6024 – The case for the Water-Carrier

Introduction

The concept of attaching a separate water vehicle to a steam locomotive, though virtually unknown in the UK, is not new. Overseas, in more remote parts where it proved unfeasible to provide permanent infrastructure to enable locomotives to pick up water while on the move, the use of a large water-tank/tender vehicle attached to the locomotive was commonplace, and accepted as the most obvious, practical solution.

Noting this practice, the Society's initiative is a logical response to the context in which steam traction operates on the modern railway in the absence of the traditional watering infrastructure. It is recognition that steam can cause problems to other traffic and if some of the causes can be removed, then if possible they should be. Conversely, other traffic can cause problems for steam traction. Out of course delays beyond the control of the locomotive owner can seriously damage punctuality and disrupt the operation, causing inconvenience to passengers and losses to the promoter, and distort water usage and potentially compromise the well-being of the locomotive.

By using the water-carrier on selected routes, the efficiency of operations can be substantially improved by removing the need entirely for watering on Network Rail. Effectively, in adopting a tried and tested method, watering operations can return to being as simple and inherently efficient as the accepted practice of times past.

The current methods of watering will always have the potential for unforeseen difficulties. Things are not habitually difficult, but on the rare occasions that things do go wrong, there exists the possibility that the situation will become irreversible. Despite diligent attention to detail at the planning stage, the current arrangements can have some potentially difficult-to-manage elements leading to complications, which require instant *ad hoc* responses.

Most of No. 6024's long-distance charters have consisted of (a) an outward leg with a few hours servicing layover at the halfway point, and an inward leg, (b) a circular route returning to the start-point, with a servicing layover at about the halfway point, and (c) a one-way tour. Although routine non-stop long distance work is a thing of the past, in preservation No. 6024 has occasionally exceeded the daily distances it would habitually have worked while owned by the GW and BR. As a rule of thumb, water stops are made about every hour, after 55 or 60 miles.

Current Arrangements

Under most hire agreements with promoters the Society arranges the supply of all consumables (lubricants, fuel and water) and bears all the costs. The Society agrees with the promoter plans for watering, and carries out a risk analysis of the locations. This includes the Operations Manager and his assistants doing a survey of logistical features such as hydrant positions and pressure, hose lengths, Support Crew access and road access. He contacts road-tanker companies and seeks approval for all necessary access and use. In most instances the arrangements are straightforward, risk assessments indicate no unusual problems, and the operations are executed satisfactorily. Occasionally, problems are foreseen, and the plans revised as necessary. Very occasionally, an unforeseen problem occurs on the day which relies on swift, decisive, collaborative, improvised action by loco owner, promoter, TOC crew, Network Rail, the supplier and anyone else qualified who can help.

The locomotive's requirement for water is given primacy in our rail-tour planning. Watering arrangements on Network Rail either involve the use of adjacent Water Authority/Fire Brigade water hydrants (supervised by Fire Brigade or Water Authority officers), Fire brigade vehicles or mobile road-tankers.

Unfortunately for our passengers and also Support Crews, these facilities are reached less and less from within station-limits, and increasingly from loops and sidings such as Oxford Up Sidings, Challow, Theale, Newbury, Tiverton, Abergavenny, Wantage Road, Swindon, Dorrington, Woodborough, Tiverton, Banbury Up Sidings; and not all are in well-lit urban locations. The practical arrangements inevitably include levels of improvisation. The Support Crews have to go "lineside", that is, down on the track, and even before looking out for passing rail traffic, this is inherently hazardous because of

the nature of the locations. The Crew members are often loaded down with essential equipment, walking along the “cess”, climbing up and down embankments and cuttings, negotiating fences, and at night, sometimes without any lighting apart from hand-held lamps. On certain itineraries, the Support Coach is at the wrong end of the train. And while all this is going on, the passengers are trapped in the train, sometimes for an hour or more.

