ASHFORD'S FUTURE: IWMS
FINAL REPORT

SECTION 8 CONTENTS

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8 SHORTLISTING INTEGRATED STRATEGIES

8.1 INTRODUCTION

Considerations thus far have identified six integrated strategies, characterised by the following component system-based strategies (Table 8.1):

Table 8.1: Composition of candidate integrated strategies

Integrated strategy	Derivation (system-based strategy references)			
	FRM	Water supply	Wastewater	Ecological Water components
IS1	FD8	WS3(i)	WW1	EW2, EW3/4 EW5, EW6, EW7, EW8, EW10
IS2	FD8	WS3(i)	WW4	EW2, EW3/4 EW5, EW6, EW7, EW8, EW10
IS3	FD8	WS3(i)	WW7	EW2, EW3/4 EW5, EW6, EW7, EW8, EW10
IS4	FD8	WS4(i)	WW1	EW2, EW3/4 EW5, EW6, EW7, EW8, EW10
IS5	FD8	WS4(i)	WW4	EW2, EW3/4 EW5, EW6, EW7, EW8, EW10
IS6	FD8	WS4(i)	WW7	EW2, EW3/4 EW5, EW6, EW7, EW8, EW10

The integrated strategies may be differentiated by the choice of water supply system strategy (WS3(i) or WS4(i)) and by its wastewater management system (WW1, WW4 and WW7). All other component system strategies are common to all integrated strategies. Comparison among integrated strategies below may therefore be conveniently made primarily by reference to these differentiators.

8.2 COMPARISON OF WATER SUPPLY SYSTEM STRATEGIES

The two water supply system strategies under consideration are to follow the current regional strategy, but to reduce borehole abstractions in the Ashford supply zone. Compensation for the resulting loss of PDO is to be provided either by:

- River abstraction upstream of Wye; treatment of river water to potable standards and introduction into the existing MKW trunk main north of Kennington (WS3(i)); or
- Development of a new source outside the study area such as a desalination plant on the Romney Marshes, close to Hythe; connection to the F&DW system, and extension of the system into the MKW trunk mains system to serve Ashford (WS4(i)).

The relative strengths and weaknesses of the two alternatives are compared against performance characteristics and quality objectives, as set out below. .

Appraisal against performance characteristics

A tabulated summary of an appraisal of the two water supply system strategies against the technical, economic and other performance characteristics is presented in Table 8.2

The two strategies each involve the construction of modestly sized water treatment works, of tried and tested technologies, capable of being designed for expansion, if necessary, to cope with planned or unplanned increases in demand (subject to land availability). Increases in PDO of

Table 8.2: Comparison of Performance Characteristics of Water Supply System Strategies (Page 1 of 2)

Performance characteristic		WS3(i)	WS4(i)
TECHNICAL	Proximity principle	The proposed compensation source is located within the Study Area, close to the existing sources that are to be (partially) replaced, and the trunk main to which the new source is to be connected.	The proposed compensation source has not been explicitly identified, but most probably would comprise a full sea water RO facility on or close to the south Kent coast, within F&DW's area of operation.
	Robustness of design (to deliver higher/lower PDO)	The PDO of the compensation source can be designed to match any increased demand without impacting low flows in the Stour since (wastewater effluent) flows in the Stour will correspondingly increase. The abstraction works may be designed for modular expansion to cope with unplanned increase in demand.	If the source were a full sea water RO plant, the PDO of the compensation source, and associated infrastructure, can be designed to match any increased demand. The RO plant may be designed for modular expansion to cope with unplanned increase in demand. System reinforcement to transfer additional flows may be required.
	Reliability of design (to achieve design standards)		
	Reliability of technology (to perform without undue technical problems)	Conventional technology would be employed. Buffer storage could be provided to allow for controlled shut down in the event of unacceptable quality of raw water	Desalination is widely used around the world and the technology is well understood.
	Flexibility of design (to accommodate changes in development during 25-year development period)	The PDO of the compensation source can be designed to match any increased demand without impacting low flows in the Stour since (wastewater effluent) flows in the Stour will correspondingly increase. The abstraction works may be designed for modular expansion to cope with significant unplanned increase in demand.	If the source were a full sea water RO plant, it could be designed to allow the output to be ramped up and down to match variations in demand. The RO plant may be designed for modular expansion to cope with significant unplanned increase in demand. System reinforcement to transfer additional flows may be required.
	Potential for extension of design (beyond 2030? –climate change)	Provided land is available, the WTW could be expanded to provide higher PDO to match increase in (wastewater effluent) flows in the Stour	Provided land is available, the RO plant could be designed to allow for future expansion by the addition of extra streams. System reinforcement to transfer additional flows may be required.
	Potential for achieving higher design standards (should it prove necessary)	Depending on the process selected, a higher standard could be achieved (though potable water quality standards are not expected to be significantly changed)	The RO process effectively produces distilled water and has to be treated to make it palatable and reduce its corrosiveness
	Constructability	The plant envisaged would be conventional on a green field site	Desalination plants, while complex, should not offer construction difficulties. Marine intake and outfall may require special temporary works, but nothing insurmountable.
	Ease of maintenance	As any conventional plant	RO currently requires relatively high levels of maintenance and regular membrane replacement
	Ability to construct in phases	The plant could be designed to have a number of process streams that could be constructed in phases, though the full (say, 5Ml/d) PDO would probably be needed ASAP.	The plant could be designed to have a number of process streams that could be constructed in phases, though the full (say, 5Ml/d) PDO would probably be needed ASAP.
	Sustainability	As with any conventional WTW there would be the need for power, chemicals and the disposal of sludge. New technologies should be incorporated where ever possible to improve efficiency	RO has high energy requirements, needs regular membrane replacement and generates a concentrated saline waste, which would require discharge back to sea via an outfall.
	Disruption to existing infrastructure	This would be a new facility that would be located relatively close to existing infrastructure and into which it could be connected.	In the case of an RO plant located on the south Kent coast, F&DW's infrastructure would have to be modified to accommodate the additional source in the south of their operating area to release existing sources in the north for export to Ashford.
	Reliability for achieving discharge consent	n/a	n/a
	Land take	The plant would likely occupy a green field site adjacent to the Stour. An indicative process footprint would be around 1500m2 (minimum) to which would need to be added the area needed for buffer storage.	An RO plant on the South Kent coast would require land to be allocated/purchased probably to the west of Hythe on the edge of Romney Marshes. F&DW have considered a small RO plant in this location for compensation water for their own GW abstractions. An indicative process footprint would be 1600m2 (minimum)
	Need for crossings of the major transport corridors (M20 and CTRL)	Provision of an additional crossing of the M20 or CTRL is not required as the compensation source works and system connections would be located north of Ashford. A crossing of the Stour and the Ashford to Canterbury rail link may be required depending on the location of the works.	In the case of an RO plant located on the south Kent coast, a crossing of the M20 and CTRL should not be necessary in the short term if F&DW's infrastructure was modified so the new source fed the F&DW area around Hythe to the south of the M20/CTRL corridor and existing sources to the north, that currently supply Hythe, are utilised for Ashford. In the longer term a crossing of both the M20/CTRL near Sellindge would improve the integration of the MKW and F&DW networks once Brabourne Lees reservoir and the connection to Broad Oak are complete.

