 people using the loo, the buckets fill up every 2-4 days. 3 buckets last through the week. The buckets get rinsed with waterbutt rain water and cleaned using biodegradable detergent. Sun and air also help with disinfecting the buckets and keeping them fresh.

A 200-l Hotbin fills after 3-4 months of use; 3 Hotbins allow for a rotation where the contents stay in the bin for a minimum of 7 months. After that the shrunk contents are moved to a curing 'cool' bin, layered with extra greens for a T boost and corrugated shredded cardboard for aeration, to compost for another 8-12 months. The original cool bin was used for vermicomposting so worms help with the curing stage.

Shredded garden waste gets used as 'druff' (cover material) before being composted; a covered storage area by the back door is large enough to house a few bags of druff as well as the spare loo buckets (empty or full).

Hotbins sit over a 'mulch basin' – a small hollow filled with woodchip – to absorb any run-off and rinsing water from buckets. Paths between them are also mulched with woodchip to minimise any suspect material clinging to the soles of the shoes.

Finished humanure compost is used for mulching crops which are not eaten raw. The perennial vegetable planting had to be redesigned to avoid potential contamination by splashing from emptying or rinsing buckets and moving compost bin contents.

Design: The finished Compost Loo

The compost loo was initially placed in the bathroom, and later moved to the under-stairs cupboard right by the back door, once that had been adapted to its new function.

Survey: Accepting Feedback from the system

Hotbins perform best when new material is added frequently, so emptying buckets as soon as they are full works better than storing them until all fill up (as per Jenkins' advice) – unless when starting a new bin when several loads at once work best. Composting everything together (humanure, kitchen and garden waste) gives best Hotbin performance.

Moisture is necessary for composting, but compost does not heat up well if it is too wet. Some pee is good for activating the C-rich druff, but there was too much of it in our bins.

Although newer Hotbins have a leachate outlet (and I drilled holes into the bottoms of the earlier models), the perforated inner bottom of the compost bin sags to its base under the weight of the material inside, impairing aeration and stopping excess liquids draining away. Anaerobic environment helps preservation, not composting, so tweaking is required.

Once you stop adding material to the full Hotbin, it cools down. Worms (tiger/brandling) find a way in, effectively turning the cooling Hotbin into a vermicomposting bin. This process continues in the curing cool bin, when material is transferred together with the worms.

However careful we are about where our poo ends up, other creatures who treat the garden as their toilet (squirrels, cats, foxes) have no such qualms.

Druff sometimes starts composting and going mouldy in bags, especially if stored outdoors.

Design: Phase 3 - Tweaking

The basic design seems sound but tweaks are needed to optimise the system's performance.

Less pee in the non-separating compost toilet: encourage the males to use an empty milk bottle for pee (to be emptied in different parts of the garden) while I come up with a design for a pee-only toilet.

This will be upstairs, since elevation enables gravity-draining into the garden; only a narrow hole needs to be drilled into the wall for the pipe, and as the space required for a unisex urinal is a lot smaller than for a full-blown compost loo, it can fit next to the flushing toilet. Upstairs is also where the bedrooms are, and no one wants to traipse down the stairs at night for a wee.

Prepare druff in smaller batches and store in open buckets in the loo to avoid mould.

Take extra food hygiene measures (like washing salads in salty water), and plan periodic prophylaxis with natural anti-parasitic medicines (like Chanterelle in raw or freeze-dried form which contains mannose – the bitter substance that makes this mushroom unpalatable to larvae and other parasites and even dissolves the shells of parasite eggs).

Use humanure less restrictively: after 6 months of hot composting and a year of vermicomposting, the humanure itself will be safer than average garden soil!

Design: Ethics

Earth care: Saving water and energy spent on purifying that water twice around flushing loos, and energy that goes into running and maintaining municipal sewerage infrastructure; Nourishing the soil and its diverse inhabitants.

People care: Guilt-free toilet trips. A choice of compost loo or conventional to cater for different preferences.

