

Appendix 5.9.B – Third party report – MWH

Wessex Water

September 2018

Business plan section	Supporting document
	Board vision and executive summary
1	Engaging customers
2	Addressing affordability and vulnerability
3	Delivering outcomes for customers
4	Securing long term resilience
5	5.1 Protecting and enhancing the environment
	5.2 Using water efficiently
	5.3 Providing excellent drinking water quality
	5.4 Minimising sewer flooding
	5.5 Bioresources
	5.6 Maintaining our services
	5.7 Accommodating growth and new development
	5.8 Water resources bid assessment framework
	5.9 Water resources RCV allocation
	5.10 Bioresources RCV allocation
6	Markets & innovation: open systems & DPC
7	Markets & innovation: retail
8	Securing cost efficiency
9	Aligning risk and return
10	Financeability
11	Accounting for past delivery
12	Securing trust, confidence and assurance
13	Data tables and supporting commentaries

Valuation of Dams



Prepared for:
Wessex Water Services Ltd.



October 11, 2017

WESSEX WATER SERVICES LTD.

VALUATION OF DAMS

Main Contributors	Aspect/Section	Notes
Hadi Panahandeh	All	

Project Code: 41522804		Document No: 01		Controlled Copy No: <i>(in COLOUR – not black)</i>	
Revision No	Date	Description/Amendment	Checked	Reviewed	Authorised for Issue
1	12/10/2017	For Information	JPT	GSH	ICC


ONLY CONTROLLED COPY HOLDERS WILL BE ISSUED
WITH AMENDMENTS TO THIS DOCUMENT.
PLEASE DESTROY ALL SUPERSEDED COPIES OR CLEARLY MARK THEM AS "SUPERSEDED".

Distribution Record


DISTRIBUTION						
Name	Client	File				
Controlled Copy No.	1	2				

Sign-off Sheet


This document entitled Valuation of Dams was prepared by MWH now part of Stantec for the account of Wessex Water Services Ltd. Any reliance on this document by any third party is strictly prohibited. The material in it reflects MWH now part of Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between MWH (now part of Stantec) and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that MWH (now part of Stantec) shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by 
(signature)

Hadi Panahandeh

Reviewed by 
(signature)

Jonathan Troke

Approved by 
(signature)

Giles Hird

Table of Contents

1.0 INTRODUCTION.....1.1
2.0 METHODOLOGY.....2.1
3.0 COST ESTIMATES.....3.2
4.0 REFERENCES.....4.2

APPENDIX A WESSEX WATER BRIEFING DOCUMENT
APPENDIX B COST ESTIMATION SHEETS – CONCRETE DAMS
APPENDIX C COST ESTIMATION SHEETS – EARTH EMBANKMENT DAMS
APPENDIX D COST ESTIMATION SHEETS – CONVERTED GRAVEL PIT.S

VALUATION OF DAMS

October 11, 2017

1.0 INTRODUCTION

As part of Wessex Water Services Ltd. (Wessex Water) preparation for Ofwat's next Periodic Review (PR19) MWH, now part of Stantec (MWH) were engaged to undertake the valuation of 13 reservoirs as part of the regulated capital value (RCV) for water resources price controls.

To enable a realistic RCV to be determined for each asset, work has been carried out to establish the Modern Equivalent Asset Value (MEAV) for each reservoir to estimate what it would cost at 2017-18 prices to build a new dam at the existing site of an equivalent capacity, height and length but to a modern design philosophy.

The work was carried out in accordance with the Wessex Water brief dated 7th August 2017, which is included as Appendix A to this report. The structures that have been valued are summarized in Table 1, using data taken from the latest Section 10 Inspection Reports.

Table 1 – Summary of Dams Valued in this Study

	Dam Height (m)	Reservoir Capacity (m ³)
Concrete gravity dams		
Nutscale	14.1	178,000
Hawkridge	22.5	864,000
Clatworthy	30	5,364,000
Earth Embankment dams		
Leigh	12.5	120,000
Luxhay	19	547,000
Sutton Bingham	18.1	2,614,000
Monkswood	15.5	231,000
Durleigh	10	959,000
Ashford	5.7	50,000
Otterhead	2	11,000
Converted Gravel Pits		
Blashford Lake	3	520,000
Ivy lake	2	120,000
Ellingham Intake Pond	3	100,000

VALUATION OF DAMS

October 11, 2017

2.0 METHODOLOGY

Work was carried out by estimating the approximate quantities of the principal items in the existing dams, using “as built” drawings, Section 10 reports and other available information. Where there were features in the existing dam that are considered to be outdated, e.g. deep puddle clay filled cut-off trenches, then the design of the replacement dam has assumed modern practice both in terms of construction materials and construction methods.

No 3D CAD modelling was carried out and instead the primary quantities for each dam were estimated on the basis of representative cross-section designs applied over appropriate lengths. Quantities were developed for appurtenant structures (i.e. draw off works, spillways, etc.) on a similar basis. Principal quantities included excavation (earth / rock), fill (earth, drainage material, rip-rap, etc.), grouting, concrete (mass, reinforced), etc.

Cost rates for various materials and activities have been estimated using data from a combination of sources including previous MWH projects, the design report for Gallica Reservoir provided by Wessex Water Services Ltd., and published cost indices.

The approach can be loosely defined as a “Class 5 Opinion of Probable Construction Cost (OPCC)” in general accordance with the Association for the Advancement of Cost Engineering’s (AACE) cost estimate classification system (Recommended Practice 18R-97) with indicative accuracy of +/- 50%.

The OPCC only covers the cost of dam construction and does not, for example, include any sums to cover property or land rights purchase, legal or planning costs, unusual environmental mitigation measures, local infrastructure improvements for access, design and management costs, or any taxes that may be incurred.

VALUATION OF DAMS

October 11, 2017

3.0 COST ESTIMATES

The cost estimates using the methodology described above are given in Tables 2 – 4 below.

Table 2 – Summary of valuation for concrete dams

Dam	Height (m)	Length (m)	Concrete Volume (m ³)	Construction Cost ¹	Additional Costs ²	Total Capital Expenditure ³
Nutscale	14.1	90.0	6,000	£5,012,000	£3,007,000	£8,018,000
Hawkridge	22.5	164.8	22,000	£7,841,000	£4,705,000	£12,545,000
Clatworthy	30.0	248.2	48,000	£18,159,000	£10,895,000	£29,054,000

Table 3 – Summary of valuation for earth embankment dams

Dam	Height (m)	Length (m)	Fill Volume (m ³)	Construction Cost ¹	Additional Costs ²	Total Capital Expenditure ³
Leigh	12.5	300.0	134,000	£11,428,000	£6,857,000	£18,285,000
Luxhay	19.0	430.0	227,000	£17,853,000	£10,712,000	£28,565,000
Sutton Bingham	18.1	310.0	108,000	£14,303,000	£8,582,000	£22,885,000
Monkswood	15.5	160.0	141,000	£10,385,000	£6,231,000	£16,616,000
Durleigh	10.0	430.0	90,000	£11,265,000	£6,759,000	£18,023,000
Ashford	5.7	250	12,000	£5,008,000	£3,005,000	£8,013,000
Otterhead	2.0	60.0	1,000	£609,000	£365,000	£974,000

Table 4 – Summary of valuation for converted gravel pits⁴

Dam	Capacity (m ³)	Depth (m)	Perimeter (m)	Construction Cost ¹	Additional Costs ²	Total Capital Expenditure ³
Blashford Lake	520,000	3.0	3,000	£310,000	£186,000	£495,000
Ivy Lake	120,000	2.0	2,000	£296,000	£178,000	£473,000
Ellingham Intake Pond ⁵	100,000	3.0	1,000	£498,000	£299,000	£796,000

VALUATION OF DAMS

October 11, 2017

- 1 This is the estimated contractor costs to carry out the scheme as a single contract and includes the principal quantities such as excavation (earth / rock), fill (earth, drainage material, rip-rap etc.), grouting, concrete (mass / reinforced) etc.
- 2 These are additional costs incurred by Wessex Water before and during construction and are deemed to include contingency, surveys, design and management costs.
- 3 This is the sum of 1 and 2 and represents Wessex Water's Total Capital Expenditure.
- 4 The Converted Gravel Pit costs do not include excavation for a new pit. It has been assumed that existing gravel pits are converted into reservoirs.
- 5 Ellingham Lake includes a 9m deep 0.8m wide slurry cut-off wall, as per the existing arrangement.

