

Collaborative Research Programme  
On River Basin Management Planning Economics

Report on WFD Benefits Survey – Further Analysis on  
the Sensitivity of Aggregate Results to Use of  
Declining Discount Rate

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# WFD Benefits Survey – Further Analysis on the Sensitivity of Aggregate Results to Use of Declining Discount Rate

*A Note by NERA for DEFRA, 21 March 2008*

DEFRA has asked NERA to undertake a package of analysis to provide further results from the Water Framework Directive benefits assessment survey research, which was completed as Collaborative Research Programme Project 4b/c. This note reports briefly on the findings from the first analysis component, which was to produce aggregate results on the benefits of the six implementation scenarios provided to us by DEFRA, based on the declining discount rate schedule recommended in HM Treasury “The Green Book”. The declining discount rate schedule is included in Appendix A, and our main tables of new results are presented in Appendix B. The comparable results from the NERA-Accent final report<sup>1</sup> are included alongside the new results for reference.

## **Main Finding –Increases of 10%-15% Across Scenarios and Elicitation Methods**

Our main finding from the new modelling work is that the revised approach has led to increases of between 10% and 15% in the net present value of the benefits across all the scenarios, and for PCCV mean and median, DCCV, and CE methods.

Table 1 presents the percentage change in aggregate WTP for England and Wales households due to the use of the declining discount rate schedule, relative to using the fixed 3.5% rate. Figures are presented for each scenario and elicitation method.

**Table 1**  
**Impact of Using Declining Discount Rate, Relative to Using Fixed 3.5% Rate, By Scenario and Elicitation Method**

Scenario	Change in Present Value of Aggregate WTP for England and Wales Due to Use of Declining Discount Rate, Relative to Fixed 3.5% Rate		
	PCCV (Mean)	DCCV	CE (Unscaled)
Scenario 1 - Maximum	9.6%	9.6%	10.1%
Scenario 2 - Front Loaded	11.3%	11.3%	11.8%
Scenario 3 - Even Loaded	12.2%	12.2%	12.6%
Scenario 4 - Back Loaded	13.1%	13.1%	13.6%
Scenario 5 - Less Stringent Objectives	12.2%	12.2%	12.6%
Scenario 6 - Nature Assimilation Lag	14.8%	14.8%	15.3%

*Source: NERA*

The use of a lower discount rate in far off years has the effect of bestowing a higher weight to environmental status in the distant future. Thus the increase in aggregate WTP due to the use of the declining discount rate schedule is largest for “Scenario 6 – Nature Assimilation Lag”, which entails full delivery by 2065, and smallest for “Scenario 1 – Maximum”, which entails full delivery by 2015. Results for PCCV and DCCV are identical, and very similar to those based on the CE.

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<sup>1</sup> NERA-Accent (2007) “The Benefits of Water Framework Directive Programmes of Measures in England and Wales”, A Final Report to DEFRA re CRP Project 4b/c. 6 November 2007

## Appendix A. Declining Discount Rate Schedule

**Table A.1**  
**Declining Discount Rate Schedule**

<b>Period of Years</b>	<b>Discount Rate</b>
0-30	3.5%
31-75	3.0%
76-125	2.5%
126-200	2.0%
201-300	1.5%
301+	1.0%

*Source: HM Treasury "The Green Book", p. 99*

## Appendix B. Aggregation Results Tables

**Table B.1**  
**Aggregate PCCV Estimates of WFD Benefits by Policy Scenario and Country – Fixed 3.5% Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	47.4	969.01	27,686.11	42.9	51.91	1,483.02	47.1	1,020.55	29,158.65
Scenario 2 - Front Loaded	40.9	836.43	23,898.01	37.1	44.80	1,280.11	40.7	880.92	25,169.07
Scenario 3 - Even Loaded	38.3	782.56	22,358.78	34.7	41.92	1,197.66	38.0	824.18	23,547.97
Scenario 4 - Back Loaded	35.8	731.35	20,895.64	32.4	39.18	1,119.29	35.6	770.25	22,007.01
Scenario 5 - Less Stringent Objectives	28.7	587.08	16,773.84	26.0	31.45	898.50	28.5	618.31	17,665.99
Scenario 6 - Nature Assimilation Lag	31.3	639.93	18,283.69	28.4	34.28	979.38	31.1	673.96	19,256.14

