

3 Need and Alternatives

3.1

3.1.1

Need for the Scheme

Introduction

Replacement of the Cross-Solent main is a key feature of Southern Water's water resource plan for the Isle of Wight, for the period to 2030. This section explains why it is necessary to replace the main and describes the consideration given to alternatives.

The Cross-Solent main is a vital component of the water supply infrastructure serving the Isle of Wight. Over the course of a year it carries about 27% of the total volume of water supplied to the island's consumers, and a higher percentage at times of peak demand.

The twin pipelines laid across the Solent in 1980 have reached the end of their design life and their condition is deteriorating. In February 2003, one of the pipes was damaged by a ship's anchor. Until a repair was completed, the temporary loss of half of the available transfer capacity placed a significant strain on the island's water resources.

Investigations showed that the damaged pipeline failed at a significantly lower load (approximately 8 tonnes) than its ultimate design load of 67 tonnes. This indicates that the armoured layers surrounding the inner pipeline have deteriorated, giving concern over the ability of the pipes to continue to withstand the normal pumping pressures associated with water transfer.

Without the ability to transfer water from the mainland, it would not be possible to meet peak demands for water on the island. There is thus a fundamental need both to replace the underwater section of the main between Lepe and Gurnard and to ensure that the capacity of the new main is sized to play the role in meeting the Isle of Wight's forecast water needs to 2030 envisaged in the water resource plan.

The overland sections of the main, which complete the link between Testwood Water Supply Works at Totton with Broadfields service reservoir on the island, are in satisfactory condition and have sufficient additional capacity to handle the anticipated growth in demand for water.

3.1.2

The Process of Water Resource Planning

As a statutory water undertaker, under section 8 of the Water Industry Act 1991 Southern Water has a duty to develop and maintain an efficient and economical system of water supply within its area. To do so it has to plan ahead.

Water resource planning in England and Wales is carried out in a statutory context, involving other official bodies with linked duties and responsibilities. The Environment Agency has to secure the proper use of water resources in England and Wales, within a general framework of policy and directions determined by the Secretaries of State. The Director General of Water Services (DGWS) must ensure that companies can finance the proper conduct of their functions. The Secretary of State, the DGWS, the Environment Agency and Southern Water each have environmental duties to take into account.

Southern Water's water resources plan for the period 2002/03 to 2029/30 (April 2004) has been prepared in accordance with the "Water Resources Planning Guideline" (the Guideline) published by the Environment Agency, which sets out a structured approach developed in consultation with Ofwat (the Office of Water Services, led by the DGWS) and the water industry.

The Environment Agency published its advice to Ministers on the water resources plans submitted by water companies in the document "Maintaining Water Supply", published in July 2004, which does not dispute the plan submitted by Southern Water.

Southern Water's water resources plan compares the supply of water available to the company with the demand for water, to establish a supply-demand balance. The methodology used to determine available supply and forecast demand and the factors to be considered when developing proposals to bridge any gap, are set out in the Guideline.

The plan assesses the amount of water likely to be available from sources (the 'deployable output') which may be constrained by environmental and other factors. In many cases the deployable output is significantly less than the consented level.

Calculations of deployable output and headroom acknowledge that output from an individual source or groups of sources may be significantly below the licensed volume. Many abstraction licences were granted some years ago and do not always reflect the current sustainability of the licensed volumes. The Environment

Agency reviews licences where there is evidence that abstractions are harmful to the environment. However, in many cases an abstraction volume approaching the licensed value is required only under conditions of highest demand for water supplies and for short periods of time only. Under dry year conditions the available water resource and the deployable output will be significantly less than the licence volume.

Demand forecasts take account of population forecasts and the proposals of the statutory development plan. Factors that might reduce the rate of demand increase, such as domestic supply metering and leakage reduction, are also assessed. The detailed position on metering and leakage in the Isle of Wight distribution system is described below under the heading of alternatives. In brief, almost all properties in the Isle of Wight are already metered and leakage is below the calculated economic level.

The plan calculates 'headroom' - an important element of the supply-demand balance which allows for uncertainty. This is done using a probability based approach according to the latest industry guidelines. The forecast implications of climate change for river flows and groundwater recharge are also factored in, using approved methodology.