VALUATION OF DAMS

October 11, 2017

4.0 REFERENCES

Nutscale

Section 10 Report Nutscale – September 2015
K20 Drawing No. 1 – Upstream and Downstream Elevation

Hawkridge

Section 10 Report Hawkridge – June 2009
Drawing No. 45 – Dam Longitudinal Section

Clatworthy

Section 10 Report Clatworthy – September 2010
Drawing No. 223657 – details of concrete dam

Leigh

Section 10 Report Leigh – November 2009

Luxhay

Section 10 Report Luxhay – December 2013
Drawing No B7023/003A/R

Sutton Bingham

Section 10 Report Sutton Bingham – November 2016
Longitudinal Section of Embankment and Cut-off Trench Drawing

Monkswood

Section 12 Report Monkswood – May 2015
Longitudinal Section of Embankment and Puddle Trench - Drawing

Durleigh

Section 10 Report Durleigh – September 2015
Durleigh Reservoir Longitudinal Section of any Puddle Core Drawing

Ashford

Section 10 Report Ashford – November 2016
Longitudinal Section Drawing

Otterhead

Section 10 Report Otterhead – December 2012

Blashford Lake

Section 10 Report Blashford Lake – May 2012

Ivy Lake

Section 10 Report Ivy Lake – May 2012

Ellingham Lake

Section 10 Report Ellingham Lake – February 2009

APPENDIX A – WESSEX WATER BRIEF

Wessex Water Valuation of dams Consultant brief

Introduction

At PR19 there will be separate price controls for water resources (i.e. dams, boreholes and river abstraction assets and services) and water network plus, which comprises the remainder of the water system (i.e. water treatment works, pumping station, distribution mains etc.).

To provide input data to the financial modelling for the price controls, it is necessary to allocate our RCV (regulatory capital value) between the two price controls. For information a link to Ofwat's guidance is: [water-resources-pre-2020-legacy-rcv-allocation-pr19-technical-guidance/](#).

The proposed approach to the RCV allocation is to:

- Firstly assess the MEAV (modern equivalent asset value) of the assets – the gross MEAV.
- Secondly determine the recent expenditure on maintenance of the assets and the remaining life of the assets so that the net MEAV can be assessed.

Assistance from an engineering consultant is sought for the first part. The second part of the assessment will be carried out by Wessex Water.

This brief sets out a draft scope of services for the valuation of **dams**. Other water resource assets will be valued by WW and its cost consultants.

The aim of the work is to establish the MEAV for dams i.e. what it would cost to build a new dam of the equivalent capacity, height and length. Costs to be at 2017-18 price base.

Scope

The dams to be valued are listed in Table 1 overleaf.

Approach

There is insufficient data on out-turn costs for recently completed dams in the UK to develop a cost curve for dams (because there have been no new water supply dams constructed). Furthermore site specific characteristics mean that there can be a very wide variation in the construction costs for reservoirs of a similar capacity.

Therefore an alternative approach is required. Possible approaches could include

- Estimating quantities
 - estimating the principal quantities for existing dams, using as built drawings, section 10 reports and other available information.
 - pro rata the principal quantities for a similar overseas dam by length/height.
 - obtaining principal quantities for similar structures at overseas dams e.g. draw off works, spillways.
 - principal quantities could include : excavation of earth/rock, fill (earth fill, drainage materials, rip rap), grouting, concrete (mass and reinforced) etc.

- then WW estimators could use unit rates to determine the capital cost, with additions for preliminaries, design etc.
- Costs from previous design studies, pro rated as appropriate.
- Costs for overseas dams of a similar scale.
- Estimating quantities or costs for a sub set of the dams and then interpolating for the remaining dams – see below.
- A combination of the above.

No design work or site visits are required.

A range of capital costs would also be useful.

Information available

As part of Contract B0599 and other previous contracts, MWH have carried out the section 10 inspections (including review of record drawings and site visits) for:

- Ivy and Blashford lakes
- Nutscale
- Durleigh +
- Ashford +
- Sutton Bingham +.

In addition WW are able to provide the design report for proposed dam at Gallica (near Sutton Bingham, 20m high earth fill embankment with puddle clay core) that was studied to the Water Resources Management Plan c10 years ago. The report includes principal quantities and cost estimates.

+ If costs can be established for these dams, then it would be acceptable to interpolate for the remaining earth fill dams (Ivy/Blashford, Leigh, Luxhay, Monkswood).

For the concrete dams an estimate for Clatworthy could be used to determine the cost for Hawkridge.

Timescales

Agree brief	11 August 2017
Submit fee proposal	18 August 2017
Complete assessment	by 15 September 2017
Review meeting	w/c 18 September 2017
Completion	by 29 Sept 2017

Julian Welbank
7 Aug 2017

Table 1 - Dams to be valued

WW Site ID	Reservoir	Year Built	Capacity m ³	Max. Height m	Dam Type	Impounding or Non-impounding	Subject to Reservoirs Act 1975	EA Risk designation	Crest length m
12092	Nutscale	1942	178,000	15	Mass concrete gravity arch	Impounding	Yes	High risk	90
12033	Clatworthy	1959	5,364,000	30	Mass concrete gravity	Impounding	Yes	High risk	170
12049	Durleigh	1936	959,000	8.2	Earth fill embankment with puddle clay core	Impounding	Yes	High risk	430
12004	Ashford	1934	50,000	5.5	Earth fill embankment with puddle clay core	Impounding	Yes	High risk	250
12062	Hawkridge	1960	864,000	20	Mass concrete gravity	Impounding	Yes	High risk	200
11777	Leigh	1893	120,000	12.5	Earth fill embankment with puddle clay core	Impounding	Yes	High risk	300
11208	Luxhay	1905	544,000	19	Earth fill embankment with puddle clay core	Impounding	Yes	High risk	430
12111	Sutton Bingham	1956	2,614,000	15	Earth fill embankment with puddle clay core	Impounding	Yes	High risk	225
12087	Monkwood	1890	231,000	15	Earth fill embankment with puddle clay core	Impounding	Yes	High risk	160
12009	Ivy Lake	1987	120,000	2	Earth fill embankment around worked out gravel pit	Non-impounding	Yes	Not high risk	200
12009	Blashford Lake	1985	520,000	6	Earth fill embankment around worked out gravel pit	Non-impounding	Yes	Not high risk	130
12009	Ellingham Intake Pound	1989	100,000	9	Earth fill embankment with bentonite cement slurry cut off	Non-impounding	Yes	Not high risk	170
12095	Otterhead	1885	15,000	4	Earth fill embankment with bentonite cement slurry cut off	Impounding	No	Not high risk	80

APPENDIX B – COST ESTIMATION SHEETS CONCRETE DAMS

Valuation of dams

Front Sheet

Calcs by: HP
Checked by: JPT

Client:	Wessex Water
----------------	--------------

Concrete Dams

Summary: (Figures rounded to the nearest 1000)

Dam	Height (m)	Length (m)	Concrete Volume (m3)	Construction Cost	Additional Costs	Total Capital Expenditure
Nutscale	14.1	90.0	6,000	£5,012,000	£3,007,000	£8,018,000
Hawkridge	22.5	164.8	22,000	£7,841,000	£4,705,000	£12,545,000
Clatworthy	30.0	248.2	48,000	£18,159,000	£10,895,000	£29,054,000

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Nutscale Reservoir
Dam Type:	Concrete Gravity Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 The dam has a slightly curved horizontal alignment with a height of 14m and a length of 90m. There is a 30.2m long central overflow and the full supply level (FSL) is at 203.2m OD. The reservoir capacity is 178,000 m³. Surface Area: 33,691 m², Catchment size: 5.36km²

	Existing Dam	Replacement
crest width	1.83m	3m
upstream face	Vertical	Vertical
downstream face	Concrete blocks with a variable slope: 0.67 (H) : 1 (V) at the bottom and steeper at the top.	0.7 (H) : 1 (V) for the entire downstream face.
Cutoff	Substantial cutoff beneath the dam. Particularly deep on the south side of the valley where it reaches a maximum depth of 18m. Grouting was carried out from the base of the cutoff trench.	Similar to existing
Overflow weir	30.2m long central overflow at 203.2m OD.	Similar to existing
Draw off	The draw-off tower is integral with the dam and is located to the south of the overflow. Four 10-inch diameter draw-off pipes pass from the reservoir into the 2.25 m diameter shaft and connect to the 18-inch vertical stack. The outlet pipe turns at the base of the shaft and passes out through the dam to the Meter House at the foot of the dam. The stated capacity of the draw-off works is 3.5 MI/d. There is also a 760 mm diameter scour pipe.	Similar to existing
Wave wall	None	None