Table 8.2: Comparison of Performance Characteristics of Water Supply System Strategies (Page 2 of 2)

	Performance characteristic	WS3(i)	WS4(i)
ECONOMIC	Whole life cost	Indicated PV of 30 years' costs £54.0 million	Indicated PV of 30 years' costs £72.3 million
	Capex	Indicated CAPEX of WTW and connection to MKW system £50.6 million	Indicated CAPEX of desal plant and connection to F&DW/MKW systems £62.6 million
	Opex	Indicated 30 years' OPEX of WTW and pumping plant £23.9 million (undiscounted)	Indicated 30 years' OPEX of desal and pumping plant £41.1 million (undiscounted)
	Cost / benefit ratio	No significant difference in 'benefits' between strategies. B:C ratios will therefore be in inverse relationship to whole life costs. WS3(i) ratio will be 1.34 times that of WS4(i)	No significant difference in 'benefits' between strategies. B:C ratios will therefore be in inverse relationship to whole life costs. WS4(i) ratio will be 0.75 times that of WS3(i)
OTHER	Visual impact	It is likely that the new works would detract from the semi-rural nature of the area suggested for the Works	A RO plant on the south Kent coast could have considerable visual impact, particularly on the edge of Romney Marshes
	Benefit to communities	The river quality downstream of Wye should be improved by a slight reduction of the effluent content in the Stour and an increase in flows from the chalk springs resulting from the reduction of groundwater abstractions	There will be a positive benefit to the Great Stour resulting from increased chalk spring flows, but an RO plant will not provide any particular benefit to the community in which it is located, and may be seen as environmentally unfriendly following the rejection of TWUL proposal for the Thames
	Likely political will	Possible objections to the use of a green field site, but should attract support for a local, single water company (MKW) solution to a river water quality issue, which could be implemented reasonably quickly.	Potential PR problems with RO plant following the rejection of TWUL proposal for the Thames. The strategy needs the support of councils and politicians who may see no benefit to themselves or their constituency
	Consistency with policies	The proposal addresses the Agency's concern for over-abstraction of groundwater and slight improvement of summer low flows over current levels.	Not a local solution but enhances integration between MKW and F&DW. It addresses the Agency's concern for over-abstraction of groundwater and improvement of summer low flows (slightly).
	Funding availability	Funding would have to be under PR09 and linked to environmental requirements of the WFD.	Funding could be a problem under current arrangements. If F&DW built plant to supply relatively expensive water to own customers how do they get recompensed by export to MKW. A joint funding arrangement such as those for Bewl and Broad Oak may be needed
	Safeguarding access to the countryside	There would be a trade-off between the need to develop a green field site and the potential improvements to the river downstream of Wye. The works should not affect access to the countryside	Would require development of a coastal site, possibly west of Hythe. The works (and seawater intake) are small-scale and should not affect public access to the countryside
	Benefits to biodiversity	Potential improvements to the river downstream of Wye from (slightly) improved water quality	Increased chalk spring flows will improve low flows in the Stour, slightly diluting the effluent content
	NIMBY –Public acceptability	Possible objections to the proposed works on a green field site and the effluent reuse	Local opposition to the required works may be expected, as it is of no local benefit

WS3(i) rely on increased river flows from growth in treated wastewater effluent (resulting from increased water consumption). Other re-uses of wastewater effluent proposed in integrated strategies based on WS3(i) could therefore limit the expansion of compensation flows to meet demands that could not otherwise be met from other planned (regional) sources in the strategy.