Emptying the buckets is one of the few smelly points in the process, but smell disappears as soon as you cover up the contents with something like garden waste or veg peelings.
I therefore try to empty the buckets while no neighbours are enjoying their time outside, and prepare cover material and rinsing water before tipping out the buckets.

Fair shares: Not everyone can install a compost toilet, but as we can, we'll be removing some load from the municipal sewerage facilities and so freeing up the capacity for others who have no other option.

We are also adding some knowledge to the humanure composting lore, so others can benefit from our experience.

Design: Principles

Cycling of resources, nutrients and energy; **Biological resources**: returning to the soil those nutrients which go into food production, with the help of soil life which in turn feed plants.

Diversity: promoting a diversity of microorganisms and other soil creatures (through hot and cold composting and vermicomposting) which benefit a wide range of plants.

Obtain a yield and **Produce no waste:** pee and poo as waste and pollutant → resource

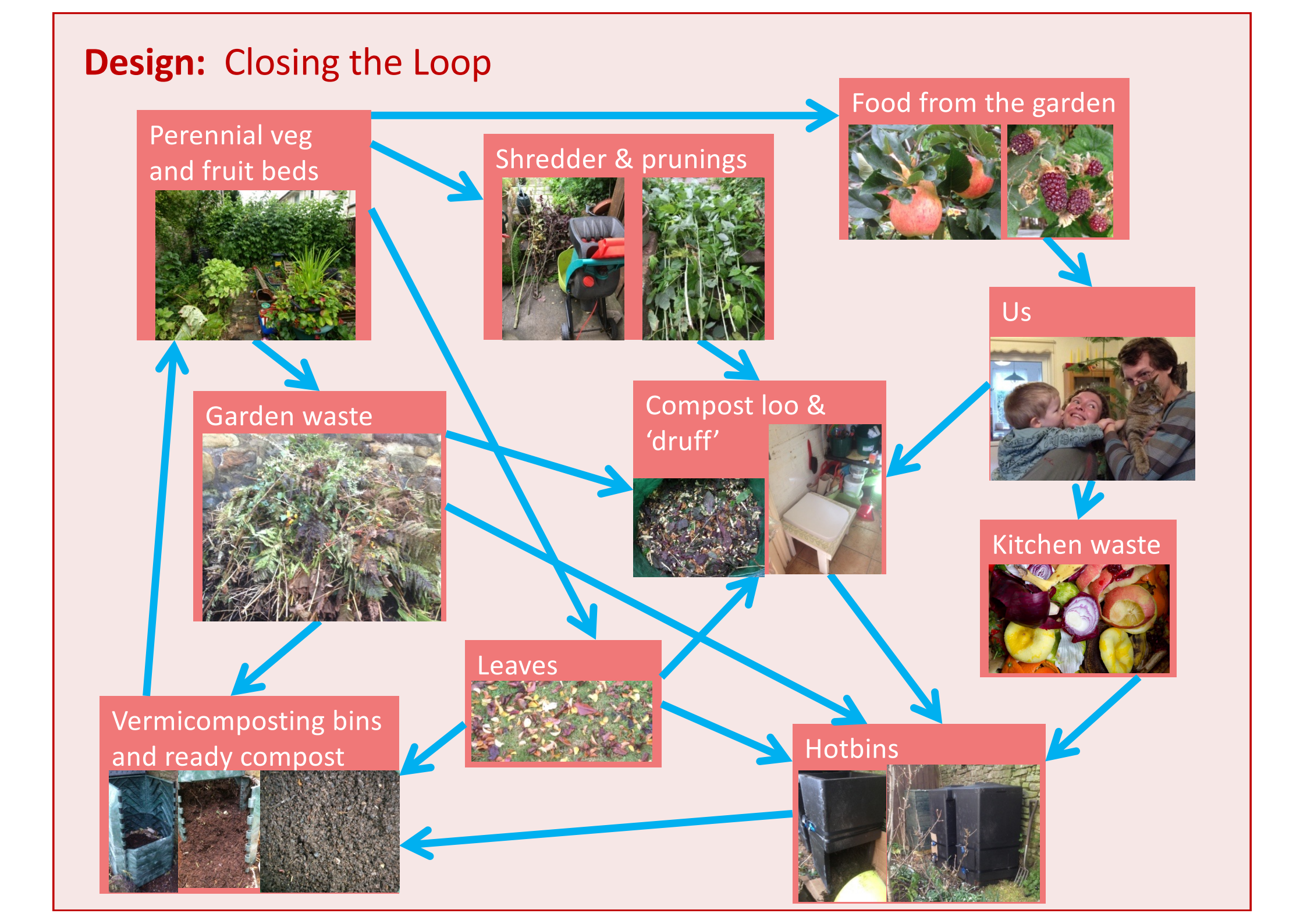
Relative location: siting the composters in the drier far end of the garden to utilise the water from rinsing the buckets for watering the plants there. Moving salad veg away from composting area so nothing gets splashed onto plants we eat raw. Siting the toilet so it's close to the back door, convenient for emptying and not too far to carry heavy loads.