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Nutscale Reservoir
Dam Type:	Concrete Gravity Dam
OS Grid Reference:	⊗
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	"Section D"	"Section E"	"Section F"	"Section G"	"Section H"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Height of Dam	6.45	11.92	13.70	14.00	13.21	6.75	0.56	1.59		m		-	
Volume of Concrete beneath crest	293.22	428.98	340.63	612.06	430.17	468.81	7.15	8.17	2,157.65	m3	£ 164.77	£ 355,513.36	C10 Sulphate resisting mass concrete *
Upstream Surface Area	97.74	142.99	113.54	204.02	143.39	156.27	2.38	2.72	863.06	m2	£ 70.77	£ 61,082.13	Formwork *
Section Length	15.14	12.00	8.29	14.57	10.86	23.14	4.29	1.71		m AOD		-	
Downstream Volume	220.80	596.36	544.57	999.79	662.80	369.32	0.46	1.51	3,395.62	m3	£ 164.77	£ 559,493.21	C10 Sulphate resisting mass concrete *
Downstream Surface Area	119.31	174.54	138.60	249.04	175.03	190.75	2.91	3.32	1,053.50	m2	£ 70.77	£ 74,560.24	Formwork *
Protection on the downstream face	59.65	87.27	69.30	124.52	87.51	95.38	1.45	1.66	526.75	m3	£ 87.00	£ 45,826.62	Concrete Blocks *
Volume of protection on upstream face	48.87	71.50	56.77	102.01	71.69	78.13	1.19	1.36	431.53	m3	£ 87.00	£ 37,542.63	Concrete Blocks *
Excavtion Volume for removal of boulders & Sand (0.5m)	101.91	139.15	118.39	184.36	69.77	-	-	1.51	615.09	m3	£ 8.75	£ 5,378.92	
Excavtion of topsoil (0.5m)	34.21	50.05	39.74	71.41	50.19	54.69	0.83	0.95	302.07	m3	£ 8.75	£ 2,641.61	
Spillway Volume of Concrete (0.5m thickness)					243.43				243.43	m3	£ 164.77	£ 40,109.43	C10 Sulphate resisting concret *
Spillway Surface Area					486.86				486.86	m2	£ 70.77	£ 34,456.78	Formwork *
Concrete Blocks Surrounding the Spillway									16.12	m	£ 87.00	£ 2,805.03	
Stilling Basin									625.00	m3	£ 208.25	£ 276,848.22	Cost includes: £70.77 per m2 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71 *
Excavation Volume - Rock (6.0m)	683.08	816.57	626.02	1119.17	797.66	1072.90	87.15	42.30	5244.85	m3	£ 73.43	£ 385,102.91	
Grouting (20m deep)	302.86	240.00	165.71	291.43	217.14	462.86	85.71	34.29	1800.00	m2	£ 165.00	£ 297,000.00	
Dam Crest Roadway	30.29	24.00	16.57	29.14	21.71	46.29	8.57	3.43	180.00	m2	£ 57.20	£ 10,296.00	2m wide running surface *
Length of Scour Pipe 450mm dia									1,119.17	m	£ 254.34	£ 284,650.73	
Scour valves & actuators									4.00	No.	£ 4,769.60	£ 19,078.40	
Length of Supply Main 750mm dia									1119.165274	m	£ 718.56	£ 804,191.88	
Draw-off valves & actuators									4	No.	£ 43,049.60	£ 172,198.40	
Access ancillaries (hatches, doors, flooring)												£ 140,013.00	£10000 per meter height of dam *
Access Road to Site									955	m	£ 240.00	£ 229,200.00	
Instrumentation												£ 50,000.00	Based on dam length / size *
Quality Testing												£ 55,532.69	Based on concrete volume *
Building services (Tunnel)												£ 140,013.00	£10000 per meter height of dam *
Diversions & Enabling Works												£ 92,408.58	Proportional to reservoir area *
General & Preliminary Items									20	%		£ 835,188.75	

Total: £ 5,011,132.52

Pre-Construction Surveys										20	%	£ 1,002,226.50	
Contingency										20	%	£ 1,002,226.50	
Wessex Water Design & Management										20	%	£ 1,002,226.50	

Total Capital Expenditure: £ 8,017,812.04

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Hawkridge Reservoir
Dam Type:	Concrete Gravity Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 Hawkridge is a mass concrete gravity dam across a relatively steep sided valley and consists of seventeen monoliths. The dam has a near central overflow comprising othe two monoliths immediately adjacnet to the valve shaft and two arms consisting of five and seven monoliths to the south and north respectively. TWL: 97.54, capacity 864,000m³. Height: 22.42m from foundation. Surface Area: 97,570m², Catchment Size: 10.89km²

	Existing Dam	Replacement
crest	1.5m wide, nominal level of 99.074m OD. Sufraced with a bituminous material. Length: 165m	3m
upstream face	1 (H) : 24 (V). PVC waterstops are present just behind the upstream side of the monolith joints.	vertical
downstream face	1 (H) : 1.29 (V) with a vertical section to retain the access along the top of the dam.	0.7 (H) : 1 (V)
Overflow weir	four monoliths in two separate pairs with a total length of 44.8m with allowance for the bridge piers. The surface is protected by a layer of reinforced concrete (Class C) for approximately 1.8m below the overflow level. Flow down the downstream face is retained within the overflow monoliths by low confining walls which conenct into the end walls of the energy dissipation facilities at the toe of the overflow section.	similar to existing
Construction	Mass gravity construction consisting of 17 mass Class B concrete monoliths with a 450mm thick outer layer on both the upstream and downstream faces of a stronger mass concrete (Class A). Up to 7m of surface materal was removed.	similar to existing
Grouting	there is a substantial upstream concrete toe through which grouting was carried out. Drawings show that the grout curtain continues along the fill length of the dam with a depth broadly equivalent to the height of the dam above.	similar to existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Hawkridge Reservoir
Dam Type:	Concrete Gravity Dam
OS Grid Reference:	×
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	"Section D"	"Section E"	"Section F"	"Section G"	"Section H"	"Section I"	"Section J"	"Section K"	"Section L"	"Section M"	"Section N"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Height of Dam	3.88	10.06	13.80	16.10	18.83	21.13	22.42	20.70	18.25	15.67	13.22	9.92	8.05	4.02					
Volume of Concrete beneath crest	152.98	156.80	373.17	287.78	655.94	997.55	1,808.91	753.29	657.67	538.60	303.07	186.39	195.57	236.13	6,086.54	m3	£ 164.77	£ 1,002,872.64	C10 Sulphate resisting mass concrete *
Upstream Surface Area	50.99	52.27	124.39	95.93	218.65	332.52	602.97	251.10	219.22	179.53	101.02	62.13	65.19	78.71	2,434.61	m2	£ 70.77	£ 172,306.78	Formwork *
Section Length	13.14	5.20	9.02	5.96	11.61	15.74	26.89	12.13	12.01	11.46	7.64	6.27	8.10	19.56					
Downstream Volume	69.26	184.04	600.66	540.43	1,440.77	2,458.72	4,731.51	1,818.79	1,400.45	984.36	467.50	215.64	183.63	110.86	15,206.61	m3	£ 164.77	£ 2,505,573.23	C10 Sulphate resisting mass concrete *
Downstream Surface Area	62.25	63.80	151.84	117.09	266.89	405.89	736.02	306.50	267.59	219.15	123.31	75.84	79.58	96.08	2,971.83	m2	£ 70.77	£ 210,327.22	Formwork *
Protection on the downstream face	31.12	31.90	75.92	58.55	133.45	202.94	368.01	153.25	133.80	109.57	61.66	37.92	39.79	48.04	1,485.91		£ 87.00	£ 129,272.46	Concrete Blocks *
Volume of protection on upstream face	25.50	26.13	62.19	47.96	109.32	166.26	301.49	125.55	109.61	89.77	50.51	31.06	32.60	39.35	1,217.31		£ 87.00	£ 105,904.13	Concrete Blocks *
Excavtion of topsoil (0.5m)	17.85	18.29	43.54	33.57	76.53	116.38	211.04	87.88	76.73	62.84	35.36	21.75	22.82	27.55	852.12		£ 8.75	£ 7,451.72	
Spillway Volume of Concrete (0.5m thickness)	106.10	275.07	377.24	440.12	514.78	577.66	613.02	565.87	499.06	428.33	361.53	271.14	220.06	110.03	613.02		£ 164.77	£ 101,007.18	C10 Sulphate resisting concret *
Spillway Surface Area					1,029.56										1,029.56	m2	£ 70.77	£ 72,866.38	Formwork *
Concrete Blocks Surrounding the Spillway															22.28		£ 87.00	£ 3,876.61	
Stilling Basin															625.00	m3	£ 208.25	£ 284,597.97	Cost includes: £70.77 per m2 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71 *
Excavation Volume - Rock (6.0m)	236.55	93.52	162.28	107.27	209.04	283.31	484.10	218.39	216.19	206.29	137.53	112.77	145.80	352.07	2,965.12		£ 73.42	£ 217,712.14	
Grouting (22.5m deep)	295.68	116.90	202.85	134.09	261.30	354.13	605.12	272.99	270.24	257.86	171.91	140.97	182.25	440.09	3706.40	m2	£ 165.00	£ 611,550.96	
Dam Crest Roadway	26.28	10.39	18.03	11.92	23.23	31.48	53.79	24.27	24.02	22.92	15.28	12.53	16.20	39.12	329.46	m2	£ 57.20	£ 18,844.83	2m wide running surface *
Length of Scour Pipe 600mm dia															107.27	m	£ 452.79	£ 48,571.81	
Scour valves & actuators															4.00		£ 24,836.90	£ 99,347.60	
Length of Supply Main 350mm dia															107.271547	m	£ 254.34	£ 27,283.66	
Draw-off valves & actuators															4		£ 1,587.30	£ 6,349.20	
Access ancillaries (hatches, doors, flooring)																		£ 224,200.00	£10000 per meter height of dam *
Access Road to Site															203	m	£ 240.00	£ 48,720.00	
Instrumentation																		£ 50,000.00	Based on dam length / size *
Quality Testing																		£ 212,931.45	Based on concrete volume *
Building services (Tunnel)																		£ 224,200.00	£10000 per meter height of dam *
Diversions & Enabling Works																		£ 147,972.00	Proportional to reservoir area *
General & Preliminary Items															20	%		£ 1,306,747.99	