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.2**  
**Aggregate PCCV Estimates of WFD Benefits by Policy Scenario and Country – Declining Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	47.4	969.01	30,349.84	42.9	51.91	1,625.71	47.1	1,020.55	31,964.05
Scenario 2 - Front Loaded	41.5	849.37	26,602.67	37.6	45.50	1,424.99	41.3	894.55	28,017.58
Scenario 3 - Even Loaded	39.2	800.76	25,080.07	35.5	42.89	1,343.43	38.9	843.35	26,414.00
Scenario 4 - Back Loaded	36.9	754.55	23,632.74	33.4	40.42	1,265.90	36.7	794.68	24,889.69
Scenario 5 - Less Stringent Objectives	29.4	600.72	18,814.76	26.6	32.18	1,007.82	29.2	632.67	19,815.45
Scenario 6 - Nature Assimilation Lag	32.8	670.19	20,990.72	29.7	35.90	1,124.38	32.6	705.84	22,107.14

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.3**  
**Median PCCV Estimates of WFD Benefits by Policy Scenario and Country – Fixed 3.5% Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Median WTP	Annual WTP	PV WTP	Median WTP	Annual WTP	PV WTP	Median WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario1 - Maximum	26.8	547.47	15,641.87	24.3	29.33	837.87	26.6	576.58	16,473.81
Scenario2 – Front Loaded	23.1	472.56	13,501.70	20.9	25.31	723.23	23.0	497.69	14,219.81
Scenario3 – Even Loaded	21.6	442.12	12,632.08	19.6	23.68	676.64	21.5	465.64	13,303.94
Scenario4 – Back Loaded	20.2	413.19	11,805.45	18.3	22.13	632.37	20.1	435.17	12,433.34
Scenario5 – Less Stringent Objectives	16.2	331.69	9,476.75	14.7	17.77	507.63	16.1	349.33	9,980.78
Scenario6 – Nature Assimilation Lag <sup>(1)</sup>	17.7	361.54	10,329.77	16.0	19.37	553.32	17.6	380.77	10,879.18

*Source: NERA; Results are based on econometric models derived from the pref sample; (1) The results for Scenario 6 in this table differ slightly from those presented in the NERA-Accent final report, due to an error being discovered.*

**Table B.4**  
**Median PCCV Estimates of WFD Benefits by Policy Scenario and Country – Declining Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Median WTP	Annual WTP	PV WTP	Median WTP	Annual WTP	PV WTP	Median WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	26.8	547.47	17,146.80	24.3	29.33	918.48	26.6	576.58	18,058.79
Scenario 2 - Front Loaded	23.5	479.87	15,029.76	21.3	25.70	805.08	23.3	505.40	15,829.14
Scenario 3 - Even Loaded	22.1	452.41	14,169.53	20.0	24.23	759.00	22.0	476.47	14,923.16
Scenario 4 - Back Loaded	20.8	426.30	13,351.83	18.9	22.83	715.20	20.7	448.97	14,061.97
Scenario 5 - Less Stringent Objectives	16.6	339.39	10,629.81	15.0	18.18	569.39	16.5	357.44	11,195.17
Scenario 6 - Nature Assimilation Lag	18.5	378.64	11,859.16	16.8	20.28	635.24	18.4	398.78	12,489.91

