

Chock Conservation Plan

EDTA

Objects are immersed in 5% w/v solution of triammonium citrate in tap water. Baths are changed every other week until no more evidence of iron removal is present. Following removal from the citrate solution, the objects are rinsed by changing water baths regularly until no colour change is observed.

PEG

Following chelation treatment, the objects are treated using a two-step PEG immersion process. The final concentrations are 15% w/v PEG 400 and 20% w/v PEG 4000.

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	15.00	5.25

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	5.00	1.92	1.75	0.29
5.00	10.00	2.03	1.85	0.30
10.00	15.00	2.16	1.97	0.32
15.00	20.00	2.30	2.09	0.34

Based on 35 L of treatment solution

PEG 400 top-up: 14/11/12

1st full top-up: 10/12/12

5-10% : 9/1/13

10-15%: 1/2/13

15-20%: 28/2/13

Freeze-drying

The chocks are placed in the small freeze-drier and frozen to -30C for 24 hours. They are then placed under vacuum. Weight is monitored as well as moisture content, using a protimeter.

Post-conservation

Following drying, any loose elements are re-adhered using Paraloid B-72. The chocks are packaged in an acid-free box, and placed in the shipping container for storage.

Conservation Treatment Methodology for Cordage

Stage One: Mechanical Cleaning

The cordage was cleaned primarily using a soft paintbrush and a stream of water dripped from a syringe. The use of the syringe allowed the force and speed of the water to be closely controlled. Particularly large or densely adhered deposits were cleaned with a scalpel or small spatula, with the clay deposits lifting away easily and revealing the surface of the cordage.

Stage Two: Chemical Treatment

The cordage was all packaged in netlon, which allowed disparate fragments to be kept together, as well as allowing labels to be associated with the cordage without actual attachment to the object. The cordage was then placed in treatment tanks in a single layer, into a solution of 2% glycerol plus 5% PEG 200 in cold tap water. The objects were left in the treatment solution for 4 weeks.

It was noticed that the solution was giving off a foul, slightly sulphurous scent. This may have been due to its being stored in the conservation lab, which was generally much warmer than the warehouse. A white, foamy mass was also noted on the surface of the solution, but the cordage did not seem affected, other than having absorbed the smell.

Stage Three: Freeze-drying

The cordage was removed from the solution and gently rinsed to try and remove some of the smell. It was then placed in a freezer and frozen for 48 hours. The cordage was then put in a small freeze-dryer, brought to 30C and the vacuum begun. The cordage was weighed every two hours until weight loss plateaued, and it was then removed from the freeze-dryer and stored in the conservation lab. It was observed that the smell still lingered, but was much decreased. It is hoped that, if an opportunity to safely 'air out' the cordage can be arranged, the smell would be completely or mostly purged.

Stage Four: Consolidation

Following freeze-drying, it was found that the surface of several pieces of cordage (particularly those made of grass stems) had begun to delaminate and was very fragile. Solutions of 5% and 10% Paraloid B-72 in acetone were mixed up, and dripped onto the surface of the the fragile cordage, with the stronger solution chosen for those fragments that were the most prone to damage. (A few pieces also had the adhesive injected into them, to keep the loose fibers held together.

Stage Five: Packaging

Following consolidation, the rigging was packaged in bespoke boxes made of acid-free carboard, with acid-free tissue acting as cushioning where needed. The boxes were placed into a controlled storage environment.

Conservation Treatment of COW 3051/MSG 549 (composite wood and Fe) Pulley Block

Regime A: 10% PEG 200 + 30% PEG 3350

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	10.00	1.00

16 August

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	5.00	0.52	0.50	0.05
5.00	10.00	0.55	0.53	0.05
10.00	15.00	0.58	0.56	0.06
15.00	20.00	0.61	0.59	0.06
20.00	25.00	0.65	0.63	0.07
25.00	30.00	0.70	0.67	0.07

Final percentage	Remove L	Add kg	Add L	Notes
5	.52	.5	.05	6 September
10	.55	.53	.05	27 September (1 October)
15	.58	.56	.06	18 October
20	.61	.59	.06	8 November
25	.65	.63	.07	29 November (30 Nov)
30	.70	.67	.07	20 December (probably a day or so earlier)

18 weeks (4.5 months) total, using 1.36 L and 3.45 kg. Freeze-drying will take place early in the New Year

To keep the 1% v/v Hostacor percentage steady, ~5 ml should be added with every top up.