3.1.3

The Cross-Solent Main in the Context of the Isle of Wight's Water Supply Infrastructure

As noted previously, around 27% of the Isle of Wight's water supply is pumped from the Testwood Water Supply Works (WSW) at Totton, near Southampton, which treats water abstracted from the River Test. The remainder comes from island resources, principally Carisbrooke WSW (23%) and Sandown WSW (25%) which put into supply water abstracted from the chalk aquifer and the River Yar respectively. The remainder (25%) comes from smaller individual sources on the island. Several other small sources are licensed for abstraction but, largely for environmental reasons, they contribute little to the public supply.

The general arrangement of water sources and storage reservoirs on the Isle of Wight is shown in Figure 3.1. The Carisbrooke WSW is centrally located and is able to supply most parts of the Island's distribution system. The Cross-Solent main feeds Newport and West Wight, whereas Sandown WSW feeds the resorts of East Wight (Ryde, Sandown, Shanklin and Ventnor). The Knighton WSW feeds West Ryde and Wootton, but is linked to the Sandown WSW supply zones. A number of the smaller sources including Calbourne, Chillerton, Niton and St Lawrence have until recently been operated as 'stand-alone' sources, but network

reinforcement work in progress will link them to provide additional security of supply.

The Cross-Solent main is thus critical to maintaining sufficient supplies to the Isle of Wight, especially in drought conditions. Even under normal operational conditions, the configuration of the bulk transfer and distribution systems requires a continuing supply from the mainland. From the Testwood WSW, water is pumped through a trunk main, with a branch to the Esso Oil Refinery at Fawley, to Mopley, where a booster pumping station delivers the supply through the Cross-Solent main to Broadfields WSW. At Broadfields WSW the supply is pumped onwards to Alvington Reservoir and for supply to customers.

Any shortfall of supply from the mainland places heavy reliance on the Carisbrooke WSW, and resulting additional abstraction on the island depletes essential aquifer storage needed to meet summer peak demands. Thus, records of abstraction at Carisbrooke during the period when the mainland supply was reduced following the loss of one of the two existing mains, due to an anchor strike, reveal the source to be under considerable stress, despite the initially healthy groundwater levels following the exceptionally wet winter of 2002/03.

In accordance with s50 of the Habitats Regulations, the Environment Agency has recently reviewed abstraction consents on the Isle of Wight. The review concluded that abstraction from a number of sources might be having an adverse environmental impact on European Sites (designated under the Habitats and Wild Birds Directives). Investigations are currently underway to assess mitigation options, which could involve reductions in deployable output.

Water resources on the Isle of Wight are planned to meet summer demand during the week of highest demand (PPDO) and the annual average demand (MDO).

PPDO (peak period deployable output) is defined as the water available in the drought planning year during the critical period of peak demand for water. Typically this will be the week of maximum demand during the summer. MDO (minimum deployable output) is the water available at the time of lowest water availability in the drought planning year and will typically occur during autumn when demand for water is average for the year.

Table 3.1 summarises the supply-demand balance for the Isle of Wight from Southern Water’s water resource plan, calculated in accordance with the Environment Agency’s Guideline. Negative figures indicate a deficiency in supply. The table identifies the Isle of Wight’s dependency on the Cross-Solent transfer and highlights the necessity of replacing the existing life-expired asset. It also confirms the need to increase the deployable output available to the Isle of Wight to meet forecast longer term needs.

Table 3.1 *Balance of supply and demand*

Year	With existing Cross-Solent transfer		Without existing Cross-Solent transfer	
	Balance on Average (Ml/d)	Balance on Peak (Ml/d)	Balance on Average (Ml/d)	Balance on Peak (Ml/d)
2003-04	-3.14	1.22	-14.99	-10.63
2010-11	-4.38	-0.59	-16.23	-12.44
2015-16	-5.6	-2.48	-17.45	-14.33
2020-21	-6.76	-4.29	-18.61	-16.14
2025-26	-8.02	-6.27	-19.87	-18.12

3.1.4

Consideration of Alternatives

Southern Water’s resource plan concludes that the replacement of the existing Cross-Solent main is required to secure the existing water supply to the Isle of Wight. It is evident from Table 3.2, and from the experience of the difficulties encountered during the period when one of the mains was damaged, that there are no other viable resource options.

The plan also concludes that the preferred resource option for the Isle of Wight, which needs to operational by 2012, is an increase in supply from the mainland. This option has been agreed by the Environment Agency, included in the Agency’s advice to Ministers and specifically recognised by the DGWS in Southern Water’s business plan. The following paragraphs explain how this conclusion has been reached.