Observe and Interact and **Self-regulate and accept feedback** – tweaks and modifications to the design based on the real-life performance of its components: **Follow reality, not the theory** (J. Chapman).

Integrate not segregate – combining the tasks of preparing 'druff' and garden tidying and pruning. More hands-on compost management and more attention to the process. (But this does add complexity too!)

Problem is the solution (or rather the 'problem is not the problem'!): The worry about contaminating the garden with humanure becomes almost baseless considering how many other creatures poo in the garden (foxes, cats, squirrels, mice etc.) – without going to the trouble of composting their doings! A solution to this problem (Chanterelles) also removes the 'problem' of using humanure in food growing.

Design: Closing the Loop



Reflection on the design

Although we succeeded in closing the fertility loop to a large extent, it is of course not completely closed – we do source food from outside the garden, and some of our own 'products' are left in other people's toilets. We also import seedling compost to be used for indoor propagation and use commercial compost for any exported plants.

The design is a testament to a learning process around composting 'humanure' rather than an unmitigated success, and the acquired knowledge can lead us to design a better system in less restrictive conditions. But the project definitely succeeded in overcoming nervousness and uncertainly around the whole subject of humanure.

This design presentation does not include the low-tech 'pee-only toilet' I am currently designing with the professional help of a plumber cum PDC graduate Steve (from Interzone Heating Solutions).

Some factors one simply cannot foresee – about half-way through the project my husband developed a range of allergies, including to soil fungi and moulds, which made him stop using the compost loo. Potentially a different kind of cover material could solve the issue, but for now the compost loo has 2 rather than 3 users (being somewhat less of an effort to manage). On the plus side, my son now wouldn't contemplate using the conventional loo if there is a choice of a compost toilet, and it's the attitudes of the younger generation that determine success of any efforts in sustainability.

Reflection on the design process

This project benefitted from the Simplest Design Process, which:

- accepts a circular nature of working on a project, and
- uniquely of the design frameworks gives a legitimate role to all ideas and research, which is consistent with the idea that Permaculture is information- and imagination-intensive.

The design went around several loops as I refined the Ideas and Research results against the Survey, before even Phase 1 of the design was conceived.

Linear design frameworks like SADIMET would not have been best suited to that, and moreover, would have created an impression of failure rather than making all the instances of rethinking and reassessment a legitimate part of the design process.

The subject matter of this project seems to be a no-brainer from the viewpoint of Permaculture ethics and principles, yet I needed all the encouragement of the Diploma, several PDCs (attended both as a student and assistant teacher), and real-life examples of working (and smell-free!) humanure systems to finally get on with designing a compost loo.

In this instance, treating the project like any other Permaculture design definitely helped with any residual attitudinal issues ☺