THE CAMPAIGN FOR
GREENER HEALTHCARE

GREEN NEPHROLOGY: CONSERVING WATER IN HAEMODIALYSIS
CASE STUDY AND HOW-TO GUIDE

Version 1.0 – 4th January 2010

CASE STUDY 1: Canterbury Dialysis Unit

When the Canterbury dialysis unit updated its water purification system with the installation of a new reverse osmosis plant in 1997, it was soon apparent that large volumes of reject water were being 'lost to drain'. Within two years, and with the help of the hospital's Estates Department, a simple system capable of recycling 800 litres of this water per hour was installed at a cost of £15,000. The system has now been running for over ten years, saving the Trust £7,500 each year on mains water and sewerage costs.

The salvaged reject water is directed to a recovery tank in the basement. From there it is pumped up to the grey water tank on the roof, which then supplies the water to the hospital toilets. Float switches divert reject water to the drain if the grey water tank becomes full, and diverter valves direct the reject water directly to the drain from the reverse osmosis system during monthly chemical disinfections.

The Thomas Becket Dialysis Unit, Kent & Canterbury Hospital.

CASE STUDY 2: Ashford Dialysis Unit

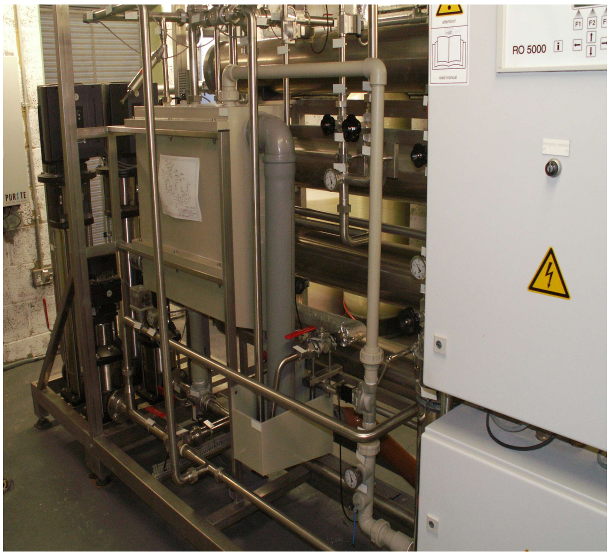
A similar system was included in a new-build satellite dialysis unit in Ashford, where the conserved water feeds into the local laundry room. Because water recovery was designed in from the start,

t +44 (0)1865 515811 e firstname.lastname@kintoa.org www.greenerhealthcare.org
Summertown Pavilion Middle Way Oxford OX2 7LG

the costs were much lower: just £2500.

"Back in 1999 I was amazed how simple this all was to do – 10 years later, given the savings we've made, I'm amazed nobody else has done it too."

(Steve Milne, Renal Technical Manager, Kent and Canterbury Hospital, UK)



The reverse osmosis system in the Ashford Satellite Dialysis Unit.

BACKGROUND

Haemodialysis has a considerable environmental impact, commonly requiring frequent patient travel, using large amounts of electricity and producing significant plastic and packaging waste. Furthermore, it consumes vast quantities of water. Producing the 120 litres of dialysate required for a typical four hour session requires approximately 400 litres of mains water. Reverse osmosis is an important step in the purification process that this water undergoes (see figure 1). Reverse osmosis systems vary in efficiency, but commonly reject up to two thirds of the water presented to them. Termed 'reject water', this high grade grey water does not come into contact with the patient at any stage and poses no infection risk, yet it is needlessly 'lost to drain' in almost all dialysis facilities. This guide outlines a simple methodology for salvaging reject water so that it can be put to an alternative use, such as in the hospital laundry or sanitation systems, to produce steam for equipment sterilisation or to feed low-pressure boilers.

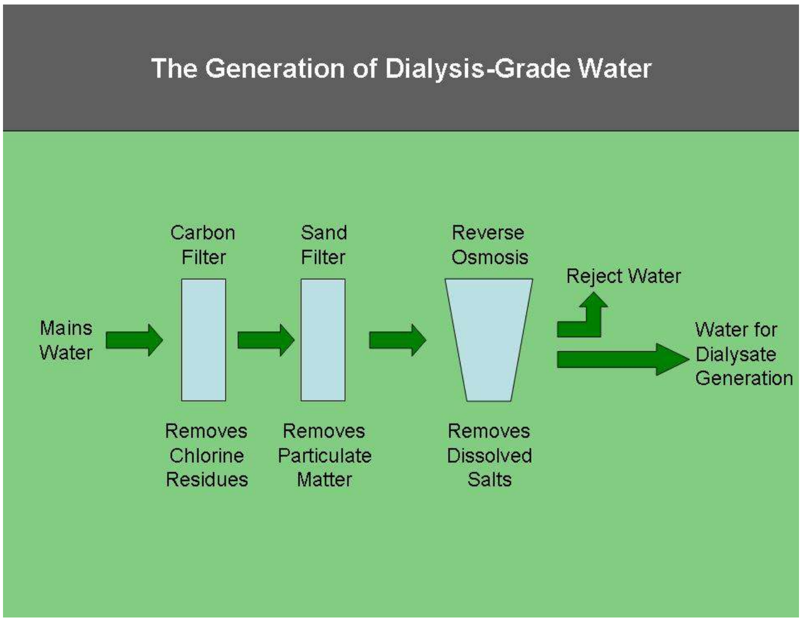


Figure 1.