Freeze-drying

Object was frozen to -30C over a period of 36 hours. The vacuum was then turned on. Object was monitored by temperature and by using a protimeter to measure moisture content.

Post Freeze-drying

As of June 2013, the object was still in conservation. Post-freeze-drying will likely consist of removing excess PEG with warm water and packaging the object for storage.

COW 3112 PEG Schedule

REGIME A: 10% PEG 200 + 30% PEG 3350

4 L of water

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	10.00	0.40

Done 30/1/13

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L	Date
0.00	7.50	0.31	0.30	0.03	21/2/13
7.50	15.00	0.34	0.33	0.03	13/3/13
15.00	22.50	0.37	0.36	0.04	4/4/13
22.50	30.00	0.41	0.39	0.04	25/4/13

Ready to Freeze-dry on 23 May, 2013.

Freeze-drying

The object is placed in the small freeze-drier and frozen to -30C for 24 hours. It is then placed under vacuum. Weight is monitored as well as moisture content, using a protimeter.

Post-conservation

Following drying, any excess PEG is removed using warm water, and the object is packaged in a bespoke box made of acid-free cardboard and placed in a controlled storage environment.

Treatment regime for fragment of 3049

For 2 L treatment bath:

Current % v/v	Desired % v/v	Replace L
0.00	8.00	0.16

Done 7/2/13

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	12.50	0.25	0.25	0.02
12.50	25.00	0.29	0.29	0.02

0-12.5: 28/2/13

12.5-25: 21/3/13

Freeze-drying

The object is placed in the small freeze-drier and frozen to -30C for 24 hours. It is then placed under vacuum. Weight is monitored as well as moisture content, using a protimeter.

Post-conservation

Following drying, the object is packaged with the rest of COW 3049.

Conservation Procedure for Leather Objects

Surface Clean

The leather was initially surface-cleaned using water under variable, gentle pressure (via a syringe) and a soft brush. A bamboo stick was used to loosen adhered clay and dirt as needed.

Following surface cleaning, the leather pieces were traced onto Melinex.

Chelation

While undergoing treatment, the leather fragments were kept between two pieces of netting that were sewed together. This allowed all the fragments of a given MSG number to stay together, as well as allowing identifying information to be easily included.

The leather initially underwent chelation treatment by being immersed in a 5% solution of ethylenediaminetetraacetic acid (EDTA) in tap water for several hours.

Following treatment, the leather was rinsed by soaking in tap water that was regularly changed until no colour change in the rinse solution was detected, a process which took 4 days.

Glycerol Treatment

After rinsing, the leather was put into a solution of 25% v/v glycerol in tap water for a period of one week.

Freeze-drying

Following removal from the glycerol solution, the leather fragments were repackaged in sympatex and placed in a freezer overnight. The following day they were placed in the freeze-dryer under very low vacuum. (This was not intentional, but was due to a misunderstanding in how the freeze-dryer operates.) The fragments were weighed every two hours to monitor the rate of drying.

Reshaping

Following freeze-drying, it was found that some of the fragments needed to be gently reshaped. Initially following a procedure described by Elizabeth Peacock, a frame was constructed out of correx and bulldog clips, but was abandoned due to fears that the clips would leave marks on the leather, even if padded.

Instead, a small humidity chamber was approximated by placing the leather in a Stewart box that held an open beaker of water and a humidity indicator card. The box was closed and placed near a radiator that was left on around the clock. The RH inside the box soon rose to 90%+, and the piece was kept there for several days, before being reshaped. Pieces that needed to be flattened were put between layers of blue towelling, with panels of correx creating the outer layer of the 'sandwich'. (That is, there was a panel of correx, several layers of blue towelling, the leather, layers of blue towelling and a final panel of correx.) Heavy books were placed atop this set-up and left for several days.

It was found that the leather could be easily reshaped, and although some deformity would follow, generally the fragments retained their new shapes.