Timings are dictated by the need to “thread” the charter through the paths of regular traffic, so it is the existing schedule which dictates the time we stand. As a result sometimes water-stops end up being either too short or too long and the timings do not reflect the precise needs of the locomotive. For instance, if there has been an unexpected loss of water *en route*, all the water-stop timings can turn out to be inadequate, resulting in irretrievable delays. This puts punctuality at risk and also compromises the management of the locomotive.

Over the years the Society has experienced a number of complications:

- Excessive water consumption due to out of course delays and unexpected additional load
- Total loss of water pressure at a previously checked hydrant
- Pump breakdown and wrong fittings on road-tankers
- Wrong amount of water on road-tanker
- Delivery of detergent-contaminated water in road-tanker
- Arrival at water-stop with less water in the tender than expected

Fortunately, these problems arise only rarely, but - and leaving aside the potential of a major problem with the locomotive if it runs short of water - when they do there is a massively increased chance of the train’s path being lost, so accumulating further delays and despite the efforts of everyone, the situation can become irretrievable.

To streamline the existing methods of watering the Society has modified and adapted the locomotive by fixing standard Fire Brigade fittings, and it carries a plethora of stand-pipes, hoses, adapters, etc. Dependent on delivery rates, replenishing the tank by 2,000 gallons might take 15-30 minutes. The tender tank has been slightly increased and can now carry just over 4,000 gallons. However, there is no further scope within the existing design of the locomotive and the tender for any more modifications which would provide a significant increase in the water capacity.

The vehicle’s design and usage

The vehicle has an axle-loading limit similar to the locomotive (22½ tons). It is fitted with two tanks totalling *ca.* 7,100 gallons capacity. When the tanks are full the vehicle weighs about 56 tons, and when empty 25 tons. The tanks feed by gravity up to 7,100 gallons into the locomotive’s tender tank, making a total available of about 11,100 gallons. Allowing for a safety margin and dependent of the route, this gives the locomotive a theoretical potential range of between 250 and 310 miles with a 350 ton train loaded train without the need for water-stops; for a 500 ton train the range would be between 170 and 220 miles. However, while the potential for such an operation is available it would be rare for No. 6024 to run for these mileages and with these volumes of water.

It should be stressed that it is not envisaged that long distances would be scheduled without any stops at all. Whether the rail-tour is an out and back, a circular or a one-way, it is anticipated that station pick up and set down stops will take place as usual, also with the usual brief stops for crew-changes and pathing.

It is recognised that for the following reasons the vehicle will be unsuitable for use where:

- gradients on a route are so severe that there is already an existing load restriction with a resultant unacceptable impact on payload,
- there are no turning facilities at the half-way point/destination,
- platform lengths prevent it
- double-heading is involved.

Arrangements for turning have been carefully considered and provided the proposals are supplied at the outset of the planning process, turning requirements such as propelling outside stations limits are accommodated.

A number of ideas and criticisms have been voiced in discussions, the press and websites over the years:

Ÿ *The 'King' could run long-distances non-stop* - Theoretically yes, but in practice improbable. Even timed at 75 mph. steam charter schedules inevitably conflict with faster service traffic and the priority given to these trains means we have to stand while they go past. What we do want to do is offer the opportunity for running in a more logical, less chaotic way, with *less* time spent in loops and sidings, so actually occupying the network for less time and therefore offering shorter journey times and greater punctuality; this will be to the benefit of passengers, promoters, the TOC and its footplate crews, Network Rail and the locomotive.

Ÿ *The vehicle will reduce the payload of the train by 2 to 3 coaches* - not so. It is clear that the vehicle cannot be used in all circumstances because the extra weight would mean the loss of a coach or more. There may also be instances where the train-length becomes an issue. Where it would definitely have these impacts we would not propose the vehicle's use. However, there are a number of routes where it need not have any effect at all. It must be understood that given the mileages we do on most rail-tours there would be *very few* occasions when the vehicle would be filled to its capacity. For instance, the water the 'King' requires to run a 450 ton train from London to Bristol and back would be in the region of 7,500 gallons in each direction. With this amount of water spread across both tanks in the vehicle and the tender, the extra weight of the vehicle plus load at the outset would be in the region of 35 tons (reducing to about 25 tons as the water gets used), additional weight easily within the locomotive's load-hauling capabilities and therefore needing to have no impact on payload at all.