The scheme assumed in the assessment of WS4(i) employs a technology (desalination) that is expensive to run and maintain (power costs could be more than 5 times higher depending on the quality (salinity) of the raw water than that of the conventional WTW proposed under WS3(i)). It is therefore a less sustainable strategy. It requires the co-operation of a water company that will derive no benefit from the use of the desalination plant, and is likely to be less acceptable politically than the alternative 'local' solution. Implementation might therefore be unacceptably delayed.

The only tangible advantages that this strategy has over WS3(i) are that there is no physical limit to the PDO that could be provided (though the much higher unit cost of water production would discourage its expansion), and that there would be no limit to the re-use of increased volumes wastewater effluent for other purposes, though there would be a heavy price to pay for such use (equal to the cost of provision of the additional desalinated water supply)

Appraisal against quality objectives

The relative benefits associated with the shortlisted strategies were evaluated in terms of meeting the study's Quality Objectives Targets. As might be expected given the limited areas of differentiation, the strategies have little to distinguish between them. Indeed, they rate equally on every Target except for 1.1(b): *"Reduce licenced groundwater abstractions in Chart Leacon GWMU to 60% of 2003 levels by 2010".* Against this target, those strategies based on WS3(i) have been rated 'amber' in Figure 7.16 while those based on WS4(i) are rated 'green', the latter being rated higher due to the greater volume of water available for compensation..

The partial meeting of the target under WS3(i) is related to the timeframe in which it might be implemented. The quantum of the percentage reduction equates to about 4.8Ml/d. As the compensation is to come entirely from river abstraction it can only be at a rate that does not reduce low flows in the Stour below those currently experienced. If this compensation is to come wholly from increased wastewater (treated effluent) flows derived from new development, then such increase may not be realised until 2015. However, there are two mitigating effects that, subject to further investigations, that may facilitate earlier implementation of WS3(i), within the timeframe of the target:

1. The headroom available from the planned transfer of existing resources in 2008 may itself permit limited reduction of local groundwater abstractions, the balance being provided by a 'Phase 1' WTW with a PDO of, say, 2.5Ml/d.
2. Since one principal reason for reducing groundwater abstractions is to augment spring flows, if the abstraction boreholes production in the Chart Leacon GWMU are cut back, it might be expected that spring flows in their vicinity may experience an increase.

8.3 COMPARISON OF WASTEWATER MANAGEMENT SYSTEM STRATEGIES

The three wastewater system strategies under consideration are all based on the provision of treatment capacity to meet the growth of wastewater flows, with treated effluent being retained within the Stour catchment. The principle features of the three wastewater strategies are:

- All wastewater flows being conveyed for treatment at the existing Bybrook WWTW site (WW1), discharging locally to the Great Stour.

- Bybrook WWTW expanded to treat wastewater flows from its presently served catchment, expanded to accommodate future flows from areas north of the CTRL, with two new WWTW located to the south of Ashford, based on 'natural' technologies to serve new development areas south of the CTRL. One works to discharge locally to the East Stour, the other works discharging to the Great Stour upstream of its confluence (WW4).

- Bybrook WWTW expanded to treat wastewater flows from its presently served catchment, expanded to accommodate future flows from areas north of the CTRL, with one new conventional WWTW located to the south of Ashford, to serve new development areas south of the CTRL, discharging to the Great Stour upstream of its confluence (WW7).

Conveyance systems (trunk sewers, pumping stations and rising mains) associated with new development will reflect the spatial distribution of the receiving WWTW. Effluent discharge standards associated with each WWTW will need to ensure 'no deterioration' in the receiving waters at the point(s) of discharge.

The relative strengths and weaknesses of the three strategies are compared against performance characteristics and quality objectives, and are audited against the Key Issues as set out below.

Appraisal against performance characteristics

A tabulated summary of an appraisal of the three wastewater system strategies against the technical, economic and other performance characteristics is presented in Table 8.3. These appraisals support the performance assessment scores set out in Table 7.9.

Two of the strategies (WW1 and WW7) are based on the construction of conventional (activated sludge) WWTW. The associated processes are tried and tested, robust and reliable. Treated effluent quality can be assured, provided the influent quality (and quantity) is within design tolerances, and due attention is paid to the operation and maintenance of the plant. The third strategy (WW4), by contrast, is based on a relatively untested technology which has been used on small scale plants (up to 800m^3/day) and has very a limited track record especially at the scale required at Ashford. There is consequently a significant performance risk associated with this strategy.

Referring to Table 8.4, it may be seen that there is little to choose between the three strategies in terms of conveyance system capital costs. WTWs discharging to the East Stour and/or upper Gt. Stour would have tighter discharge consents than expansions at Bybrook, due to the higher RQOs at the discharge points, resulting in cost premia for WWTW discharging to these receiving waters. Thus the total CAPEX for WW7 is slightly more than for WW1. The CAPEX associated with WW4 is slightly more again.