Packaging

The leather was packaged by MS G number in individual, bespoke boxes. Within the boxes, plastazote was cut away to allow the leather objects to be placed within a hollow. Ties were added as needed to prevent movement within the box. The boxes were put into controlled storage.

Conservation Treatment of MSG 552 / COW 3029 (Clog)

In 4 L

Regime A: 10% PEG 200 + 30% PEG 3350

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	10.00	0.40

7/2/13

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	7.50	0.31	0.30	0.03
7.50	15.00	0.34	0.33	0.03
15.00	22.50	0.37	0.36	0.04
22.50	30.00	0.41	0.39	0.04

0-7.5: 28/2/13

7.5-15: 21/3/13

15-22.5: 24/4/13

22.5-30: 20/5/13

Freeze-drying

The object is placed in the small freeze-drier and frozen to -30C for 24 hours. It is then placed under vacuum. Weight is monitored as well as moisture content, using a protimeter.

Post-conservation

Following drying, any excess PEG is removed using warm water, and the object is packaged in a bespoke box made of acid-free cardboard and placed in a controlled storage environment.

Conservation Plan for Rigging

Stage One: Ammonium Citrate

The rigging elements were placed in boxes containing a 2% solution of ammonium citrate. This treatment was chosen for the following reasons:

- It is an effective treatment for the removal of iron salts from waterlogged wood.
- Even large quantities of ammonium citrate carry relatively low health and safety risk, especially as compared to more powerful chelating agents.
- Ammonium citrate was used to treat the large timbers, and its use here reflects a consistency and continuity throughout the conservation process.
- Because treatment is carried out using ammonium citrate left over from timber treatment, no additional costs are incurred.

The treatment solution was changed every 1 or 2 weeks, and samples were taken to monitor the volume of iron being removed. Treatment effectiveness was monitored by observing the colour of the solution, both in the tanks and with the samples taken, which could easily be compared to previous samples.

Treatment was deemed ended when the colour of the solution remained virtually unchanged, signalling that no more iron was being removed from the objects. All objects were checked for visible iron staining.

Following treatment, the objects were rinsed in successive water baths until no more colour-change was detected in the solutions. The objects were left in cold water over the Christmas holidays, and were found to have finished rinsing upon examination.

Stage Two: PEG Treatment

PEG ((Poly)Ethylene Glycol) treatment regimes were determined using the PEGcon program. The objects were split into two different groups, based upon the regime required by their moisture content.

The two regimes are:

Regime A: 27% PEG 400 (achieved in two steps) followed by 5% PEG 3350 This treatment was applied to COW 1747 1807 1926 2367 3006 3018 3052 3073

Regime B: 8% PEG 400 followed by 25% PEG 3350 (achieved in two steps) This treatment was applied to 3031 3049 3009

These regimes were determined by splitting the recommended values (as determined by the PEGcon program) into two broad groups and averaging the values in each group.

The treatment steps will be broken into three-week increments. The initial treatment solution, consisting of the first step for PEG 400 for Regime A and the full PEG 400 volume for Regime B, will last for three weeks. At that point, the final percentage will be reached for Regime A, and Regime B will begin the first step of PEG 3350 treatment. Three weeks after that, Regime A will begin the 3350 treatment, and

Regime B will be topped up to the full 3350 volume, so that both regimes are at the desired ratios of PEG to water.

The rigging elements will be held at this final stage for 4 weeks before moving onto the next stage.

After the first PEG treatment, one object was freeze-dried and found to be in very poor condition. Consultation with Ian Panter pointed out that the concentration of low-molecular-weight PEG was far too high, and the concentration of high-mw PEG was probably too low.

The still-wet rigging was placed into baths of tap water which were changed approximately every week and monitored with the Brix meter.

Stage Three: Freeze Drying

Objects were loaded into the small freeze-dryer and frozen to -30C overnight. The vacuum was turned on and the temperature within the chamber allowed to slowly rise to encourage sublimation of water. The objects will be weighed regularly and the weight monitored to determine the endpoint of treatment. When the weight loss of the object has slowed to be nearly undetectable and the object appears and feels dry, all excess moisture will have been removed and the object will be removed from the freeze-dryer and placed into storage.