Ÿ *The locomotive needs to stop every hour to clean the fire* - this is a chicken and egg situation. It's true we usually run the fire down before a water-stop, cleaning it while watering and re-building it afresh for the next section of the journey. This is because we have learnt that a large fire kept hot for 45-60 minutes while the engine is being watered is likely to clinker and cause problems later, and is very wasteful of coal and water. However, running the fire down causes cooling of the fire-box and the brick-arch and will also promote the process of clinkering. It also causes considerable thermal stress to the boiler and fire-box. The most efficient and least stressful way to manage the fire is by being at a standstill for the minimum of time, and thus being able to avoid any cooling of the fire-box and brick-arch at all by keeping the fire hot and well made-up. While it is clear that stops are inevitable, minimising the time spent standing reduces the chance of clinkering, uses less coal and water, and is also less wearing on the footplate crew (as well as the locomotive

Ÿ *The vehicle is no "oil-painting"* - true, but for the moment we have to get past the issue of its looks and concentrate on explaining and promoting its operational benefits. If it can prove itself in service than the question of how it looks can be tacked properly.

Ÿ *It will put passengers off travelling* - unlikely, given that passengers will get the chance of their rail-tour starting later and finishing earlier, allowing a smoother journey occupying less time, offering a longer time at the half-way point, and spending less time trapped in their seats while the train stands in some unattractive siding for up to an hour every hour.

<u>Summary</u>

By using the water-carrier on selected routes on Network Rail a number of significant benefits will materialise.

The tour promoter and the passengers benefit as follows:

Ÿ Allows later starts, earlier finishes
Ÿ Allows greater time at halfway point
Ÿ Reduces inactive standing time
Ÿ Reduces the time passengers are left in the train unable to disembark
Ÿ Reduces the journey time without reducing the journey distance
Ÿ Increases the likelihood of punctuality
Ÿ Can reduce TOC charges on itineraries when fewer crewmen are required

Network Rail and the TOC benefit as follows:

Ÿ Eliminates planning the water-stops on Network Rail at planning stage
Ÿ Simplifies planning and pathing
Ÿ Shortens overall journey times for footplate crews, reduces doubling up of crews
Ÿ Facilitates adherence to schedules
Ÿ Eliminates the need for turning on and off loops and sidings (which may be occupied)

- **Eliminates the lengthy stationary occupation of running-lines, platforms, loops and sidings**
- **Eliminates non-railway problems due to third parties at water-stops**
- **Eliminates the risk of delays and late-running due to unforeseen problems at water-stops**
- **No potential safety issues for footplate crews and Support Crews**
- **Eliminates the risk of public trespass at water-stops**
- **Facilitates scheduled stops at stations and in loops for pathing**
- **Water delivery not reliant on mechanical or moving parts**
- **Water delivery not from remote source**

In addition to the above, the locomotive and the Society benefit as follows:

- **Reduces the risk of thermal stress**
- **Reduces wear and tear and reduces risk of poor steaming or breakdown**
- **Allows efficient use of the locomotive**
- **Allows planning for a generous reserve of water**
- **Allows control over the quality of water and water-treatment**
- **Allows greater service-time for volunteer support crew at halfway point**
- **Saves consumption of coal and water**
- **Saves costs of consumables and road-tankers.**

Use on the Main Line

In June 2007 the Water-carrier was seen in action, on its first and second passenger trains. On the 9th June, the 170-mile Shrewsbury to Paddington "Cambrian Coast Express" was scheduled to stop to check the functional and operational performance of the vehicle at planned stops at Dorridge and Banbury. No arrangements were made for re-filling with water *en route*. At the start of the journey 11,100 gallons of water were loaded into the locomotive tender and the water-carrier. With the loaded train of ten cars plus the water-carrier the laden weight of the train was estimated at 470 tons at the start at Shrewsbury and 430 tons at the finish at Paddington. Total water usage was 6,750 gallons, an average for the run of 40 gallons per mile, or 0.09 gallons per ton per mile.