Benefits of Water Conservation

There are a number of reasons why a dialysis unit might wish to salvage the reject water it produces. The **financial benefits** are, of course, important. The NHS is experiencing budget cuts related to the current financial crisis. Recycling reject water offers considerable savings on mains water costs (which are predicted to rise… ref), and also avoids the need to pay to put the reject water into the sewer. Secondly, **compliance with carbon targets** is of increasing importance, as impending regulatory and fiscal policies for carbon reduction will impact fundamentally on the cost and quality of healthcare provision. The NHS Carbon Reduction Strategy establishes NHS targets for reducing carbon emissions, and the Carbon Reduction Commitment will apply to individual Trusts from April 2010. Conserving reject water will help trusts to meet these targets. Thirdly, there are strong **environmental reasons** for saving water. Water is a finite natural resource. Climate change and population growth are leading to increasing water scarcity and many people now live in water-stressed areas. We all therefore have a responsibility to use water conservatively. Finally, this project allows Local Trusts to **demonstrate good corporate citizenship**, highlighting their decision to put social, economic and environmental considerations at the heart of their decision making.

What barriers might be encountered by units wishing to introduce this change?

The physical constraints imposed by the existing layout of the renal unit and the available space may pose a barrier to a financially-viable water conservation system. An example that this case study demonstrates is the possible need for an extra water tank (as water cannot be pumped directly out of a reverse osmosis system, but must be allowed to drain at the rate it is produced). An extra tank will not always be necessary, but will of course require storage space. Similarly, the

t +44 (0)1865 515811 e firstname.lastname@kintoa.org www.greenerhealthcare.org
Summertown Pavilion Middle Way Oxford OX2 7LG

conserved water must be directed to its intended site of use, and consideration must be given to the practicality and cost of installing the necessary pipework. For reasons such as these, it is essential to gain the support of the local Estates department.

Financial costs

The financial costs will vary from unit to unit, and may dictate whether a water conservation project is viable. However, in most cases, the costs will be small and the potential savings great. For example, the cost of incorporating the methodology into the design of the Ashford satellite unit was only £2500 (tank and control panel £1300; piping £1200). The piping was laid alongside other services required by the new build, so no cost was incurred for groundwork. The running costs of any pumps required must also be considered although, again, these are likely to be small. The cost of running the pump at the Ashford unit is less than £100 per year.

The cost of implementing the methodology at the Canterbury unit has been estimated at £15,000 in 1999. It is also possible to replace existing reverse osmosis systems with newer and more efficient ones which reject less water; this will of course increase the implementation costs (when compared to leaving existing systems in-situ), but is outside the scope of this case study.

Investment Appraisal

The return on investment will depend upon:

1. The investment: the cost of installation & maintenance.
2. The return: the savings on mains water and waste water. This can be calculated by multiplying the regional mains water and waste water rates by the volume of reject water which the system is able to provide in place of mains water for an alternative use (e.g. laundry). It is useful to factor in projected price rises and changes in demand to gain a view of future potential savings.

In general, the return on investment is likely to be greater for a new-build unit, where the installation costs may be lower, and there is greater flexibility in arranging an appropriate alternative use for the salvaged water. This is borne out in our case studies:

	Unit					
	Canterbury (retrofit)			Ashford (built in)		
Year	Investment	Savings to date	ROI	Investment	Savings to date	ROI
1	£15,000	7500	50%	£2,500	£10,558	422%
2	0	15000	100%	0	£21,116	844%
5	0	37500	250%	0	£52,790	2112%
10	0	75000	500%	0	£105,580	4223%

Environmental savings

The finite volume of water on the earth is constantly being recycled and purified; it evaporates off the earth, condenses to form clouds, before precipitating down as rain. Back on earth, the water runs off into rivers, lakes, reservoirs and seas, or percolates down into the earth's natural underground reservoirs. But the fresh water in this cycle is being used by humans at a rate faster than the recycling process can replenish, and more than one third o f the world's population now live in water-stressed countries. So we must use water wisely. A 'carbon footprint' does not therefore do full justice to the environmental benefits of water conservation. However, energy is also required to treat and move the water that we use, and conserving water therefore also saves energy and reduces the carbon footprint of the renal unit.