Following freeze-drying, there may be some PEG residue visible on the surface of the objects. This will be removed by wiping with warm water.

This phase of treatment is expected to take 2-3 weeks.

* * *

Note: This plan was radically changed when it was discovered that objects treated with regime A had received far too much low-molecular weight PEG, and not enough high-molecular weight. Following the initial PEG treatment, one object (3024) was freeze-dried as a test. The results were mixed – while the object retained its original dimensions, more or less, it was very light in colour. It had a very low weight and a texture that was almost spongy – like dried apples. Its surface was slightly sticky to the touch. This was deemed unacceptable, and all of the rigging that had undergone regime A was re-treated.

Rigging Re-treatment Procedure (After Ian Panter's technique)

For dried object, place in water and weigh regularly until weight gain stops. (The state of the piece I re-waterlogged was such that I could actually squeeze it a little to force air out and water in.

Rinse for 4 weeks, testing regularly with the Brix meter to see how much PEG is being pulled out. Change water about 1x a week.

Start with a 5% solution of PEG 4000 and increase by 5% every two weeks until a 25% concentration is achieved. Let sit for 4 weeks and freeze-dry.

Desired final	Current % w/v	Desired % w/v	Remove (L)	Add 4000 (kg)	When	Notes
25%	0	5	1.58	1.7	31 May	
	5	10	1.66	1.78	14 June	Probably move to 13 th
	10	15	1.75	1.87	3 July	Moved from 29 th June
	15	20	1.84	1.98	16 July	Done
	20	25	1.95	2.09	6 August	done

Total PEG required: 9.42kg for each tank, 18.84 in total

Begin freeze-drying beginning of September, 2012

Conservation Procedure for Small Wooden Finds

The objects treated under this procedure are as follows:

MSG 001, 002, 003, 004, 005, 006, 007, 008, 009, 010, 011, 017, 018, 019, 040

MSG 037, 038 and 039 will be treated following the Cork regime, but freeze-dried with the above objects.

Citrate:

No iron staining was found on any objects, with the exception of one of the bungs. Due to the small size, delicate nature, and general lack of visible iron deposits, it was decided to skip citrate treatment. PEG has a chelating effect, and should satisfactorily remove iron without damaging the objects the way citrate or EDTA might.

PEG:

The non-oak PEG regime will be followed, with a final concentration of 10% PEG 200 + 30% PEG 3350.

In order to limit handling of the delicate objects, they will be treated in Stewart boxes, with a limited number of objects to each box.

For 4L box:

(assume 1 step to 10% PEG 200)

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	5.00	0.21	0.20	0.02
5.00	10.00	0.22	0.21	0.02
10.00	15.00	0.23	0.22	0.02
15.00	20.00	0.25	0.24	0.02
20.00	25.00	0.26	0.25	0.03
25.00	30.00	0.28	0.27	0.03

Final %w/v	Remove L	Add kg	Add L	Date
10 (PEG 200)	.4	--	.4	24/10/12
5%	.21	.2	.02	14/11/12
10%	.22	.21	.02	10/12/12
15%	.23	.22	.02	9/1/13
20%	.25	.24	.02	1/2/13
25%	.26	.25	.03	4/4/13
30%	.28	.27	.03	25/4/13

For 6L box:

(ditto above for PEG 200)

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	5.00	0.31	0.30	0.03
5.00	10.00	0.33	0.32	0.03
10.00	15.00	0.35	0.33	0.03
15.00	20.00	0.37	0.36	0.04
20.00	25.00	0.39	0.38	0.04
25.00	30.00	0.42	0.40	0.04

Final	Remove L	Add kg	Add L	Date
10 (PEG 200)	.6	--	.6	24/10/12
5%	.31	.3	.03	14/11/12
10%	.33	.32	.03	10/12/12
15%	.35	.33	.03	9/1/13
20%	.37	.36	.04	1/2/13
25%	.39	.38	.04	4/4/13
30%	.42	.4	.04	25/4/13

Freeze-drying

The objects are placed in the small freeze-drier and frozen to -30C for 24 hours. They are then placed under vacuum. Weight is monitored as well as moisture content, using a protimeter.