Delays getting off the depot caused a 10 minute late departure from Shrewsbury. At Walsall, when 2,000 gallons had been used out of the tender the valve between the tender and the water-carrier was opened.

The lateness was maintained throughout to the first planned stop at Dorridge, which was not taken so the delay was recovered. The first official stop was made at Banbury, about six minutes early, after 102 miles running. At Banbury, 4,050 gallons had been consumed. An on-time departure and lively running maintained the schedule until near Haddenham, where signal problems caused checks and eventually, a full stand. Considerable time was lost and Paddington was reached about 15 minutes down, having used 2,800 gallons from Banbury. Of the scheduled journey time of 274 minutes, about 44 minutes (16%) were spent stationary.

On the 16th June the 260-mile "Yeovil Bethrothal" ran from Paddington to Yeovil Junction and return. Stops were planned to check the functional and operational performance of the vehicle at Newbury Racecourse (outbound) and Newbury (return), with pick-up/set-down at Reading, and pathing at Frome. No arrangements were made for re-filling with water *en route*. At the start of each leg of the journey about 10,600 gallons of water was loaded into the locomotive tender and the water-carrier. With the loaded train of seven cars plus the water-carrier the laden weight of the train was estimated at 342 tons at the start of each leg, reducing to 321 tons at Yeovil and 326 tons at Paddington. Total water consumption was 8,250 gallons, an average for the run of 32 gallons per mile, or 0.10 gallons per ton per mile.

Departure was on-time from Paddington at 0910. At Newbury Racecourse (52 miles), arrival was six minutes late after delays due to a preceding service, reducing the station stop to nine minutes. 2,250 gallons had been used. Departure from Newbury was on-time and by Haywood Road Junction the train was 4 minutes early. The booked pathing stop at Frome North was not required, nor was the station stop at Yeovil Pen Mill, and arrival at Yeovil Junction was at 1238, 42 minutes early. At Yeovil (77 miles from Newbury), 4,700 gallons had been consumed.

The return left Yeovil Junction on-time, at 1935. Arrival at Newbury was 13 minutes early, when 2,200 gallons had been used. Departure from Newbury was 7 minutes early, after a 22 minute stop. The

Reading arrival for set-down was 6 minutes early and with the use of the Up Main to London, Paddington was reached at 2238, 31 minutes early. At Paddington, 1,350 gallons had been used from Newbury.

The scheduled outbound journey time was 250 minutes, but the actual duration was 208 minutes, and about 18 minutes of the actual (about 9%) were spent stationary. The scheduled return journey time was 214 minutes, but the actual was 183 minutes, and 27 minutes of the actual (about 15%) were spent stationary.