Total: £ 7,840,487.96

Pre-Construction Surveys															20	%		£ 1,568,097.59
Contingency															20	%		£ 1,568,097.59
Wessex Water Design & Management															20	%		£ 1,568,097.59

Total Capital Expenditure: £ 12,544,780.73

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Clatworthy Reservoir
Dam Type:	Concrete Gravity Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 Clatworthy dam is a mass concrete gravity section, the crest of which is curved in plan, and is 248.2m long. The central section of dam forms the overflow. The maximum height of the dam is 30m. Capacity: 5,364,000m³. TWL: 225.7m OD. Max Height: 30m, Surface Area: 506,770m², Catchment size: 18.2 km²

	Existing Dam	Replacement
crest width	4.57m, crest level: 228.14m AOD	3m
upstream face	vertical at the top, but has a batter with varying slope at the bottom.	Vertical
downstream face	0.8 (H) : 1 (V) at the bottom and steepening at higher levels to form a high vertical sided crest.	0.7 (H) : 1 (V) for the entire downstream face.
Cutoff	there is a concrete cut-off of variable depth supplemented by a grout curtain extending about 20m into the bedrock in the valley sides and up to 30m in the valley bottom. Drains are provided in the foundation immediately downstream of the cut-off and at the downstream toe.	Similar to existing
Grouting	the grout curtain is in the valley bottom and is inclined to intersect the bedding planes.	Similar to existing
Overflow weir	the weir is split level. The central lower part of the weir is at 225.7m OD and has a length of 11.43m, divided into two equal bays. The outer three bays on each side are at a level of 225.8m and have a combined length of 54.86m. There is a crest road carried on piers across the spillway.	Similar to existing
Construction	the hearing concrete is a 10:1 mix and the 600mm thick facing concrete is 7.5:1 mix. There was 30% replacement of cement with flyash.	Similar to existing
Draw off	The outlet and scour pipework and valves are located in a shaft adjacent to the side of the spillway and constructed integrally with the concrete dam which is thickened locally either side of the spillway. There is an 18 inch diameter draw off pipe and a 24" scour pipe.	Similar to existing
Wave wall	Pre cast concrete wave wall sections	Similar to existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Clatworthy Reservoir
Dam Type:	Concrete Gravity Dam
OS Grid Reference:	✂
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Height of Dam	15.00	30.00	15.00					
Volume of Concrete beneath crest	3,818.70	6,002.10	4,349.25	11,808.38	m3	£ 164.77	£ 1,945,654.14	C10 Sulphate resisting concret *
Upstream Surface Area	1,272.90	2,000.70	1,449.75	4,723.35	m2	£ 70.77	£ 334,205.44	Formwork *
Section Length	84.86	66.69	96.65					
Downstream Volume	6,682.73	21,007.35	7,611.19	35,301.26	m3	£ 164.77	£ 5,815,515.68	C10 Sulphate resisting mass concrete *
Downstream Surface Area	1,553.77	2,442.17	1,769.65	5,765.58	m2	£ 70.77	£ 407,949.73	Formwork *
Protection on the downstream face	776.89	1,221.08	884.82	2,882.79		£ 87.00	£ 250,736.29	Concrete Blocks *
Volume of protection on upstream face	636.45	1,000.35	724.88	2,361.68		£ 87.00	£ 205,411.16	Concrete Blocks *
Excavtion of topsoil (0.5m)	445.52	700.25	507.41	1,653.17		£ 8.75	£ 14,453.32	
Spillway Volume of Concrete (0.5m thickness)	104.64	209.28	104.64	209.28		£ 164.77	£ 34,483.09	C10 Sulphate resisting mass concrete *
Concrete Blocks Surrounding the Spillway				73.24		£ 87.00	£ 6,371.75	
Stilling Basin				625.00	m3	£ 208.25	£ 266,885.01	Cost includes: £70.77 per m2 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71 *
Excavation Volume - Rock (6.0m)	1527.48	1200.42	1739.70	4,467.60		£ 73.43	£ 327,927.80	
Grouting (20m deep)	1697.20	1333.80	1933.00	4964.00	m2	£ 165.00	£ 818,796.00	
Dam Crest Roadway	169.72	133.38	193.30	496.40	m2	£ 57.20	£ 28,384.93	2m wide running surface *
Length of Scour Pipe 600mm dia				4,467.60	m	£ 452.79	£ 2,019,150.94	
Scour valves & actuators				4.00	No.	£ 24,836.90	£ 99,347.60	
Length of Supply Main 450mm dia				4467.6	m	£ 254.34	£ 1,473,832.80	
Draw-off valves & actuators				4	No.	£ 4,769.60	£ 19,078.40	
Access ancillaries (hatches, doors, flooring)							£ 150,000.00	£10000 per meter height of dam *
Access Road to Site				508	m	£ 240.00	£ 121,920.00	
Wave wall				248.20	m	£ 87.00	£ 21,593.40	248.2m long, 1m high wave wall (£87 for 1m high wall) *
Instrumentation							£ 50,000.00	Based on dam length / size *
Quality Testing							£ 471,096.38	Based on concrete volume *
Building services (Tunnel)							£ 150,000.00	£10000 per meter height of dam *
Diversions & Enabling Works							£ 99,000.00	Proportional to reservoir area *
General & Preliminary Items				20	%		£ 3,026,358.77	

Total:	£ 18,158,152.61
--------	-----------------

Pre-Construction Surveys				20	%		£ 3,631,630.52
Contingency				20	%		£ 3,631,630.52
Wessex Water Design & Management				20	%		£ 3,631,630.52

Total Capital Expenditure:	£ 29,053,044.18
----------------------------	-----------------

APPENDIX C – COST ESTIMATION SHEETS EARTH EMBANKMENT DAMS

Valuation of dams
Front Sheet

Calcs by: HP
Checked by: JPT

Client:	Wessex Water
----------------	--------------

Earth Embankment Dams

Summary: (Figures rounded to the nearest 1000)

Dam	Height (m)	Length (m)	Fill Volume (m3)	Construction Cost	Additional Costs	Estimated Total Capital Expenditure
Leigh	12.5	300.0	134000	£11,428,000	£6,857,000	£18,285,000
Luxhay	19.0	430.0	227000	£17,853,000	£10,712,000	£28,565,000
Sutton Bingham	18.1	310.0	108000	£14,303,000	£8,582,000	£22,885,000
Monkswood	15.5	160.0	141000	£10,385,000	£6,231,000	£16,616,000
Durleigh	10.0	430.0	90000	£11,265,000	£6,759,000	£18,023,000
Ashford	5.7	250.0	12000	£5,008,000	£3,005,000	£8,013,000
Otterhead	2.0	60.0	1000	£609,000	£365,000	£974,000

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Leigh
Dam Type:	Earth Embankment Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 Leigh dam has a red clay puddle core and a total length of 300m and a maximum height of 12.5m. Total reservoir capacity 120,000m³. The water which feeds the reservoir is primarily ground water, there is only a small catchment for rain fall.
 On the south side of the reservoir there is a by-wash channel to intersect flow from the hillside and divert it around the reservoir.
 Piped connections provide water from local indirect spring catchments to the south west.