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.5**  
**Aggregate DCCV Estimates of WFD Benefits by Policy Scenario and Country – Fixed 3.5% Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	176.7	3,614.42	103,269.24	193.9	234.46	6,698.80	177.7	3,849.03	109,972.41
Scenario 2 - Front Loaded	152.6	3,119.89	89,139.62	167.4	202.38	5,782.25	153.4	3,322.40	94,925.63
Scenario 3 - Even Loaded	142.7	2,918.94	83,398.29	156.6	189.34	5,409.82	143.5	3,108.41	88,811.64
Scenario 4 - Back Loaded	133.4	2,727.93	77,940.77	146.4	176.95	5,055.81	134.1	2,905.00	82,999.88
Scenario 5 - Less Stringent Objectives	107.1	2,189.83	62,566.45	117.5	142.05	4,058.52	107.7	2,331.97	66,627.62
Scenario 6 - Nature Assimilation Lag	116.7	2,386.94	68,198.19	128.1	154.83	4,423.83	117.4	2,541.87	72,624.91

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.6**  
**Aggregate DCCV Estimates of WFD Benefits by Policy Scenario and Country – Declining Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	176.7	3,614.42	113,204.95	193.9	234.46	7,343.30	177.7	3,849.03	120,553.04
Scenario 2 - Front Loaded	154.9	3,168.17	99,228.00	170.0	205.51	6,436.65	155.8	3,373.81	105,668.85
Scenario 3 - Even Loaded	146.0	2,986.84	93,548.71	160.2	193.75	6,068.25	146.8	3,180.71	99,620.92
Scenario 4 - Back Loaded	137.6	2,814.47	88,150.16	151.0	182.57	5,718.06	138.4	2,997.16	93,871.95
Scenario 5 - Less Stringent Objectives	109.6	2,240.69	70,179.08	120.2	145.35	4,552.33	110.2	2,386.13	74,734.37
Scenario 6 - Nature Assimilation Lag	122.2	2,499.83	78,295.40	134.1	162.16	5,078.81	122.9	2,662.09	83,377.52

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.7**  
**Aggregate CE (Unscaled) Estimates of WFD Benefits by Policy Scenario and Country – Fixed 3.5% Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	305.8	6,253.77	178,679.02	532.5	643.85	18,395.84	329.1	7,128.15	203,661.29
Scenario 2 - Front Loaded	263.9	5,398.11	154,231.59	459.7	555.76	15,878.86	284.1	6,152.85	175,795.70
Scenario 3 - Even Loaded	246.9	5,050.42	144,297.80	430.1	519.96	14,856.13	265.8	5,756.56	164,473.00
Scenario 4 - Back Loaded	230.8	4,719.93	134,855.07	401.9	485.94	13,883.96	248.4	5,379.85	153,710.03
Scenario 5 - Less Stringent Objectives	185.3	3,788.89	108,254.04	322.6	390.08	11,145.26	199.4	4,318.64	123,389.74
Scenario 6 - Nature Assimilation Lag	201.9	4,129.94	117,998.22	351.7	425.20	12,148.47	217.3	4,707.37	134,496.31

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.8**  
**Aggregate CE (Unscaled) Estimates of WFD Benefits by Policy Scenario and Country – Declining Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	305.8	6,253.77	195,870.03	532.5	643.85	20,165.73	330.4	7,156.95	224,157.92
Scenario 2 - Front Loaded	268.0	5,481.64	171,686.76	466.8	564.36	17,675.95	289.6	6,273.31	196,482.06
Scenario 3 - Even Loaded	252.7	5,167.90	161,860.30	440.1	532.06	16,664.27	273.0	5,914.26	185,236.46
Scenario 4 - Back Loaded	238.1	4,869.67	152,519.61	414.7	501.35	15,702.61	257.3	5,572.95	174,546.76
Scenario 5 - Less Stringent Objectives	189.6	3,876.89	121,425.59	330.1	399.14	12,501.33	204.8	4,436.80	138,962.09
Scenario 6 - Nature Assimilation Lag	211.5	4,325.26	135,468.65	368.3	445.31	13,947.13	228.5	4,949.92	155,033.28