Table 8.3: Comparison of Performance Characteristics of Wastewater Management System Strategies (1 of 2)

Performance characteristic		WW1	WW4	WW7
TECHNICAL	Proximity principle	Local discharge point but existing WWTW is remote from new development that it is to serve	Best (of the three strategies) distribution of WWTW for the areas served, though effluent discharge from one works is some distance away	Improvement on WW1 for proximity to areas served, but discharge point for the new works is some distance away.
	Robustness of design (to take higher/lower flows)	Conventional treatment technology is reasonably flexible to accommodate variation in flow/load. Extensive pumping also reasonably flexible	Flexibility of 'Natural' treatment technology to accommodate variation in flow is uncertain. Reduced conveyance issues compared to WW1	Equally flexible to WW1 in terms of treatment. Reduced conveyance issues (pumping/siltation).
	Reliability of design (to achieve design standards)	Conventional treatment technology to achieve specific standards is well understood in terms of design and operation.	'Natural' technology is relatively unproven. Safety margins for achievement of standards will have to higher.	Comparable to WW1 with reduced reliance of long distance pumping. Increased flexibility of operation.
	Reliability of technology (to perform without undue technical difficulty)	Reliance on conventional reliable technology throughout. High reliance on pumping with potential for failure (which may be mitigated by the provision of standby pumps and power)	Employs novel technology with the risk of reduced reliability. Reduced pumping requirements (potential for flooding from failure is similar to WW1, though reduced in scale)	Reliance on conventional reliable technology throughout. . Reduced pumping requirements (potential for flooding from failure is similar to WW1, though reduced in scale)
	Flexibility of design (to accommodate changes in development during 25 year development period)	Generally flexible with only significant changes being in conveyance routes. Addition CTRL crossings could be an issue	Spatial variation in development could significantly impact on ability of WWTW to perform if flows are significantly different to design. Installed conveyance system may similarly be under/over designed.	As WW4
	Potential for extension of design (beyond 2030? – climate change)	Additional treatment capacity could probably be constructed at the Bybrook site. Conveying additional flows to the site could be problematic.	Only significant issue would be additional land take at the 'Natural' technology WWTW sites. Alternatively additional WWTWs could be constructed to suit location of additional development..	Likely that additional flows could be accommodated without major problems unless new WWTW site was very compact and additional land unavailable. Alternatively, additional WWTWs could be constructed to suit location of additional development..
	Potential for achieving higher design standards (should it prove necessary)	Conventional Activated Sludge technology can be 'worked harder' to achieve moderately higher standards. Alternatively additional tertiary treatment may be required.	Capacity of 'Natural' technology to achieve higher standards is uncertain. Additional (non-natural) tertiary treatment likely to be required.	As per WW1
	Constructability	Unlikely to be any issues regarding the WWTW. There may well be problems in finding routes to convey the sewage to the WWTW under the CTRL/M20 and through the existing urban areas.	Construction of the 'Natural' technology WWTW may present some issues due to novelty. No problems likely with conveyance.	Best option. Relatively easy conventional WWTW construction on green field site and moderate expansion at Bybrook. No special conveyance problems.
	Ease of maintenance	Best option. Concentrates all treatment at current site. Familiar technology.	Maintenance requirements for 'Natural' technology WWTW uncertain and likely to involve new skills.	As per WW1 but with the additional complication of operating two sites – transfer of sludge, etc.
	Ability to construct in phases	Poor. Each conveyance route will need to be constructed in one pass. Initial low flows may cause sedimentation/septicity problems. WWTW can be constructed/commissioned in phases.	Better. Individual WWTW and conveyance links can be constructed as required.	Better than WW1. Not as good as WW4
	Sustainability (use of resources during both construction and operation)	Relatively poor. Heavy use of energy during construction (concrete) and operation (AS plant and long distance pumping)	Good. Restricted pumping requirements and use of 'Natural' treatment technology.	As per WW1, with somewhat reduced pumping requirements.
	Disruption to existing infrastructure	Poor. Extensive conveyance routes through existing developed areas. Construction on existing WWTW site may be problematic	Good. Limited need for new conveyance routes through existing development. Most WWTW construction on green field sites.	Better then WW1. Not as good as WW4.
	Reliability for achieving discharge consent	Good. Technology is well understood and operation procedures are well proven.	Uncertain, particularly when attempting to meet the proposed tight consents . Limited experience with 'Natural' technology.	As per WW1, with proviso that consent condition may be more onerous in Upper Stour (as reflected in indicative cost estimates)

Table 8.3: Comparison of Performance Characteristics of Wastewater Management System Strategies (2 of 2)