	Existing Dam	Replacement
Crest width	Covered in grass. Elevation: 159.56mOD	6.5m wide
Upstream face	the internal face is protected with stone pitching over the upper levels.	1 (H) : 5.5 (V) 500mm RIP RAP Slope protection on Gravel/Sand Filter. Upstream Toe Berm Selected Alluvium material with 500mm RIP RAP slope protection on gravel sand filter.
Downstream face	covered in grass.	1 (H): 4.5 (V) 500mm gravel under topsoil. Downstream toe berm selected alluvium.
Cutoff	A bentonite cement cut-off was constructed in part of the dam embankment following leakage through the core in 2003.	Cut-off beneath the impermeable core fill.
Overflow weir	Situated at the south east corner of the reservoir, comprises a board crested stone and brick weir at 158.33m AOD. Downstream of the overflow weir there is a stone lined channel which flows under a bridge. There is less than 1m clearance between the base of the channel and the underside of the bridge.	Concrete slabs
Construction	The earth embankment has a red clay puddle core.	0.5m excavation at the base of the new dam. 1.5m drainage mattress with filters to be placed in the excavated area. 2.5m wide filter drain to be placed downstream of the impermeable core along the length of the dam.
Draw off arrangement	The draw off works at the dam comprises a draw off tower which houses draw off valves and pipework. The tower is accessed by boat.	As per existing
Wave wall	56m long wave wall on the east embankment	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Leigh
Dam Type:	Earth Embankment Dam
OS Grid Reference:	X
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Volume of Core	7,094.22	25,152.60	5,650.68	37,897.50	m3	£ 4.96	£ 377,562.69	Total includes a lump sum £189,591.09 (Borrow Pit: excavate topsoil, disposal of topsoil, double handling of excavated topsoil)
Total Rolled Fill Volume (excluding drains)	1,684.13	124,071.15	7,453.35	133,208.63	m3	£ 11.23	£ 1,496,066.07	
Volume of RIP RAP Slope protection on upstream slope	2,277.37	8,316.90	1,813.97	12,408.24	m3	£ 74.25	£ 921,312.00	
Volume of Upstream Toe		9,198.07		9,198.07	m3	£ 30.76	£ 282,895.97	
Volume of RIP RAP Slope protection on upstream toe		4,511.00		4,511.00	m3	£ 74.25	£ 334,941.56	
Volume of Downstream Toe		23,151.14		23,151.14	m3	£ 30.76	£ 712,036.61	
Volume of Blanket drain gravel	5,851.28	13,737.06	4,660.66	24,249.00	m3	£ 45.00	£ 1,479,189.00	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Mattress Gravel Drain	2,587.94	11,386.65	2,061.35	16,035.94	m3	£ 45.00	£ 978,192.19	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Gravel under Topsoil of downstream slope	1,033.55	4,874.72	823.25	6,731.52	m3	£ 45.00	£ 410,622.51	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Topsoil for the downstream slope (250mm depth)	516.78	2,437.36	411.62	3,365.76	m3	£ 4.57	£ 15,364.69	
Volume of topsoil to be removed	2,352.68	10,834.31	1,873.95	15,060.94	m3	£ 8.75	£ 131,707.90	
Volume of Filter drain downstream of the clay core	2,307.43	8,072.63	1,837.91	12,217.97	m3	£ 59.40	£ 725,747.34	
Slurry Cut off wall 600mm wide, 3m deep (below the core)	130.30	305.91	103.79	540.00	m3	£ 174.17	£ 94,050.00	
Drawoff tower - Volume of concrete				294.20	m3	£ 208.25	£ 164,359.28	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building
Combined overflow and pipe culvert - Volume of Concrete				1,479.06	m3	£ 208.25	£ 617,221.35	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 450mm dia				83.00	m	£ 254.34	£ 21,110.39	
Scour valves & actuators				4.00	No.	£ 4,769.60	£ 19,078.40	
Length of Supply Main 300mm dia				83	m	£ 137.50	£ 11,412.50	
Draw-off valves & actuators				4.00	No.	£ 1,039.50	£ 4,158.00	
Access ancillaries (hatches, doors, flooring)							£ 125,000.00	£10000 per meter height of dam
Spillway Surface Area				214.25	m2	£ 35.35	£ 7,574.70	Concrete slabs
Stilling Basin				56.25	m3	£ 208.25	£ 23,473.49	Cost includes: £4459.96 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71
Access Road to Site				216	m	£ 240.00	£ 51,840.00	
Crest Road (Gravel: 0.3m depth, 4m wide)				360.00	m3	£ 45.00	£ 51,300.00	Cost includes safety kerbs at £117 per m
Wave wall				56.00	m	£ 87.00	£ 5,846.40	56m long, 1.2m high wave wall (pro rata from £87 for 1m high wall)
Instrumentation							£ 100,000.00	Based on dam length / size
Quality Testing							£ 133,208.63	Based on fill volume
Building services (tower & tunnel)							£ 125,000.00	£10000 per meter height of dam
Diversions & Enabling Works							£ 53,000.00	Based on reservoir area
River Diversion/Drainage							£ 50,000.00	Based on catchment
General & Preliminary Items				20	%		£ 1,904,654.33	

Total:	£ 11,427,926.00
---------------	------------------------

Pre-Construction Surveys			20	%	£ 2,285,585.20
Contingency			20	%	£ 2,285,585.20
Wessex Water Design & Management			20	%	£ 2,285,585.20

Total Capital Expenditure:	£ 18,284,681.60
-----------------------------------	------------------------

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Luxhay
Dam Type:	Earth Embankment Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 Luxhay Reservoir is an impounding reservoir located on the northern flanks of the Blackdown Hills, Somerset. It is fed by a combination of streams and springs in the direct catchment, and pipe connections from other reservoirs and sources which supply water from indirect catchments. Luxhay reservoir is trapezoidal in plan. It appears to have been partially formed by excavation along the eastern, southern and western margins. The dam is approximately 430m long with a maximum height of 19m. TWL: 144.9m AOD. Capacity: 547,000 m³, Surface area at top water level: 73,000 m², Natural Catchment area: 1.0 km²