Accounting for the energy used to power the pump, the carbon savings at the Ashford unit are approximately 750 kg CO_2 equivalents per year. This figure is reached by a two step calculation. Firstly, calculate the carbon savings made by recycling the reject water in place of mains water. To do this, apply a mains water life-cycle conversion factor (available from, for example, the DEFRA website) to the volume of water saved per year. Secondly, subtract from this the carbon cost of any electricity required to pump the water to its place of use over the course of a year (this second step requires you to know the power of the pump, the duration of its use during the year, and a conversion factor for electricity to carbon consumption).

Carbon savings (kg CO2e/year)	=	[Volume water saved in one year (L) x mains water carbon conversion factor (kgCO2e/L)]	-	[electricity used for pumping per year (kWh) x carbon conversion factor (kgCO2e/KWh)]

Major risks

Careful planning and calculations should negate the main risk – that physical barriers, or miscalculations regarding the amount of reject water produced, render the project financially unviable.

It is also important to ensure that the new use supplied by the recycled reject water (e.g. laundry or hospital toilets) has a back-up mains supply to cover any interruptions (for example during maintenance or disinfection).

t +44 (0)1865 515811 e firstname.lastname@kintoa.org www.greenerhealthcare.org
Summertown Pavilion Middle Way Oxford OX2 7LG

“HOW-TO GUIDE”: GETTING STARTED

The case study and discussion outlined above includes most of the information required to develop a sound business case for a water conservation project in a dialysis unit. The following guidance will help you explore the practicalities and assess the financial benefits further.

1. Discuss the idea with your Renal Technician. They will play a vital role in any water conservation project, understanding the local set-up better than anyone else.

2. Involve your local Estates department. The support and advice of the hospital Estates department is also vital. Their engagement may require the presentation of a sound business case. In most cases, it will be the Estates department that benefit financially from the methodology.

3. Clarify the scenario. Will the methodology be implemented into the design of a ‘new build’ dialysis unit, at the time of replacing the RO system in an existing dialysis unit, or perhaps alongside an existing and satisfactory RO system already in place in a dialysis unit? These different scenarios will influence the total costs involved, but the return on investment may still make the project worthwhile.

4. Clarify the potential volume of reject water that will be salvaged each year.

In order to maximise the financial and environmental benefits of the project, it is important to match the volume of reject water available to an alternative use that requires a similar volume. Many reverse osmosis systems record the volume of reject water produced, but this can be ascertained with a simple flow meter if necessary. It should be remembered that, where reverse osmosis systems are being replaced, the newer system is likely to be more efficient and produce less reject water.

5. Assess the quality of the reject water to be salvaged. The precise quality of the reject water produced will vary from region to region. Whilst it will almost always meet the requirements for its intended use, it is vital that this is assured prior to proceeding further. Your renal technician will be well versed in checking the water quality.

6. Given the volume and quality of the reject water available, now identify the intended use for this water. Possibilities include: sanitation, laundry, boiler feed, sterilisation units and irrigation – on site or supplied to a neighbouring facility. Practical considerations are important. For example, salvaged reject water can only be used in laundry services if the plumbing required is feasible and affordable.

7. Calculate the financial cost per year of the current practice of supplying mains water for this intended use. This will require knowledge of the mains water rates for your hospital, information which the Estates department can provide.

t +44 (0)1865 515811 e firstname.lastname@kintoa.org www.greenerhealthcare.org
Summertown Pavilion Middle Way Oxford OX2 7LG

8. Calculate the financial savings resulting from the reduction in waste water from the haemodialysis unit. This will require knowledge of the waste-water rates for your hospital. Remember that some reject water may still be lost to drain if it exceeds the demand/capacity of the salvage system, and during disinfection cycles.

9. Calculate the initial total financial expenditure incurred in implementing the methodology (including the infrastructure required to transport the reject water to the place of use). Costs may include: storage tanks, pipework, pumps and installation costs. Maintenance costs are likely to be small.

10. From these figures, develop a repayment projection and calculate the breakeven point (the point in time by which the savings - due to reduced mains water and reduced losses-to-drain - might be anticipated to have recouped the investment costs of the methodology, and from whence the use of reject water for the new purpose realises potential savings).

11. Convince your Trust to fund the work. Whilst this will certainly require the support of your Estates department, it may also require the approval of the Director of Finance. It is also worth applying for funding from Salix Finance, an organisation set up by the Carbon Trust to deliver interest free funding to accelerate investment in energy efficiency technologies within the UK public sector. Their website is http://www.salixfinance.co.uk/home.html

12. System maintenance should become part of routine estates plant room inspections - a simple check function tick list is sufficient. Water storage tanks will require cleaning in line with Trust protocols for other tanks in the hospital.

FURTHER INFORMATION & SUPPORT – PLEASE CONTACT:

Steve Milne, Renal Technical Manager, Kent and Canterbury Hospital, UK.
steve.milne@ekht.nhs.uk

Andrew Connor, Green Nephrology Fellow, The Campaign for Greener Healthcare, UK.
andrew.connor@kintoa.org

Frances Mortimer, Medical Director, The Campaign for Greener Healthcare, UK.
frances.mortimer@kintoa.org