Performance characteristic		WW1	WW4	WW7
TECHNICAL (cont.)	Land take	Land already in SWS ownership. Planit STOAT reports process footprint of 6000 m2	Additional land required at two sites. Living technology Ltd reports combined (two works) process footprint of 5600 m2. Expansion of Bybrook has a process footprint (Planit STOAT) of 2000 m2	Additional land required at new site. Planit STOAT reports process footprints of 4500 m2 at new site and 2000 m2 for expansion of Bybrook
	Need for crossings of the major transport corridors (M20 and CTRL)	Least favoured option. At least 2 crossings of the M20/CTRL required.	Good. Limited need to transfer flows across the M20/CTRL corridor.	As per WW4.
ECONOMIC	Whole life cost	Indicated PV of 30 years' costs £24.0 million	Indicated PV of 30 years' costs £29.6 million	Indicated PV of 30 years' costs £26.2 million
	Capex	Indicated CAPEX of WWTW expansions and conveyance system £21.3 million	Indicated CAPEX of WWTW expansions and conveyance system £25.3 million	Indicated CAPEX of WWTW expansions and conveyance system £23.8 million
	Opex	Indicated 30 years' OPEX of WWTW expansions and conveyance system £5.4 million (undiscounted)	Indicated 30 years' OPEX of WWTW expansions and conveyance system £8.7 million (undiscounted)	Indicated 30 years' OPEX of WWTW expansions and conveyance system £5.4 million (undiscounted)
	Cost / benefit ratio	No significant difference in 'benefits' among strategies. B:C ratios will therefore be in inverse relationship to whole life costs. B:C ratios for WW1/WW4/WW7 will be in the proportion 1.0/0.81/0.92 respectively	No significant difference in 'benefits' among strategies. B:C ratios will therefore be in inverse relationship to whole life costs. B:C ratios for WW1/WW4/WW7 will be in the proportion 1.0/0.81/0.92 respectively	No significant difference in 'benefits' among strategies. B:C ratios will therefore be in inverse relationship to whole life costs. B:C ratios for WW1/WW4/WW7 will be in the proportion 1.0/0.81/0.92 respectively
OTHER	Visual impact	Very limited visual impact. All new treatment capacity is at the existing WWTW site. Otherwise visual impact is limited to pumping station superstructures.	Significant. New 'Natural' WWTW will be enclosed in large 'greenhouse' structures.	Less then WW4, but there will be one new WWTW which can be landscaped in the conventional manner.
	Benefit to communities	This strategy eliminates the discharge of any effluent upstream of Ashford which will not cause deterioration of the quality of flows in the Stour through Ashford. Low flow problems in the River Stour through Ashford will not be alleviated.	This strategy helps to alleviate low flows in both the Upper and East Stour. Appropriate consent conditions should ensure that river quality is maintained or improved	This strategy alleviates low flows in the Upper Stour and, with appropriate consent conditions, will allow river quality to be maintained/improved.
	Likely political will	Is likely to be popular with the operating utility. May be considered by others to lack novelty/innovation/sustainability.	Can be presented as the 'green' and sustainable solution. May lack the support of those that have to operate the system.	A reasonable compromise from WW1, avoiding many of the conveyance issues. May still be considered to lack novelty and sustainability.
	Consistency with policies	Is entirely consistent with current wastewater management policy.	Requires substantial land take for green field sites. Is contrary to policy to focus treatment at a small number of locations. Suspicion of 'Natural' treatment technology by operators.	Requires a new, green field site and an additional discharge consent.
	Funding availability	Funding requirements not compatible with 5 year AMP cycle. This strategy is consistent with funding secured by SWS for AMP4.	Funding requirements not compatible with 5 year AMP cycle. This strategy may not be entirely consistent with funding secured by SWS in AMP4	As per WW4
	Safeguarding access to the countryside	This strategy requires no additional land purchase.	This is the least favoured strategy as it requires the maximum land take for new WWTWs	This strategy requires similar, but slightly less land take than WW4
	Benefits to biodiversity	This strategy impacts on the minimum length of river. Effects may be beneficial and/or harmful depending on the forms of (tertiary) treatment employed.	As per WW1, except that the effects will be more widespread throughout the Study Area due to the more upstream discharge locations.	A compromise between WW1 and WW4.
	NIMBY –Public acceptability	Should receive minimal objection due to concentration of works on the existing WWTW site.	Could be considerable objection to two new WWTW sites, but could be alleviated by 'Natural' technology.	Objection to new conventional WWTW likely, but only one site required.

Table 8.4: Wastewater strategy costs in £ millions

Wastewater Strategy	Conveyance Infrastructure		Extension to Bybrook WWTW		New southern Works		Total CAPEX*	Total OPEX * (30 years)	PV
	CAPEX	OPEX/yr	CAPEX	OPEX/yr	CAPEX	OPEX/yr			
WW1	11.3	0.08	10.0	0.10			21.3	5.4	24.0
WW4	10.5	0.06	3.0	0.06	11.8	0.17	25.3	8.9	29.6
WW7	12.8	0.07	3.0	0.06	8.0	0.05	23.8	5.4	26.2

* undiscounted

The relatively high energy consumption of WW4 results in the indicated 30-year undiscounted OPEX of WW4, being around 65% above that of either WW1 or WW7.

An assessment of the water quality impacts expected under the three wastewater strategies was undertaken and damage costs assigned to each based on increases in BOD and Ammonia. As discussed in Sections 7.7.4 and 7.7.5, the reduced sensitivity of the Great Stour downstream of Ashford and limited length of river impacted favours strategy WW1 over WW4 and WW7 discharging into the headwaters.

Socio-environmental 'performance' of the strategies is divided between the 'safe' option with no additional land requirement, nor any significant additional impact on the community (WW1) on the one hand, and the perception of an environmentally friendly 'green' alternative, but which requires construction of two WWTWs on green field sites, on the other hand (WW4). WW7 occupies the middle ground but actually scores lower than either of the others (Table 7.1).