The Environment Agency Planning Guideline requires that all unconstrained options to meet the supply requirement are identified and that a more detailed study is made of the feasible options. An economic analysis of feasible options is carried out to include environmental and social costs, using a modelling framework consistent with latest industry standards.

Nine unconstrained options to address the identified shortfall in supply to the Isle of Wight were identified and considered alongside a number of generic options. Five of the unconstrained options were discounted because they would produce no viable additional resource yield. The remaining four options, listed in Table 3.2, were taken forward for more detailed study.

Table 3.2 – Summary of feasible resource options

Resource Option	Description	Yield (Ml/d)
Sandown WSW - recover process losses	Wastewater from process losses is currently discharged to sewer. Recovery of losses to increase output	1.18
Broadfields WSW – provide treatment	Provide treatment to enable the on-site borehole to be returned to service	1.1
Increase the capacity of the Cross-Solent main	Increase the transfer from the mainland (From 12Ml/d to 20 Ml/d)	8
Chillerton Reservoir	Only major resource that might feasibly be developed on the Island	13 (peak) 10 (Average)

The principal generic resource options considered were desalination, effluent re-use, and the use of ships to tanker supplies from the mainland or elsewhere. The tankering option was discounted due to cost and the environmental implications of providing offshore anchorage and other facilities to transfer water in sufficient volumes to the Island. Re-use of effluent was also discounted. In order to avoid the potential health issues that might arise as a result of recycling effluent within a ‘closed loop’ on a small island, it would be necessary to transfer effluent from the mainland, requiring lengthy transfer mains.

Desalination was discounted due to the adverse implications for the energy balance for the Isle of Wight, cost and the likely impact on the coastline, almost all of which is a landscape and natural environment of national and international significance. Desalination proposals would have to include infrastructure to dispose of the process waste and to re-mineralise and transfer the desalinated water to customers.

Two of the feasible options identified in Table 3.2, Sandown WSW and Broadfields WSW, would deliver only small additional yields, insufficient to meet the identified long term shortfall. The water resource plan concludes that the Sandown option should proceed, and this will meet the immediate need. Further investigations are to be undertaken at Broadfields to determine the viability of the

source therefore no development work is programmed for a regulatory period 2005 – 2010.

The development of an impounded reservoir in the valley of the River Medina, probably at Chillerton, within the Isle of Wight Area of Outstanding Natural Beauty, would not have sufficient yield to replace the existing contribution from the mainland. Therefore this option includes the replacement of the Cross-Solent main, at its current capacity.

Reservoir development in this location would present significant environmental challenges. The reaction of stakeholders, were such a proposal to be put forward, is unknown. Even if consent was to be granted speedily on first application, it would take at least 10 years to prepare and implement such a scheme. A more reasonable assumption is that the consenting process would be protracted and it might take up to 25 years before a new reservoir could become operational. Convincing evidence of lack of alternatives would be required in order to override the presumption against development if it affected a nationally important landscape.

Assuming the promotion of the Sandown improvements, a new increment of supply is required from 2012. This is significantly earlier than earliest possible date at which a reservoir could become operational.

Southern Water's water resource plan accordingly concludes that an increase in supply through the Cross-Solent main is the only feasible option to meet water demand on the Isle of Wight. The analysis is in accordance with the water resource Planning Guideline, has passed the scrutiny of the Environment Agency and independent scrutiny by the Reporter appointed by the DGWS and is included in the Agency's advice to Ministers.

The extra cost attributable to specifying larger pipes when relaying the Cross-Solent main, in order to increase the transfer capacity from 12Ml/d to 20 Ml/d, is around 5-10% of the total budget. The additional environmental impact (of the difference between laying and operating 300mm diameter pipes rather than 200mm diameter pipes) would be insignificant.

Sufficient resources are available within the abstraction licence at the Testwood WSW, which is the largest treatment works in Southern Water's area, to meet the Isle of Wight's needs as identified in the water resource plan.

Southern Water is working alongside Portsmouth Water, the Environment Agency and English Nature to ensure that water supplies to the South Hampshire conurbation, which is supplied from Testwood and other works in Hampshire, continue to be provided sustainably over the long term.