	Existing Dam	Replacement
Crest width	3.5m. Dam crest level: 145.9m AOD	6.5m wide
Upstream face	3 (H) : 1 (V)	1 (H) : 5.5 (V) 500mm RIP RAP Slope protection on Gravel/Sand Filter. Upstream Toe Berm Selected Alluvium material with 500mm RIP RAP slope protection on grave/sand filter.
Downstream face	2.5 (H) : 1 (V) protected with concrete slabbing in the area immediately downstream of the overflow weir.	1 (H): 4.5 (V) 500mm gravel under topsoil. Downstream toe berm selected alluvium.
Cutoff		cut off beneath the impermeable core fill.
Overflow weir	the spillway comprises a masonry weir (elevation: 144.9m AOD, Length: 14.94m) on the right abutment. The weir comprises a main section (10.6m long) with 90 degree returns of 2.17m length at each end. Downstream of the weir there is a stepped cascade which leads into a masonry lined channel which passes through a twin arch bridge beneath the dam crest.	Concrete slabs
Construction	central puddle clay wall with selected material zone between the puddle wall and the general embankment fill material.	0.5m excavation at the base of the new dam. 1.5m drainage mattress with filters to be placed in the excavated area. 2.5m wide filter drain to be placed downstream of the impermeable core along the length of the dam.
Draw off arrangement	There is an outlet tower located within the reservoir which is connected through to the downstream toe of the dam by a masonry / brick culvert. The outlet pipework comprises a vertical stack within the tower, connected to a pipe within the culvert. The pipe in the culvert runs along the invert beneath an open mesh floor. The pipework and valves are generally 12" diameter.	As per existing
Wave wall	0.64m high wave wall, 163m long	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Luxhay
Dam Type:	Earth Embankment Dam
OS Grid Reference:	X
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Volume of Core	15,680.00	22,000.00	15,680.00	53,360.00	m3	£ 4.96	£ 454,272.15	Total includes a lump sum £189,591.09 (Borrow Pit: excavate topsoil, disposal of topsoil, double handling of excavated topsoil)
Total Rolled Fill Volume (excluding drains)	20,682.20	185,557.85	20,682.20	226,922.25	m3	£ 11.23	£ 2,548,563.73	
Volume of RIP RAP Slope protection on upstream slope	5,033.56	7,382.55	5,033.56	17,449.66	m3	£ 74.25	£ 1,295,637.58	
Volume of Upstream Toe		14,568.55		14,568.55	m3	£ 30.76	£ 448,070.41	
Volume of RIP RAP Slope protection on upstream toe		4,919.18		4,919.18	m3	£ 74.25	£ 365,249.13	
Volume of Downstream Toe		49,551.89		49,551.89	m3	£ 30.76	£ 1,524,018.01	
Volume of Blanket drain gravel	12,932.80	17,949.03	12,932.80	43,814.63	m3	£ 45.00	£ 2,672,692.43	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Mattress Gravel Drain	5,720.00	10,945.00	5,720.00	22,385.00	m3	£ 45.00	£ 1,365,485.00	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Gravel under Topsoil of downstream slope	2,284.41	4,803.16	2,284.41	9,371.99	m3	£ 45.00	£ 571,691.44	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Topsoil for the downstream slope (250mm depth)	1,142.21	2,401.58	1,142.21	4,686.00	m3	£ 4.57	£ 21,391.57	
Volume of topsoil to be removed	5,200.00	10,587.50	5,200.00	20,987.50	m3	£ 8.75	£ 183,535.69	
Volume of Filter drain downstream of the clay core	4,300.00	6,462.50	4,300.00	15,062.50	m3	£ 59.40	£ 894,712.50	
Slurry Cut off wall 600mm wide, 3m deep (below the core)	288.00	198.00	288.00	774.00	m3	£ 174.17	£ 132,660.00	
Drawoff tower - Volume of concrete				367.77	m3	£ 208.25	£ 195,059.16	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building
Combined overflow and pipe culvert - Volume of Concrete				2,049.30	m3	£ 208.25	£ 855,186.21	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 600mm dia				115.00	m	£ 452.79	£ 52,071.20	
Scour valves & actuators				4.00	No.	£ 24,836.90	£ 99,347.60	
Length of Supply Main 300mm dia				115.00	m	£ 137.50	£ 15,812.50	
Draw-off valves & actuators				4.00	No.	£ 1,039.50	£ 4,158.00	
Access ancillaries (hatches, doors, flooring)							£ 190,000.00	£10000 per meter height of dam
Spillway Surface Area				158.36	m2	£ 35.35	£ 5,598.80	Concrete slabs
Stilling Basin				112.05	m2	£ 208.25	£ 46,759.19	Cost includes: £8884.25 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71
Access Road to Site				258.00	m	£ 240.00	£ 61,920.00	Cost includes concrete blocks at £87 per m of road
Crest Road (Gravel: 0.3m depth, 4m wide)				516.00	m3	£ 45.00	£ 73,530.00	Cost includes safety kerbs at £117 per m
Wave wall				163.00	m	£ 87.00	£ 9,075.84	163m long, 0.64m high wave wall (pro rata from £87 for 1m high wall)
Instrumentation							£ 125,000.00	Based on dam length / size
Quality Testing							£ 226,922.25	Based on fill volume
Building services (tower & tunnel)							£ 190,000.00	£10000 per meter height of dam
Diversions & Enabling Works							£ 149,000.00	Based on reservoir area
River Diversion/Drainage							£ 100,000.00	Based on catchment
General & Preliminary Items				20.00	%		£ 2,975,484.08	

Total: £ 17,852,904.45

Pre-Construction Surveys				20.00	%		£ 3,570,580.89
Contingency				20.00	%		£ 3,570,580.89
Wessex Water Design & Management				20.00	%		£ 3,570,580.89

Total Capital Expenditure: £ 28,564,647.12

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Sutton Bingham
Dam Type:	Earth Embankment Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 The reservoir has a surface area of 57.5 hectares and extends from the dam about 2.5km to the southwest. A shorter limb of the reservoir extends westwards and is crossed, on a causeway, by the unclassified public road to Halstock. Dam height: 18.1m, Capacity: 2.6Mm³, Catchment: 30.3 km²

	Existing Dam	Replacement
Crest width	Crest elevation 57.35m AOD, length 310m (measured on google earth)	6.5m wide
Upstream face	The upstream face was reformed in 2007/08 and now slopes down from the wall initially at 1:4 towards	1 (H) : 5.5 (V) 500mm RIP RAP Slope protection on Gravel/Sand Filter. Upstream Toe Berm Selected Alluvium material with 500mm RIP RAP slope protection on grave/sand filter.
Downstream face	full supply level and thereafter at 1:5 down to the toe. The upstream face is covered with rip rap.	1 (H): 4.5 (V) 500mm gravel under topsoil. Downstream toe berm selected alluvium.
Cutoff	there is a foundation trench filled with concrete beneath the puddle clay core. On the left bank this extends down to more than 21.3m beneath the surface.	cut off beneath the impermeable core fill.
Grouting	the grout curtain extends down to a maximum depth of about 20m below the bottom of the foundation trench. It extends 60m beyond the end of the dam in the north and about 84m beyond the end of the dam in the south. The total cement take was 580 tonnes (excluding the grout curtain running upstream at the left abutment).	As per existing
Overflow weir	The overflow is located on the right (south) flank of the valley. It comprises a circular bellmouth-type structure, which transfers water downstream from the drop shaft to a cut and cover culvert. The culvert discharges into a concrete lined tailbay channel which continues for 50 m before it reaches the natural watercourse well downstream of the dam.	As per existing
Construction	the dam has a puddle clay core which is supported by shoulders of Cornbrash limestone and Forest Marble clay placed on natural ground after partial excavation of alluvium.	0.5m excavation at the base of the new dam. 1.5m drainage mattress with filters to be placed in the excavated area. 2.5m wide filter drain to be placed downstream of the impermeable core along the length of the dam.
Wave wall	1.27m high	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Sutton Bingham
Dam Type:	Earth Embankment Dam
OS Grid Reference:	
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	"Section D"	"Section E"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Volume of Core	9,148.68	2,799.95	11,134.52	1,527.60	12,565.86	37,176.61	m3	£ 4.96	£ 373,992.02	Total includes a lump sum £189,591.09 (Borrow Pit: excavate topsoil, disposal of topsoil, double handling of excavated topsoil)
Total Rolled Fill Volume (excluding drains)	7,252.15	12,918.22	56,781.54	10,728.26	19,591.72	107,271.89	m3	£ 11.23	£ 1,204,770.60	
Volume of RIP RAP Slope protection on upstream slope	2,301.72	835.34	3,341.33	467.49	3,448.62	10,394.51	m3	£ 74.25	£ 771,792.17	
Volume of Upstream Toe				2,343.37		2,343.37	m3	£ 30.76	£ 72,072.81	
Volume of RIP RAP Slope protection on upstream toe				1,161.92		1,161.92	m3	£ 74.25	£ 86,272.20	
Volume of Downstream Toe				3,905.54		3,905.54	m3	£ 30.76	£ 120,118.91	
Volume of Blanket drain gravel	5,758.11	5,578.14	21,425.15	2,586.23	18,186.95	53,534.59	m3	£ 45.00	£ 3,265,609.98	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Mattress Gravel Drain	2,993.77	1,314.11	5,284.96	2,258.01	24,924.39	36,775.23	m3	£ 45.00	£ 2,243,288.73	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Gravel under Topsoil of downstream slope	1,144.78	568.13	2,291.67	329.51	2,050.15	6,384.24	m3	£ 45.00	£ 389,438.84	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Topsoil for the downstream slope (250mm depth)	572.39	284.07	1,145.83	164.76	1,025.08	3,192.12	m3	£ 4.57	£ 14,572.04	
Volume of topsoil to be removed	2,646.58	1,258.55	5,071.59	726.91	4,619.25	14,322.88	m3	£ 8.75	£ 125,253.58	
Volume of Filter drain downstream of the clay core	2,458.35	810.89	3,233.34	447.66	3,504.95	7,185.95	m3	£ 59.40	£ 426,845.45	
Slurry Cut off wall 600mm wide, 3m deep (below the core)	192.29	30.77	118.17	14.26	202.50	558.00	m	£ 174.17	£ 97,020.00	
Drawoff tower - Volume of concrete						357.53	m3	£ 208.25	£ 190,786.50	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building
Combined overflow and pipe culvert - Volume of Concrete						926.64	m3	£ 208.25	£ 386,692.90	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 600mm dia						52.00	m	£ 452.79	£ 23,545.24	
Scour valves & actuators						4.00	No.	£ 24,836.90	£ 99,347.60	
Length of Supply Main 300mm dia						52.00	m	£ 137.50	£ 7,150.00	
Draw-off valves & actuators						4.00	No.	£ 1,039.50	£ 4,158.00	
Access ancillaries (hatches, doors, flooring)									£ 180,952.38	£10000 per meter height of dam
Concrete Tailbay Channel (length 50m)						520.00	m3	£ 208.25	£ 108,291.04	
Overflow Weir Volume of Concrete						136.00	m3	£ 164.77	£ 50,840.27	
Access Road to Site						170.00	m	£ 240.00	£ 40,800.00	Cost includes concrete blocks at £87 per m of road
Crest Road (Gravel: 0.3m depth, 4m wide)						372.00	m3	£ 45.00	£ 53,010.00	Cost includes safety kerbs at £117 per m
Wave wall						310.00	m	£ 87.00	£ 34,251.90	310m long, 1.27m high wave wall (pro rata from £87 for 1m high wall)
Instrumentation									£ 125,000.00	Based on dam length / size
Quality Testing									£ 107,271.89	Based on fill volume
Building services (tower & tunnel)									£ 180,952.38	£10000 per meter height of dam
Diversions & Enabling Works									£ 935,000.00	Based on reservoir area
River Diversion/Drainage									£ 200,000.00	Based on catchment
General & Preliminary Items						20.00	%		£ 2,383,819.48	