Appraisal against Quality Objectives

A main aim of the Study, as reflected in the quality objectives and targets, is to ensure that river water quality standards set through the RE Classification scheme are maintained throughout Ashford's development.

In terms of meeting the Study's quality objectives Targets, the three short-listed wastewater system strategies have little to distinguish between them. Indeed, they are rated equally on every Target. However, the review of SIMCAT modelling results discussed in Section 7.7.4 raises some issues relating to the impact on river water quality and allows some conclusions to be drawn relating to the aspirations of the Study.

None of the wastewater strategies is able to address the high levels of Total Reactive Phosphorous (TRP) currently observed throughout the River Stour. This problem is mainly attributable to diffuse inputs and poor performance at local WWTW, which might, to some degree be addressed by Ecological Water strategies EW5 and EW6.

Assuming that discharge consents, for the additional wastewater flows, are tightened as highlighted in Section 7.7.4, all three strategies meet Quality Objective 2.4 (a): *"Achieve the required reliability of compliance with the 1997 RQOs and forestall future risk of failure"*. However, whil not resulting in failures against RE standards, a deterioration in water quality will be inevitable in river stretches downstream of discharge points.

The relative impact caused by the wastewater strategies was explored in Section 7.7.4 by looking at the length of the river affected by discharges and the magnitude of deterioration. In summary, from an environmental perspective, WW1 is preferred over WW4 and WW7 as it affects the shortest stretch of river, and, should an additional works be required to serve southern Ashford, it would be preferable to discharge additional flows into the Great Stour, which is comparatively less sensitive than the East Stour.

The Study Quality Objective 4.2 (a) seeks to "*correct marginal / significant failures or the risk of failures (against Imperative Standards) for rivers designated under the Freshwater Fish Directive (FWFD)*". In order to assess the compliance of proposed strategies against this target, it was necessary to look at the Imperative and Guideline Standards stipulated by the FWFD (provided for reference in Appendix 8.1). Two Imperative SWtandards, relevant when considering the impacts of the additional wastewater discharges, are highlighted in Table 8.5, together with designated river stretches.

Table 8.5: River stretches designated as Salmonid or Cyprinid under the Freshwater Fish Directive

Designation	Great Stour	East Stour	Temp range	Permitted Rise	Total NH_4
Salmonid	Lenham - Bybrook Bridge	Source (TR14503906) to confluence with Horton Priory Dyke	10.0 – 21.5 °C	1.0 °C	1.0 mgN/l
Cyprinid	Bybrook Bridge Bretts Bridge, Canterbury	Horton Priory Dyke confluence to Ashford Great Stour Conf	10.0 – 28.0 °C	3.0 °C	1.0 mgN/l

The SIMCAT modelling indicates that all wastewater strategies will meet the requirements for both salmonid and cyprinid waters with regard to total ammonia. However, it should be noted that, when modelling no deterioration of RE quality, the predicted concentrations for ammonia shown downstream of the Bybrook WWTW in Table 7.4 are close to the threshold value of 1.0 mg/l. It may therefore be appropriate to conclude that, without tightening of effluent standards beyond that indicated by the modelling undertaken to date, the additional wastewater flows generated by the proposed development will increase the risk of failure against this parameter.

8.4 SELECTION OF SHORT-LISTED INTEGRATED STRATEGIES

On the basis of the above comparisons, it may be argued that the three integrated strategies based on water supply system-based strategy WS4(i) (IS4, IS5 and IS6) have inferior economics, lower sustainability, and lower anticipated political acceptability (which would result in potential difficulty of early implementation) than their corresponding integrated strategies based on WS3(i). It is therefore suggested that the three integrated strategies based on WS4(i) are not pursued further, unless the development of the compensation source identified in WS3(i) cannot be implemented.

Considering the relative performances of the three remaining integrated strategies, the strategy based on WW7 (IS3) is shown to be marginally stronger technically, but otherwise, WW1 appears ro be preferred over the other two strategies (Table 7.9). The Socio-economic and environmental assessment of the three wastewater strategies reflects the anticipated views of a number of stakeholders that it would be preferable to concentrate wastewater treatment at the existing site (Bybrook).

It is therefore recommended that IS2 be dropped from further consideration in favour of the remaining two integrated strategies.

The resulting 'short list' of integrated strategies therefore comprises just two:

IS1 - comprising system-based strategies FD8, WS3(i), WW1, EW2, EW3/4, EW5, EW6, EW7, EW8 and EW10

IS3 - comprising system-based strategies FD8, WS3(i), WW7, EW2, EW3/4, EW5, EW6, EW7, EW8 and EW10

Given the choice of shortlisted integrated strategies stated above, it would be simple to conclude that the only difference between them is in the choice of system-based strategy for wastewater management. This is largely true. However, due to the integrated nature of the strategy there are other subsidiary, but nevertheless important, considerations. These revolve around the choice and impact of any associated re-use of treated effluent on the sufficiency of river flows to provide the required PDO to compensate for reductions in groundwater abstraction.

The discussion below therefore focuses on the differences between the two system-based strategies and the implications of competing calls on the re-use of treated WWTW effluent within each of the two shortlisted integrated strategies.