The Environment Agency is currently reviewing licences under s50 of the Habitat Regulations and preparing catchment management plans. The early signs are that reductions will be necessary in abstraction from the River Itchen and possibly also the Test. The nature and scale of the remedial actions necessary to deal with this position depend on the scale of the reductions, which is not yet known, but include the possibility of bulk transfer pipelines and a reservoir at Havant Thicket, north of Portsmouth. These options are presaged in the companies' water resource plans.

3.1.5

Summary

In summary, it is essential to replace the life-expired Cross-Solent main. Water from the mainland is a vital resource for the Isle of Wight; without it Southern Water could not meet the island's needs. Southern Water's Resources Plan, which has been approved by the Environment Agency, confirms that the only feasible resource option for the Isle of Wight that is available to meet the water needs in the period after 2012 is an increase in supply from the mainland. This option has been agreed by the Environment Agency and recognised by the DGWS in the Company's business plan. The additional environmental impact of increasing the diameter of the twin pipelines across the Solent has been assessed as not being significant and the extra cost of doing so is 5 – 10% of the capital cost.

3.2

Alternative Options

As discussed in section 3.1, an analysis of additional water resources to the Isle of Wight by Southern Water identified that increasing the supply of water from the mainland to the Isle of Wight is the only feasible option.

Following the initial screening of all options, five shortlisted solutions for increasing the water supply (including the do nothing option) were assessed against technical, environmental and social parameters.

The five preferential solutions considered as part of this study are outlined below. The options considered and the reasons for their being adopted or rejected are summarised in this section.

- *Option 1: Do Nothing*

This option would involve no active intervention and would inevitably result in the failure of the existing Cross-Solent mains pipes (which have reached the end of their design life), resulting in the loss of a water supply to the Isle of Wight.

This would have extensive detrimental effects on the inhabitants, visitors and industry on the Isle of Wight and would result in bad publicity for Southern Water as the company would fail to comply with its contractual obligation (regulated by OFWAT) to supply water to its customers.

This option has not been considered further as it is not socially acceptable and would result in a severe risk of water shortage in the near future as the existing local water resources are unable to support the water demand on the Isle of Wight.

Options 2 - 5

Options 2 - 5 involve larger capacity pipeline(s) to account for future growth in water demand. Alternative solutions of a single 450mm diameter pipeline, twin pipelines and multiple smaller diameter pipelines offering equivalent total carrying capacity were considered and the preferred solution of two pipelines of 300mm diameter adopted, to allow some security and operational flexibility at the vulnerable marine crossing. Four installation options were then considered.

- *Option 2: The 'All Marine' Invasive Trenching Option.*

This option would entail laying twin flexible pipes (approximately 3.5km of flexible 300mm pipe) directly on the seabed from shore to shore from a vessel, with invasive trenching across the foreshore. The pipeline material could be either rigid welded steel, un-reinforced solid wall flexible High Performance Polyethylene (HPPE) (PE100 SDR11 16 bar rated), or armoured flexible pipe similar to the existing pipelines. Steel pipe would involve a temporary stringing yard on land. Plastic pipe options could be assembled elsewhere and towed floating to site or could be laid from a reel on a vessel. Existing services, abandoned cables and other hazards would need to be accurately identified to determine the optimum route.

Dredging would be difficult in the deeper section, with depths to seabed up to 25m.

Sub-options that could be pursued in the off-shore areas comprise direct lay on the seabed without trenching, which would be unacceptable in terms of its high vulnerability to damage by vessels, and a pipeline in a pre-dredged or post-dredged trench for all or part of its course, which would subsequently be buried. Rock armour or mattress protection could be considered in the deeper or more vulnerable sections (perhaps in lieu of trenching) to protect the pipes.

This option has been discounted on environmental grounds. The invasive trenching would have an adverse impact upon the foreshore and shallows of the internationally designated conservation sites including the Solent Maritime Special Area of Conservation (SAC) and the Solent and Southampton Water Special Protection Area (SPA) and Ramsar site.

- ***Option 3: The 'Combined' Option. Proposed Solution***

The foreshore/inshore sections of the pipe will be installed by a trenchless technique 'horizontal directional drilling (HDD)' from land to below the low water mark (and beyond Gurnard Ledge on the Isle of Wight side) to avoid disturbance to the internationally designated conservation sites, involving drill lengths in the order of 900 to 1100m on each side of the crossing. The central section will be constructed on the seabed for the approximate 2250m long mid section by an embedment (pressure jetting) technique, which will bury the pipeline to a depth of approximately 1.5m. Connections between the marine and HDD pipeline sections will be undertaken by divers depending on the type of pipe material used, or if flexible pipes are involved, on board a vessel.

