RECYCLING BEDS

A practical guide for the sizing, and building of recycling beds for the evapo-transpiration of excess liquids generated by Sun-Mar Central Composting Toilet Systems in summer cottage applications in Ontario, Canada .

C.M.Wilkinson
Spring 2001

INTRODUCTION

Those Sun-Mar Central Composting Toilet Systems which incorporate 1 pint flush toilets in the bathroom, such as the CENTREX, CENTREX NE, and CENTREX AC/DC are not necessarily able to evaporate the small amount of flushing liquid they receive.

Regulations may call for such excess liquid to be received in a facility such as a cess pool, septic system, or holding tank. However, these facilities may return the nutrients to the groundwater, and in many environments this may cause the character of lakes and bodies of water to change in a way that is undesirable for those wishing to use the water for recreation.

Where Sun-Mar Central type units are installed in "fragile" environments, it often makes sense to provide a Recycling Bed. A Recycling bed provides a **closed loop system** where the excess liquid, if any, is evaporated, and the nutrients are taken up and used by plants. In this way, CENTREX units are converted into self contained systems which operate completely **independent of the environment**, and do not affect it in any way.

Recycling Beds are small, relatively shallow at 18" deep (24" with a safety reservoir), and inexpensive beds which take advantage of well documented natural processes. They are extremely simple for the cottage owner to size and built.

This guide provides a shortcut to give the cottage owner the necessary information to build the correct sized bed. However, should you be interested in more background on recycling technology, we invite you to request additional information.
Because Recycling Bed technology is not yet incorporated into many regulation handbooks, cottagers wishing to use a Recycling Bed should seek the approval of the appropriate local authorities.

This principles and figures used in this guide are based on Professor Alfred P. Bernhart's work over many years, published in his 1985 book "Evapo Transpiration Nutrient Uptake Soil Infiltration of Effluent Water[1].

[1] Published and Distributed by A.P. Bernhart, 23 Cheritan Av. , Toronto M4R 1S3, Ont. Canada
Tel: (416) 488-3626. International Standard Book Number 0-9690560-0-7

Determining the Necessary Size of Recycling Bed for use with a Sun-Mar Centrex unit in Seasonal Application.

The appropriate bed size is determined by calculating the expected number of person days using the unit over the course of the season, and then finding the appropriate column in the in the Bed Sizing Table on Table 2.

To calculate the estimated people days over the course of the season, fill out Table 1 below

TABLE 1 **People/Days per Season**

	(A)	(B)	(C)	(A)x(B)x(C)
	# Weekends	Average # People	Days	
Weekend Use			2	
	# Full Weeks	Average # People	Days	
Full Weeks			7	
TOTAL PEOPLE DAYS PER SEASON				

Add the number of weekend use days to the number of full week days to arrive at an estimate of Total People Days per season.

By referring to Table 2, this number can then be used to determine the appropriate column and hence the right sized Recycling Bed for your needs.

A Table for Determining The Required Size of the Recycling Bed

By taking the number of person days per season from Table 1 and referring to the appropriate column in Table 2, the required bed surface area can be selected.

TABLE 2 **Bed Size Table**

Total Person Days per Season	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**
Total Input per Season (Litres)	325	650	975	1300	1625	1950	2275	2600	2925
Bed Surface Area Needed (Sq. M)	**0.3**	**0.6**	**0.9**	**1.1**	**1.4**	**1.7**	**2**	**2.3**	**2.6**
Reservoir Capacity available (Litres)	43	86	128	171	214	257	300	342	385

Notes to Table 2

Total Person Days per Season is derived from Table 1. If the estimate lies between two columns, it is suggested that the higher column be used.

Total input per Season is calculated by taking the number of person days at 3.25 Litres per head per day. This is the expected output when using a Sealand 1 pint toilet. It assumes that the Sealand is being operated normally. No allowance has been considered for evaporation occurring within the unit because of the fan or heating element (if any).

Table 3 summarizes the amount of evaporation and transpiration obtained by a recycling bed both by month and over the course of the whole season. Over the 6 month season this amount is 1139.25 Litres per Sq. Metre. The Bed Surface Area Needed is therefore derived by dividing the Input per Season by 1139.25.