Total: £ 14,302,916.89

Pre-Construction Surveys						20.00	%		£ 2,860,583.38
Contingency						20.00	%		£ 2,860,583.38
Wessex Water Design & Management						20.00	%		£ 2,860,583.38

Total Capital Expenditure: £ 22,884,667.03

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Monkswood
Dam Type:	Earth Embankment Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 The dam was constructed in 1893 to supply water to the City of Bath. It is about 160 m long with a maximum height of about 15.5 m. The dam has a puddle clay core 5 m wide at original ground level tapering to 3 m wide about 3 m below crest level, with a narrow top section approximately 1.5 m wide. Below original ground level there is a puddle clay core trench up to 17 m deep. This terminates in the Blue Lias Clay.
 maximum height: 15.5m, length: 160m, Capacity 231,714m³, Surface area: 3.8 hectares, Catchment size: 1.2 km²

	Existing Dam	Replacement
Crest width	3.6m wide and covered in grass. Elevation: 111.35m AOD	6.5m wide
Upstream face	3 (H) : 1 (V) faced with concrete at the top and dry rubble pitching 450mm thick lower down. Below the emergency spillway the face of the dam is protected by concrete blocks joined together by polypropylene ropes.	1 (H) : 5.5 (V) 500mm RIP RAP Slope protection on Gravel/Sand Filter. Upstream Toe Berm Selected Alluvium material with 500mm RIP RAP slope protection on grave/sand filter.
Downstream face	2.6 (H) : 1 (V)	1 (H): 4.5 (V) 500mm gravel under topsoil. Downstream toe berm selected alluvium.
Cutoff		Slurry cut off beneath the impermeable core fill.
Overflow weir	Main spillway located at the south end of the dam (weir level 110.14m AOD, weir length: 3.05m) Emergency spillway constructed in 1992 over the southern end embankment. The spillway has a bottom width of 18m and slopes up to the dam crest at either end at a gradient of 6 (H) : 1 (V) The level of the sill is 110.5m AOD (ie 360 mm above the level of the sill of the main spillway)	As per existing
Construction	In 1945, to prevent leakage sheet piles were driven along the crest of the dam over a length of 100m to a depth of 5.5m.	0.5m excavation at the base of the new dam. 1.5m drainage mattress with filters to be placed in the excavated area. 2.5m wide filter drain to be placed downstream of the impermeable core along the length of the dam.
Draw off arrangement	The draw-off is through a wet tower known as the straining well. This has a 450 mm dia upper drawoff and a 380 mm dia lower drawoff. There is also a 300 mm diameter scour. The upper and lower drawoffs are connected into a 450 mm diameter pipe which starts at the old reservoir to the west and runs beneath the floor of the reservoir before entering the straining well and thence the tunnel.	As per existing
Wave wall	0.6m high Recommended in the 2009 S10 report.	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Monkswood
Dam Type:	Earth Embankment Dam
OS Grid Reference:	×
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Volume of Core	10,109.30	11,119.80	3,949.56	25,178.66	m3	£ 4.96	£ 314,464.52	Total includes a lump sum £189,591.09 (Borrow Pit: excavate topsoil, disposal of topsoil, double handling of excavated topsoil)
Total Rolled Fill Volume (excluding drains)	63,172.96	69,487.57	7,978.48	140,639.00	m3	£ 11.23	£ 1,579,516.60	
Volume of RIP RAP Slope protection on upstream slope	3,040.65	3,344.59	1,073.78	7,459.03	m3	£ 74.25	£ 553,832.64	
Volume of Upstream Toe	1,795.80	5,729.93		7,525.73	m3	£ 30.76	£ 231,461.33	
Volume of RIP RAP Slope protection on upstream toe	1,059.27	2,110.64		3,169.91	m3	£ 74.25	£ 235,365.69	
Volume of Downstream Toe	2,992.95	15,208.75		18,201.70	m3	£ 30.76	£ 559,811.42	
Volume of Blanket drain gravel	9,590.49	10,549.13	2,955.95	23,095.58	m3	£ 45.00	£ 1,408,830.42	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Mattress Gravel Drain	4,819.55	5,301.30	1,535.94	11,656.79	m3	£ 45.00	£ 711,064.19	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Gravel under Topsoil of downstream slope	2,092.27	2,301.41	627.49	5,021.17	m3	£ 45.00	£ 306,291.40	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Topsoil for the downstream slope (250mm depth)	1,046.13	1,150.70	313.75	2,510.59	m3	£ 4.57	£ 11,460.82	
Volume of topsoil to be removed	4,628.53	5,091.19	1,417.09	11,136.81	m3	£ 8.75	£ 97,391.37	
Volume of Filter drain downstream of the clay core	2,938.75	3,232.50	1,097.10	7,268.35	m3	£ 59.40	£ 431,739.99	
Slurry Cut off wall 600mm wide, 6m deep (below the core)	211.59	232.74	131.65	575.98	m	£ 174.17	£ 100,316.87	
Drawoff tower - Volume of concrete				328.16	m3	£ 208.25	£ 178,529.04	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building
Combined overflow and pipe culvert - Volume of Concrete				1,799.82	m3	£ 208.25	£ 751,076.58	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 450mm dia				101.00	m	£ 254.34	£ 25,688.54	
Scour valves & actuators				4.00	No.	£ 4,769.60	£ 19,078.40	
Length of Supply Main 300mm dia				101	m	£ 137.50	£ 13,893.06	
Draw-off valves & actuators				4	No.	£ 1,039.50	£ 4,158.00	
Access ancillaries (hatches, doors, flooring)							£ 155,000.00	£10000 per meter height of dam
Bywash channel Volume of concrete				580.98	m3	£ 208.25	£ 121,219.32	
Spillway Surface Area				1922.60	m2	£ 35.35	£ 67,971.63	Concrete slabs
Stilling Basin				202.50	m2	£ 208.00	£ 84,453.94	Cost includes: £16046.25 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71
Access Road to Site				120	m	£ 240.00	£ 28,800.00	
Crest Road (Gravel: 0.3m depth, 4m wide)				191.99	m3	£ 45.00	£ 27,359.15	Cost includes safety kerbs at £117 per m
Wave wall				160.00	m	£ 87.00	£ 8,352.00	160m long, 0.6m high wave wall (pro rata from £87 for 1m high wall)
Instrumentation							£ 125,000.00	Based on dam length / size
Quality Testing							£ 140,639.00	Based on fill volume
Building services (tower & tunnel)							£ 155,000.00	£10000 per meter height of dam
Diversions & Enabling Works							£ 106,000.00	Based on reservoir area
River Diversion/Drainage							£ 100,000.00	Based on catchment
General & Preliminary Items				20%			£ 1,730,753.19	