Post-conservation

As of June 2013, objects are still undergoing freeze-drying. Post-conservation care will probably include removing excess PEG with warm water and packaging for storage.

Conservation Treatment Methodology for Textiles

Cleaning

Textiles were cleaned, when wet, by gentle brushing with a soft paintbrush. Drips of water from a syringe or squeeze-bottle were used to keep the fabric surface wet and to wash away loose soil.

Dry textiles that needed to be cleaned were treated under a microscope, using a bamboo stick or dull scalpel to loosen the soil, and a soft paintbrush to brush it away. Wetting the soil was tested, but found that this did not remove surface soil as well as when it was dry.

Drying

The drying of textiles took place over the course of a few hours. The textile was placed between layers of blue towelling, with correx adding support, a light weight, and acting as a vapour barrier (see Fig. 1).

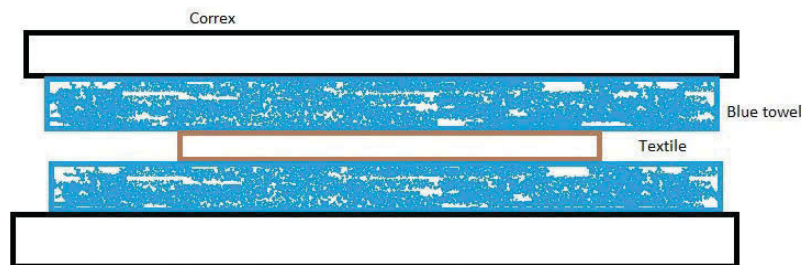


Fig. 1

This set-up allowed for a controlled air-dry that could be easily checked regularly, to ensure that the textile was not over-drying.

Packaging

Textiles were packaged on a piece of correx and placed in a tight-fitting, sealed polythene bag. This allowed for protection from dirt and dust, as well as giving some support to the textile and placing it in a buffered atmosphere.

Treatment Plan for Iron Bolts

Each bolt will be treated in turn, to account for variations between the two. The first step will be to brush the surface with a large paintbrush, removing any loosely-adhered corrosion. Then the surface will be swabbed with IMS in order to degrease, and to remove further corrosion.

Following this light cleaning, all non-magnetite corrosion will be removed with a scalpel and/or glass bristle brush. Ideally, only a dark, stable surface will be visible following this stage.

If the bolt appears to be in particularly poor condition, treatment with tannin or electrolytic reduction will be explored as possible treatment options.

Following all cleaning, Renaissance Microcrystalline wax will be applied to the surface to protect it and enhance its aesthetic appeal, as the bolts will likely go on display at some point. The storage conditions will be carefully monitored, with the bolts packaged with indicating silica gel and a humidity indicator card. A microenvironment with an RH of 15% will be targeted.

Conservation Treatment of MSG 879 (composite wood, leather and Fe) Pump Spear

Regime A: 10% PEG 200 + 30% PEG 3350

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	10.00	0.75

Plus 75 ml of Hostacor IT

29/08/2012

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	5.00	0.39	0.38	0.04
5.00	10.00	0.41	0.40	0.04
10.00	15.00	0.43	0.42	0.04
15.00	20.00	0.46	0.44	0.05
20.00	25.00	0.49	0.47	0.05
25.00	30.00	0.52	0.51	0.05

Final percentage	Remove L	Add kg	Add L	Notes
5	.39	.38	.04 (40 ml)	20 September
10	.41	.40	.04	11 October
15	.43	.42	.04	6 November
20	.46	.44	.05	11 January
25	.49	.47	.05	1 February
30	.52	.51	.05	4 April

Treatment complete 2 May, 2013

2.62 kg of PEG 4000 and 1.02 L of PEG 400

Freeze-drying

The object is placed in the small freeze-drier and frozen to -30C for 24 hours. It is then placed under vacuum. Weight is monitored as well as moisture content, using a protimeter.

Post-conservation

Following freeze-drying, the leather was found to be delaminating and deposits of PEG were on the surface.

The PEG was removed using warm water applied with cotton swabs. As of writing (June 2013), delamination hadn't yet been repaired, but will probably be done by softening the leather with warm water and adhering with dilute PVA.