8.5 COMPETITION FOR TREATED EFFLUENT

With the obvious exception of times of excessive runoff during storm events, the Study has demonstrated that during the summer months, even without the planned development within the Study Area, ground and surface waters will be in short supply. Pressures to relieve the over-abstraction of groundwater and low flows in the Stour, reflected in the Study's aspirational quality targets, and expected to be enforced under the Water Framework Directive, have strongly directed the identification of the preferred integrated water management strategy. Putting aside, for the purpose of this discussion, the considerations of FRM and water supply planning/demand management, which are common to both shortlisted integrated strategies, wastewater management options that would 'lose' treated effluent to other catchments have been dropped in favour of those which retain this resource within the Stour catchment.

The shortlisted strategies both rely on the growth of treated effluent volumes (due to population increase) to facilitate the following interventions:

- Abstraction from the Stour, upstream of Wye, to provide compensation for reduction in borehole abstractions in the Ashford water supply zone (WS3(i))
- Potential supply of irrigation water for willow coppicing, dependent on proximity (EW2)
- Creation of wetlands associated with one or more WWTW, either integrated into the process (as constructed reedbeds) or nearby as 'natural' wetlands (EW5)

Numerous other interventions, common to each integrated strategy, would adversely impact on the volume of treated effluent generated, or surface water flows, including:

- water demand management measures that achieve better than Scenario B performance assumed in the strategies;
- promotion of agricultural land management techniques that reduce the volume and improve the quality of runoff to watercourses (EW6);
- SUDS that through detention enhance evaporation in summer months or through infiltration, reduce summer runoff (though such groundwater recharge may result in increased spring/watercourse flows (FD8);
- natural wetland creation utilising the diversion of existing tributary flows or sub-catchment detention ponds (EW5);
- green roofs - minor overall impact due to limited application (EW7); and
- grey water discharge to SUDS – minor overall impact due to limited application (EW8).

Clearly, the extent to which all the identified strategies can be implemented will be limited by the extent to which they affect river flows. The two over-riding concerns appear to be that:

1. sufficient water is available in the Stour upstream of Wye (and from other regional resources) to permit a level of river abstraction (and corresponding reduction of groundwater abstraction) that does not prejudice the ability to meet the requirements of the WFD; and

2. seasonally low flows in all parts of the Stour and its tributaries are not reduced, and if at all possible, are enhanced.

The two integrated strategies differ in the areas of competition for treated effluent in the following respects:

- IS1 (based on WW1) can only provide enhanced river flows to support wetland creation (at or) downstream of Bybrook WWTW, whereas, subject to the constraints identified above, IS3 (based on WW7) could also support wetland creation at or near the proposed southwest WWTW site or between it and the associated effluent discharge point on the Great Stour.
- IS1 may only be able to provide treated effluent to irrigate a willow coppice industry (or other Non-mains Water consumer should it be proven a viable demand) located within economic distance of Bybrook WWTW, whereas IS3 might additionally be able to supply irrigation water to areas to the south of Ashford within economic distance of the proposed new WWTW.
- IS1 can only mitigate reductions in seasonally low flows in the Stour downstream of Bybrook, whereas IS3 provides enhancement of flows in that part of the upper Great Stour downstream of the proposed discharge point.

8.6 ASSESSMENT OF SHORTLISTED INTEGRATED STRATEGIES

8.6.1 Technical performance

In the technical performance assessment (of 15 characteristics) summarised in Table 7.9, the two strategies were found to be almost equally balanced: being assigned the following (unweighted) scores (out of a maximum of 75) in respect of the combined Mains Water elements:

IS1	54
IS2	55

In the performance assessments, each is based on the construction of additional capacity using conventional (activated sludge) technology.

The distribution of WWTW in Strategy IS3 better addresses the proximity principle than IS1, though the remote point of discharge of treated effluent to the Great Stour from the new WWTW is a negative attribute.

There are a number of other technical aspects associated with IS3 that favour it over IS1, including:

- Less need to construct trunk conveyance systems through the existing urban areas
- Less construction interference with operations at Bybrook WWTW (though expansion will still be required to deal with additional flows from development within the current catchment of the works)
- Less reliance on pumping to convey sewage to the WWTWs.

Against this there are technical aspects associated with that favours it over IS3, namely:

- No additional land is needed for provision of the increased WWTW capacity
- Any odour problems that might occur with WWTW located upwind of the new development areas would be avoided
- Improved management, operation and maintenance, being located at a single site
- Sludge management is simplified, with no requirement to transport from the southern works to Bybrook for treatment

8.6.2 Economic considerations

Of all the metrics available with which to compare strategies, quantifiable costs associated with each component are perhaps the easiest to consider, since they may simply be summed.

The indicative Mains Water strategy present value (PV) costs (which will represent the majority of any integrated strategy costs) are recorded in Table 7.8 as being, for the two shortlisted integrated strategies:

IS1	£78.1M
IS3	£80.2M

The 2.7% difference is due entirely to the higher CAPEX associated with the southern WWTW than the further expansion of Bybrook, reflecting the need to treat effluent to a higher standard for discharge to the upper Great Stour. The corresponding higher operating cost associated with the southern works is compensated for by the lower operating cost of the pumping stations associated with the conveyance systems to and from this works.