The suggested designof the Recycling Bed allows for a total depth of 24" of which the bottom 6" is a safety reservoir. The Reservoir Capacity line shows the safety volume available for varying sized beds.

Bed sizing assumes that use is relatively evenly spaced throughout the season

Recycling Bed Performance Figures

	May	Jun	Jul	Aug	Sep	Oct
Evaporation from semi-saturated sand bed (Litres per day/Sq.M)	7.9	9.4	9.7	8.1	5	2.7
Transpiration and energy from bacterial action (Litres per day/Sq. M)	1.15	1.55	1.725	1.675	1.175	0.65
Less Precipitation/Sq. M (Litres per day)	-1.83	-2.085	-2.51	-2.565	-2.275	-1.485
TOTAL DAILY OUTPUT FROM BED/SQ. M (Litres per day)	7.22	8.865	8.915	7.21	3.9	1.865
TOTAL OUTPUT/SQ. M PER MONTH (Litres per month)	216.6	265.95	267.45	216.3	117	55.95
TOTAL OUTPUT/SQ. M PER SEASON (Litres per season)	1139.25					

Notes to Table 3

Evaporation, Transpiration and Precipitation figures are all taken from Professor A.P. Bernhart s work Evapo Transpiration Nutrient Uptake Soil Infiltration of Effluent Water . To arrive at the numbers in the above Table figures for Pickle Lake in Northern Ontario and Toronto, Ont. Have been averaged.

Evaporation numbers are those for a liquid at a depth of 8" in a semi saturated sand bed. These are conservative numbers because evaporation increases as the level rises in the bed towards the surface, and decreases as it falls.

Transpiration numbers have been based on planting the bed with immature grass rather than shrubs.

Precipitation numbers assume a 30% run off due to the domed construction of the bed.

The main Safety factors in bed sizing are:-
1. The reservoir capacity
2. The fact that evaporation would improve beyond these numbers when liquid rises above the 8" level.
3. Transpiration would improve if the bed were planted with shrubs

Building a Recycling Bed

Recycling Beds are simple and inexpensive to construct. All beds shown in this guide are 24" deep with the bottom 6" being used as a safety reservoir.

The bed should be sited so that the drain hose from the CENTREX unit will gravity feed into the bed with a gentle slope. If this is not possible the hose can be fed into a 12 Volt bilge pump of the kind used on boats. These pumps, such as the Rule Industries Model 96B, are built into a small container (about ½ gallon capacity) into which a float switch is built. The pump is activated as the level in the container rises, and the excess liquid pumped to the bed.

If the Recycling Bed is to built on rocky ground, a sand layer about 1" deep should be placed under the plastic sheet. If the bed is not on rocky ground the base should be compacted so that no settlement occurs in the spring.

The plastic sheet should be 10--20 mil thick and should be extended upwards right round the sides so that the upper edge of the sheet is right up to the surface. The sheet should be supported from the outside. If an overlap is required this should be about 50cm (20") to keep the bed watertight.