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.9****Aggregate CE (Scaled to PCCV) Estimates of WFD Benefits by Policy Scenario and Country – Fixed 3.5% Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	46.6	953.69	27,248.16	42.1	50.89	1,453.97	48.8	1,058.02	30,229.21
Scenario 2 - Front Loaded	40.3	823.20	23,519.98	36.3	43.93	1,255.03	42.2	913.26	26,093.16
Scenario 3 - Even Loaded	37.7	770.18	22,005.10	34.0	41.10	1,174.20	39.4	854.44	24,412.54
Scenario 4 - Back Loaded	35.2	719.78	20,565.10	31.8	38.41	1,097.36	36.9	798.53	22,815.01
Scenario 5 - Less Stringent Objectives	28.3	577.80	16,508.50	25.5	30.83	880.90	29.6	641.01	18,314.60
Scenario 6 - Nature Assimilation Lag	30.8	629.81	17,994.47	27.8	33.61	960.19	32.3	698.71	19,963.14

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.10****Aggregate CE (Scaled to PCCV) Estimates of WFD Benefits by Policy Scenario and Country – Declining Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	46.6	953.69	29,869.75	42.1	50.89	1,593.86	49.0	1,062.30	33,271.51
Scenario 2 - Front Loaded	40.9	835.94	26,181.86	36.9	44.61	1,397.07	43.0	931.14	29,163.61
Scenario 3 - Even Loaded	38.5	788.09	24,683.34	34.8	42.05	1,317.11	40.5	877.85	27,494.44
Scenario 4 - Back Loaded	36.3	742.61	23,258.91	32.8	39.63	1,241.10	38.2	827.19	25,907.78
Scenario 5 - Less Stringent Objectives	28.9	591.22	18,517.14	26.1	31.55	988.08	30.4	658.55	20,625.99
Scenario 6 - Nature Assimilation Lag	32.3	659.59	20,658.67	29.1	35.20	1,102.35	33.9	734.71	23,011.41

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.11****Aggregate CE (Scaled to DCCV) Estimates of WFD Benefits by Policy Scenario and Country – Fixed 3.5% Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	173.9	3,557.25	101,635.67	190.1	229.87	6,567.57	184.2	3,990.35	114,010.07
Scenario 2 - Front Loaded	150.1	3,070.53	87,729.56	164.1	198.41	5,668.98	159.0	3,444.38	98,410.85
Scenario 3 - Even Loaded	140.5	2,872.77	82,079.05	153.5	185.63	5,303.85	148.8	3,222.53	92,072.38
Scenario 4 - Back Loaded	131.3	2,684.78	76,707.86	143.5	173.49	4,956.77	139.0	3,011.65	86,047.24
Scenario 5 - Less Stringent Objectives	105.4	2,155.19	61,576.74	115.2	139.27	3,979.01	111.6	2,417.59	69,073.87
Scenario 6 - Nature Assimilation Lag	114.9	2,349.18	67,119.40	125.6	151.80	4,337.17	121.7	2,635.20	75,291.35

*Source: NERA; Results are based on econometric models derived from the pref sample.*

**Table B.12****Aggregate CE (Scaled to PCCV) Estimates of WFD Benefits by Policy Scenario and Country – Declining Discount Rate**

Policy Scenario	England			Wales			England and Wales		
	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP	Mean WTP	Annual WTP	PV WTP
	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million	£/hh/yr	£million/yr	£million
Scenario 1 - Maximum	173.9	3,557.25	111,414.21	190.1	229.87	7,199.45	185.0	4,006.48	125,484.14
Scenario 2 - Front Loaded	152.5	3,118.05	97,658.35	166.6	201.48	6,310.57	162.1	3,511.81	109,991.13
Scenario 3 - Even Loaded	143.7	2,939.59	92,068.90	157.1	189.95	5,949.38	152.9	3,310.81	103,695.81
Scenario 4 - Back Loaded	135.4	2,769.95	86,755.75	148.0	178.99	5,606.05	144.0	3,119.75	97,711.69
Scenario 5 - Less Stringent Objectives	107.8	2,205.24	69,068.94	117.9	142.50	4,463.15	114.7	2,483.73	77,791.31
Scenario 6 - Nature Assimilation Lag	120.3	2,460.28	77,056.88	131.5	158.98	4,979.32	127.9	2,770.98	86,788.00

*Source: NERA; Results are based on econometric models derived from the pref sample.*