6024 Water Carrier - Sample Itineraries

A	B	C	D	E	F	G	H	G
	Sample Itinerary	*Usual Intermediate Water-stops*	*Miles*	*Estim. Water requ'd*	*Water Carrier Use*	*Max. Load (tons)*	*Mark 1/ Mark 2 Coaches*	*Comments*
1	London Paddington-Westbury-Kingswear	Newbury, Frome, Taunton/Tiverton Jnct.	209	10500	Yes	485	12 or 13	
2	Kingswear-Westbury-London Paddington	Exeter, Frome, Theale	209	10500	Yes	485	12 or 13	
3	London Paddington-Bath-Bristol TM	Challow	118	8000	Yes	530	13	
4	Bristol TM-Bath-London Paddington	Wantage Rd	118	8000	Yes	530	13	
5	London Paddington/Victoria-Swindon-Worcester	Challow, Gloucester Yard	147	10000	Yes	485	12 or 13	
6	Worcester-Swindon-London Paddington/Victoria	Kemble, Wantage Road	147	10000	Yes	485	12 or 13	
7	London Paddington/Victoria-Swindon-Gloucester	(Kensington O), Challow	114	8000	Yes	485	12 or 13	
8	Gloucester-Swindon-London Paddington/Victoria	Kemble, Wantage Road	114	8000	Yes	485	12 or 13	
9	London Paddington/Victoria-Westbury-Yeovil Jnct	(Kensington O), Newbury RC, Frome	128	8500	Yes	530	13	
10	Yeovil Jnct-Westbury-London Paddington/Victoria	Frome, Theale	128	8500	Yes	530	13	
11	London Paddington/Victoria-Westbury-Bath-Bristol TM	(Kensington O), Newbury RC, Hawkridge Jnct	127	8500	Yes	530	13	
12	Bristol TM-Bath-Westbury-London Paddington/Victoria	Woodborough,Theale	127	8500	Yes	530	13	
13	Bristol TM-Reading-Westbury-Bath-BTM	Wantage Road, Newbury RC, Hawkridge Jnct	170	10000	Yes	530	13	
14	Bristol TM-Kingswear	Taunton, Exeter	112	7500	Yes	485	12 or 13	
15	Bristol TM-Severn Tunnel-Hereford-Worcester-Birmingham SH	Magor, Hereford, Worcester	133	8000	Yes	435	10 or 11	Load Limit (Old Hill or Lickey)
16	Bristol TM-Cardiff-Carmarthen	Port Talbot	115	8000	Yes	485	12 or 13	Reduce Load for Cockett Bank
17	Carmarthen-Cardiff-Bristol TM	Port Talbot	115	8000	Yes	485	12 or 13	Reduce Load for Cockett Bank
18	Bristol TM-Hereford-Shrewsbury	Magor, Hereford	120	8500	Yes	530	13	
19	Shrewsbury-Hereford-Bristol TM	Hereford, Magor	120	8500	Yes	530	13	
20	Bristol TM-Worcester-Hereford-Bristol TM	Gloucester Yard, Worcester, Hereford, Magor	166	10000	Yes	530	13	
21	Bristol TM-Hereford-Shrewsbury-Bescot	Magor, Hereford, Shrewsbury	162	10000	Yes	530	13	
22	Tyseley-Bromsgrove-Gloucester-Chepstow-Newport	Gloucester	104	7500	Yes	530	13	
23	Newport-Chepstow-G'ster-Bromsgrove(Stourbridge Jnct)-Tyseley	Gloucester	104	7500	Yes	435	10 or 11	Load Limit (Old Hill or Lickey)
24	Shrewsbury-Wolverhampton-Princes Risborough-London Paddington	Saltley, Banbury	160	10500	Yes	530	13	
25	Swansea-Cardiff-London Paddington	Port Talbot, Newport, Bristol Parkway, Wantage Rd	191	12000	Yes	485	12 or 13	Stop at Newport
26	Minehead-Westbury-London Paddington	Bishops Lydeard, Frome, Theale	167	11000	Yes	485	12 or 13	Attach WC at Bishops Lydeard
27	Kingswear-Bristol TM	Exeter, Taunton	112	7500	Yes	485	12 or 13	

Notes:
(1) Maximum Load indicated is at start-point and reduces by *c.* 4.5 tons for every 1,000 gallons used
(2) Estimated Water Required includes contents of the tender (4,000 gallons) with the balance carried by the Water Carrier
(3) Estimated Water Required is based on previous records for each section and includes a reserve of *c.* 1,000 gallons
(4) Total amount of water available is *c.* 10,500 gallons plus reserve before the need to re-fill.