The works will involve drilling rigs on land with temporary working areas including a mud-handling plant on each shore. Polyethylene (PE) is considered to be the most appropriate pipe material for the HDD, though steel and armoured flexible pipes are possible alternatives. Additional area may be needed in the short term for pipe stringing on land (compound area) or alternatively a flexible pipeline could be assembled elsewhere floated out to sea and pulled back towards the rig site.

As with all the options, the proposed solution will require an area of terrestrial land-take for a working area (i.e. to set up rig sites) and will necessitate encroaching upon a small area of arable land within the New Forest National Park and in a field south of Cliff Farm at Gurnard.

However, this option will not generate significant quantities of arisings and will therefore not lead to major impacts on traffic and transportation routes.

This is considered to be the most environmentally acceptable option as it avoids disturbance to the intertidal areas of the internationally and nationally designated conservation sites that would be experienced through trenching (option 2). Also, the HDD pipeline sections would emerge at a minimum distance of 50m beyond the designated conservation sites so that a relatively small volume of drilling lubricant such as bentonite on drill break out at the seabed will not adversely impact on the designated sites.

This option will also have minimal impacts on the local landscape character and the visual effects of this option will be limited to the construction works.

- *Option 4: HDD The Whole Length of the Pipeline.*

With current technology the maximum viable single drill length is in the order of 2.0 to 2.3km, however it is possible in theory to drill from both shores and meet in the middle to form a continuous drilled hole of approximately 3.7km length overall. There are two sub-options:

(3a) 'U' shape format, where there would be no impact at all on the seabed or marine environment. In this case the pipeline would be strung out on land on one side and pulled all the way through to the other by a land based winch. The pipeline would probably have to be steel to cope with the large pull forces involved.

(3b) Alternatively, it could be a 'W' format, whereby a drill from each side would emerge at a similar mid channel location. In this case flexible pipeline could be pulled back from reels on a marine vessel or jack-up platform located at the mid channel location.

This option would avoid direct disturbance to the internationally designated conservation sites although in the case of the “W” option there would be some release of drilling lubricant.

As with option 3, this option would require an area of terrestrial land-take in order to set up rig sites and would necessitate encroaching upon an area of land within both the Lepe Country Park and New Forest National Park, and in the field south of Cliff Farm at Gurnard.

This option would generate approximately 2500m³ of arisings. This would result in higher volumes of construction traffic than the proposed scheme (option 2), which will generate approximately 1850m³.

This option would involve high construction risks due to the considerable length that would require drilling and may be limited by technology. In order to undertake a drill of this length, a very long stringing yard would be required (between 500m and 2km), which would not be practicable. Consequently, this option was rejected on technical grounds.

- *Option 5: Tunnelling*

This option would involve the construction of a ‘conventional’ tunnel extending approximately 4km from shore to shore and at least 3.5m internal diameter (for practical construction and safety reasons). This would require a bore diameter of around 4.2m and a cross-sectional area of 13.85m². Consequently, this would result in a large and expensive project, with significant quantities of tunnel arisings (estimated to be approximately 72,000m³ assuming a bulking factor of 1.3) needing to be transported and disposed to land. It is estimated that approximately 7,200 truck loads would be required to dispose of the arisings, which would have major adverse traffic implications. It is not a viable option unless considered as a shared multi-utility project, which is not feasible within the current regulatory programming constraints of Ofwat and Ofgem.

Microtunnelling could be used for the shorter inshore trenchless sections of option 3, but on initial consideration seems unlikely to be an attractive choice when compared to horizontal directional drilling (HDD), given the small pipe diameters involved. There are significant doubts as to the viability of Microtunnelling here, as recovery of the tunnel boring

machines at the seaward end would be extremely risky, difficult and impractical.

Both options may be considered as an alternative to HDD, but are unlikely to be attractive options given the small pipe diameters and high costs involved. The construction of a tunnel would also result in a high level of waste, which would present significant environmental impacts. Consequently, this option has been rejected on both economic and environmental grounds.

The above options and sub-options would all have very different impacts, constraints, risks, costs and study requirements. Investigations including desk studies, consultations, ground investigations and surveys have been undertaken in order to select the preferred option 'option 3' for the outline design and planning applications.