8.6.3 Key Issues and Quality Targets

As indicated earlier, there is no discernable difference in the ways in which the two integrated strategies address the Key Issues or meet the Study's quality Targets. However, as highlighted in Section 7.7.4 when the river is considered as the 'carrier' of the treated effluent and the more subtle water quality impacts of the two strategies are interrogated, it is apparent that IS1 has less potential to cause deterioration in water quality. This is for two key reasons:

1. Any deterioration in water quality would impact a shorter stretch of river
2. The river downstream of Bybrook has higher flows and is therefore less sensitive, relative to headwaters. Therefore IS1 carries less risk of marginal failure against RQOs.

8.6.4 Socio-environmental considerations

There are a number of positive acceptability attributes associated with IS1 that favour it over IS3, resulting from the concentration of the expansion of wastewater treatment capacity at the existing Bybrook site:

- It minimises any visual impact
- It is known to be favoured by the operating utility (Southern Water Services)
- It is entirely consistent with the current wastewater management policy
- It will receive fewer objections from the public
- Public access to the countryside will be unaffected

Against this, the only socio-environmental aspect associated with IS3 that favours it over IS1 is:

- Low flows in stretches of the Great Stour (downstream of Brookfield Road bridge) will be enhanced by treated effluent flows

In the performance assessment (of eight socio-environmental characteristics) summarised in Table 7.9, IS1 (in respect of the combined Mains Water elements) was found to be better than IS2: being assigned the following (unweighted) scores (out of a maximum of 40):

IS1	30
IS3	24

8.7 PREFERRED STRATEGY

8.7.1 Identification of preferred strategy

Overall, the performance assessment of the Mains Water elements of the two shortlisted integrated strategies shows a preference for IS1 in the assigned unweighted total scores: being assigned 101 points out of a possible maximum 135, across 27 assessed characteristics, against 95 points for IS3 (Table 7.9). The principal differences being the better performance of IS1 on socio-environmental aspects.

Given that IS1 is indicated to be slightly less expensive to implement, and that technically it may be viewed as essentially having no lower performance than IS3, it is concluded that IS1 is the preferred integrated strategy for water management to support Ashford's planned growth.
Further consideration of each of the component sub-strategies, the range of further investigations and studies required, and the implementation of the preferred integrated strategy as a whole, is provided in Section 9.

8.7.2 Beyond 2031

Pressure to develop Ashford beyond the 31,000 new homes is unlikely to cease once this target is reached. A measure of 'future-proofing' should therefore be provided in the preferred strategy.

For some of the water management systems, provided sustainable solutions can be found, it might be assumed that, up until a limit to growth is identified, modest additional expansions might be accommodated by incremental interventions. For example:

- Potable water supplies to meet increased demand may have to come from as-yet unidentified additional regional sources
- FRM measures, such as bank raising and channel improvements, already provided to deal with the planned development, may need limited heightening to deal with any increase in flood flows that cannot be detained in locally provided SUDS or compensation storage areas associated with any further development.

However, expansion of wastewater infrastructure is likely to be constrained, not least by the potential for further increases in treated effluent discharges to impact adversely on river water quality with unacceptable consequences on the aquatic ecology and biodiversity.

There may also be physical constraints to the provision of wastewater infrastructure. Provision of additional wastewater treatment capacity may not, in the event, be possible at Bybrook, and augmentation through the then much enlarged urban area of the conveyance systems, designed to deal with flows from the Option 6 development, may be unduly difficult and/or prohibitively expensive. In such a scenario, it might be appropriate to consider alternative ways of managing additional wastewater flows. One such alternative might be the introduction of a second WWTW south of Ashford, to treat flows from new development areas, and areas developed under Option 6 in its vicinity (by re-directing discharges from previously constructed pumping stations, thereby freeing up capacity in the installed system to deal with additional flows from infill development for treatment at Bybrook WWTW).

On the provision of a second WWTW, it should be noted that there is broad similarity in the technical and economic performance of WW7 (on which IS3 is based and which is predicated on the provision of a second WWTW in the southwest of Ashford) compared with WW1. The socio-economic performance of IS3 is inferior to IS1, principally on account of the proximity of the indicated new WWTW south of Ashford to future development, and the higher vulnerability of the receiving waters for the treated effluent. A number of these concerns could be mitigated, if not overcome, by applying much tougher controls on potential odours and the visual impact of the southern works, and a much higher standard of treatment than considered for this site under WW7.

Such controls would of course significantly increase the capital and operating cost of a southern WWTW.

Clearly, as indicated above, it is likely that there would be a significant cost premium to be paid in implementing such a future strategy, and the many environmental sustainability issues would need to be fully addressed. However, with the encroachment of new development on the potential sites identified in this Study for southern WWTW, it might be prudent at some stage in the not too distant future to consider reserving one or more of these sites for the establishment of future WWTW.

Thus, subject to future assessment of the ability of the Stour (or other receiving water) to accept further effluent flows above those projected to arise from the currently planned development, and the impracticability of further expansion of Bybrook WWTW, it is recommended that provision be made in the Local Development Framework to reserve, by land use designation, areas of land for possible future WWTW, in the general locations of the two sites considered for WW4/WW7.