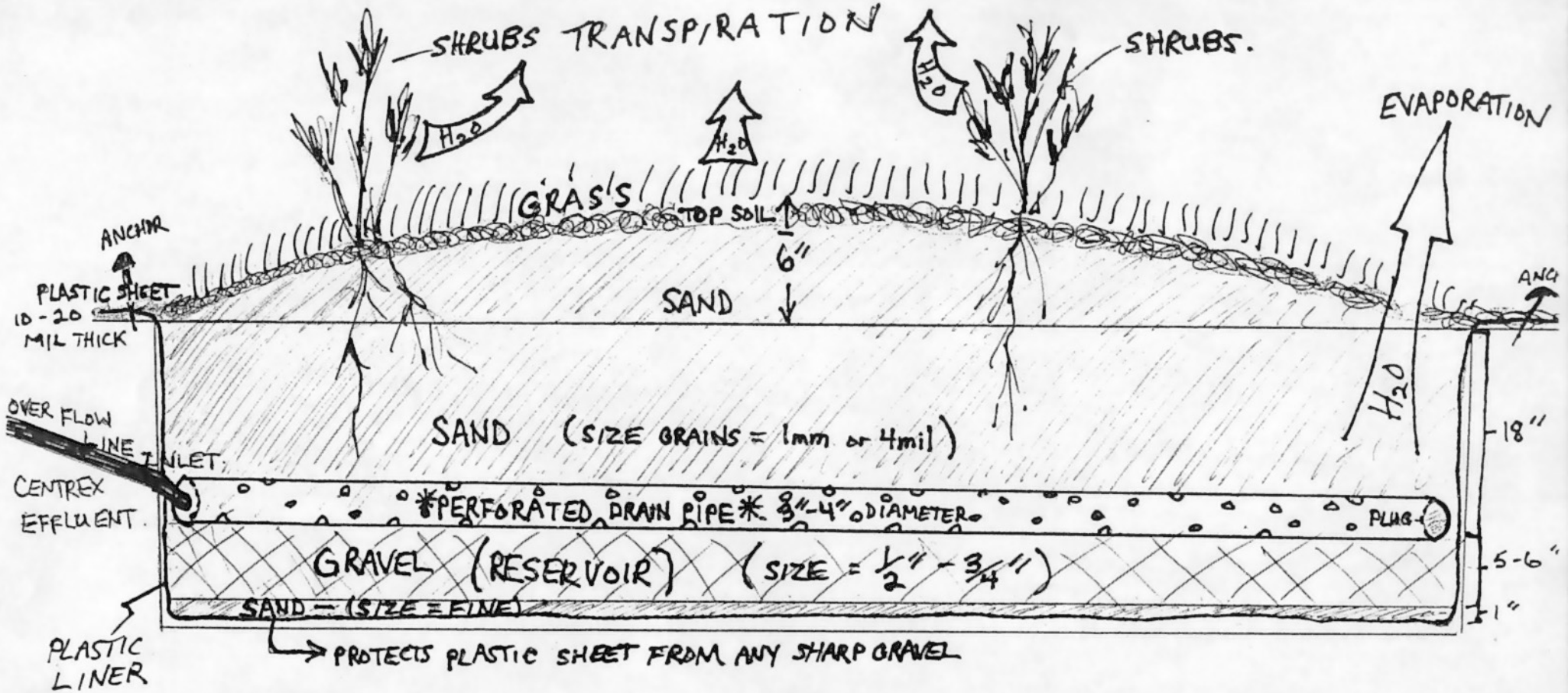
Immediately above the sheet put 1" of sand to protect the sheet from sharp stones, and above this fill the bed with a 6" base of loosely placed ½"-¾" gravel.

Immediately on top of the gravel, down the centre of the bed place a level 3" or 4" perforated drain pipe. The drain hose from the unit should be led into this perforated pipe in the bed.

Fill the bed (about another 18") with sharp sand of a grain size of about 1mm (4mil). Ensure that after settling, the bed will have a centre crown of about 6" above the side walls for diversion of stormwater and precipitation. The bed should be level with the surface around the perimeter.

Putting no more than a sprinkle of top soil on the surface, seed grass and plant shrubs (bare-root) in the bed.

Create trenches around the beds where necessary and appropriate to keep storm away from the bed.



- THIS SYSTEM MAY BE INCORPORATED INTO ① AN ABOVE-GROUND FRAMEWORK (TO SUPPORT THE SHEET & BED CONTENTS) OR ② A PIT OR HOLE IN THE GROUND.

* IF "IN-GROUND"... PERIMETER TRENCHES SHOULD BE EMPLOYED TO DIVERT STORM WATER.

- DIMENSIONS OF BED WILL DEPEND UPON EXPECTED INPUT SEE CHART ON PREVIOUS PAGES.

- PERFORATED PIPE SHOULD BE WRAPPED IN NYLON OR CHEESECLOTH (OR SOMETHING SIMILAR) TO PREVENT SAND ENTERING INTO HOLES.