Ammonium Citrate:

STEP ONE:

4 July: 200 g of citrate into the tank and add water to 400 L line

Place oak elements in tank

+ 3 weeks: new citrate solution

PEG treatment:

REGIME B – Barrel Staves

For 300 L tank

15% PEG 200 + 20% PEG 3350

STEP ONE (16/1/13)

Replace 45 L of water with PEG 200

STEP TWO

Current % w/v	Desired % w/v	Remove (L)	Add 3350 (kg)	Add 400 (L)	When
0	5	16.46	15	2.47	21/2/13
5	10	17.42	15.87	2.61	21/3/13
10	15	18.49	16.85	2.77	17/4/13
15	20	19.71	17.96	2.96	

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Treatment complete on:, at which point freeze-drying can begin.

Note: As of 14 June, 2013 conservation had not yet completed. A lengthy wait for PEG delivery meant that the process took much longer than initially planned. Once the PEG treatment is complete, the barrel staves will be freeze-dried and placed into controlled storage.

Misc Non-Oak Conservation Process

Final concentration will be 10% PEG 400 and 30% PEG 3350 (following Regime A).

Volume of water is: 64 L (filled to 15cm)

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	10.00	6.4

31/1/13

PEG 3350:

Current	Desired	Remove L	Add kg	Add L	Date
0.00	6.00	3.97	3.83	0.40	28/2/13
6.00	12.00	4.23	4.08	0.42	21/3/13
12.00	18.00	4.53	4.37	0.45	17/4/13
18.00	24.00	4.88	4.71	0.49	7/5/13
24.00	30.00	5.28	5.10	0.53	

Note: As of 14 June, 2013 conservation had not yet completed. A lengthy wait for PEG delivery meant that the process took much longer than initially planned. Once the PEG treatment is complete, the objects will be freeze-dried and placed into controlled storage.

Misc Oak Conservation Process

Final concentration will be **15% PEG 200 + 20% PEG 3350**
(following Regime B).

Volume of water is: 131 L

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	15.00	19.65

31/1/13

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	5.00	7.19	6.55	1.08
5.00	10.00	7.61	6.93	1.14
10.00	15.00	8.07	7.36	1.21
15.00	20.00	8.60	7.84	1.29

Current	Desired	Remove L	Add kg	Add L	Date
0.00	5.00	7.19	6.55	1.08	28/2/13
5.00	10.00	7.61	6.93	1.14	21/3/13
10.00	15.00	8.07	7.36	1.21	16/4/13
15.00	20.00	8.60	7.84	1.29	07/05/13

Ready to freeze-dry 4 June

As of June 2013 freeze-drying had not yet begun. It is envisioned that following freeze-drying, any excess PEG will be removed with warm water, and the objects will be placed into storage, packaged with acid-free tissue.

1682: Pump Elements Conservation Process

Final concentration will be 10% PEG 400 and 30% PEG 3350 (following Regime A).

Volume of water is: 300 L ()

Initially, put into a single bath of 1% EDTA in water (17/1/13)

PEG 400:

Current % v/v	Desired % v/v	Replace L
0.00	10.00	12.20

Done: 19/2/12

PEG 3350:

Current % w/v	Desired % w/v	Remove L	Add 3350 kg	Add 400 L
0.00	6.00	7.59	7.32	0.76
6.00	12.00	8.09	7.81	0.81
12.00	18.00	8.66	8.36	0.87
18.00	24.00	9.33	9.00	0.93
24.00	30.00	10.10	9.74	1.01

Current	Desired	Remove L	Add kg	Add L	Date
0.00	6.00	7.59	7.32	0.76	13/3/13
6.00	12.00	8.09	7.81	0.81	16/4/13
12.00	18.00	8.66	8.36	0.87	7/5/13
18.00	24.00	9.33	9.00	0.93	
24.00	30.00	10.10	9.74	1.01	

Note: As of 14 June, 2013 conservation had not yet completed. A lengthy wait for PEG delivery meant that the process took much longer than initially planned. Once the PEG treatment is complete, the pump elements will be freeze-dried and placed into controlled storage.