Total:	£ 10,384,519.12
---------------	------------------------

Pre-Construction Surveys				20%		£ 2,076,903.82
Contingency				20%		£ 2,076,903.82
Wessex Water Design & Management				20%		£ 2,076,903.82

Total Capital Expenditure:	£ 16,615,230.60
-----------------------------------	------------------------

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Durleigh
Dam Type:	Earth Embankment Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category A Reservoir
 The reservoir is impounded behind an earth embankment dam that was built across the valley of the Durleigh Brook, which is a tributary of the River Parrett. The dam is located at the eastern end of the reservoir and has a slightly curved alignment in plan. It has a maximum height of about 10 m and a length of 430 m. The overflow and draw-off facilities are combined in a single structure that is located midway along the embankment.
 The dam has a slightly curved alignment in plan, a maximum height of about 10m and a length of 430m. FSL: 22.05m AOD, Capacity: 959,000m³. Surface Area: 314,000 m³, Catchment size: 17.32 km².

	Existing Dam	Replacement
Crest width	the crest of the dam is 2.5m wide and is grass covered. Elevation: 23.77m OD	6.5m wide
Upstream face	2.5 (H) : 1 (V) protected by random stone pitching.	1 (H) : 5.5 (V) 500mm RIP RAP Slope protection on Gravel/Sand Filter. Upstream Toe Berm Selected Alluvium material with 500mm RIP RAP slope protection on grave/sand filter.
Downstream face	2 (H) : 1 (V) is grass covered.	1 (H): 4.5 (V) 500mm gravel under topsoil. Downstream toe berm selected alluvium.
Cutoff	a clay filled cut-off trench that was extended down into the underlying mercia mudstone (aka Keuper Marl).	cut off beneath the impermeable core fill.
Overflow weir	the overflow is located at the tower close to the centre of the dam. Excess water in the reservoir will spill out over a complex weir that is formed by the south, east and north part walls of the structure. The weri is set at 22.25m OD and has an effective length of 16.9m.	As per existing
Construction	the dam has a clay core 1.3m wide at the top and about 2.8m wide at the bottom	0.5m excavation at the base of the new dam. 1.5m drainage mattress with filters to be placed in the excavated area. 2.5m wide filter drain to be placed downstream of the impermeable core along the length of the dam.
Wave wall	The crest of the dam is nominally set at an elevation of 23.77 m OD while the top of the wave wall is at 24.07 m OD. (Height: 0.3m)	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Durleigh
Dam Type:	Earth Embankment Dam
OS Grid Reference:	×
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	"Section D"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Volume of Core	5,705.93	7,615.87	20,432.64	11,713.41	45,467.85	m3	£ 4.96	£ 415,116.58	Total includes a lump sum £189,591.09 (Borrow Pit: excavate topsoil, disposal of topsoil, double handling of excavated topsoil)
Total Rolled Fill Volume (excluding drains)	5,674.68	13,951.03	57,790.45	12,234.69	89,650.85	m3	£ 11.23	£ 1,006,868.69	
Volume of RIP RAP Slope protection on upstream slope	1,377.66	2,107.53	5,803.10	2,997.72	12,286.02	m3	£ 74.25	£ 912,237.04	
Volume of Upstream Toe			4,709.75		4,709.75	m3	£ 30.76	£ 144,853.10	
Volume of RIP RAP Slope protection on upstream toe			3,427.50		3,427.50	m3	£ 74.25	£ 254,492.06	
Volume of Downstream Toe			11,213.47		11,213.47	m3	£ 30.76	£ 344,881.33	
Volume of Blanket drain gravel	-	10,687.34	25,805.79	7,046.35	43,539.48	m3	£ 45.00	£ 1,959,276.39	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Mattress Gravel Drain	1,691.19	3,074.12	8,699.84	11,961.80	25,426.94	m3	£ 45.00	£ 1,144,212.08	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Gravel under Topsoil of downstream slope	617.66	1,271.50	3,658.88	1,550.12	7,098.16	m3	£ 45.00	£ 319,417.22	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Topsoil for the downstream slope (250mm depth)	308.83	635.75	1,829.44	775.06	3,549.08	m3	£ 4.57	£ 16,201.55	
Volume of topsoil to be removed	1,452.22	2,859.26	8,181.04	3,562.39	16,054.91	m3	£ 8.75	£ 140,400.14	
Volume of Filter drain downstream of the clay core	1,507.37	2,132.05	5,786.59	3,170.20	12,596.20	m3	£ 59.40	£ 748,214.43	
Slurry Cut off wall 600mm wide, 3m deep (below the core)	132.35			235.31	367.67	m	£ 174.17	£ 64,035.51	
Drawoff tower - Volume of concrete					265.91	m3	£ 208.25	£ 152,551.64	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building
Combined overflow and pipe culvert - Volume of Concrete					1,087.02	m3	£ 208.25	£ 453,620.51	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 600mm dia					61.00	m	£ 452.79	£ 27,620.37	
Scour valves & actuators					4.00		£ 24,836.90	£ 99,347.60	
Length of Supply Main 450mm dia					61.00	m	£ 254.34	£ 15,514.86	
Draw-off valves & actuators					4.00		£ 4,769.60	£ 19,078.40	
Access ancillaries (hatches, doors, flooring)								£ 100,000.00	£10000 per meter height of dam
Stilling Basin					126.75	m2	£ 208.25	£ 52,893.85	Cost includes: £10049.83 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71
Access Road to Site					92.00	m	£ 240.00	£ 22,080.00	
Crest Road (Gravel: 0.3m depth, 4m wide)					516.00	m3	£ 45.00	£ 73,530.00	Cost includes safety kerbs at £117 per m
Wave wall					430.00	m	£ 87.00	£ 11,223.00	430m long, 0.3m high wave wall (pro rata from £87 for 1m high wall)
Instrumentation								£ 125,000.00	Based on dam length / size
Quality Testing								£ 89,650.85	Based on fill volume
Building services (tower & tunnel)								£ 100,000.00	£10000 per meter height of dam
Diversions & Enabling Works								£ 416,000.00	Based on reservoir area
River Diversion/Drainage								£ 250,000.00	Based on catchment
General & Preliminary Items					20.00	%		£ 1,758,347.34	

Total: £ 11,264,061.34

Pre-Construction Surveys					20.00	%		£ 2,252,812.27
Contingency					20.00	%		£ 2,252,812.27
Wessex Water Design & Management					20.00	%		£ 2,252,812.27

Total Capital Expenditure: £ 18,022,498.14

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Ashford
Dam Type:	Earth Embankment Dam
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category B Reservoir
 the dam is L shaped in plan and has a puddle clay core. The length of the dam is approximately 250m and the maximum height is 5.62m. Capacity 50,000m³, TWL: 34.88m AOD,
 The Hawkridge dam is upstream of Ashford and has a catchment area of 10.9 km². The catchment area between Hawkridge and Ashford is 3.06 km² so the total catchment area of Ashford reservoir is 13.96 km².

	Existing Dam	Replacement
Crest width	The crest is 2.5 to 3m wide (record drawings show this to be 1.8m) Elevation 36.0m AOD	6.5m wide
Upstream face	2.5 (H) : 1 (V) and is covered with pitched stone some of which has a skim of concrete on top.	4 (H) : 1 (V)
Downstream face	2 (H) : 1 (V), there are finger drains at 9.15m intervals beneath the downstream shoulder and a 225mm dia pipe and rubble drain along the toe of the dam.	3 (H) : 1 (V)
Cutoff	beneath the dam, the puddle clay core was cut a minimum of 610mm into the underlying Marl.	cut off beneath the impermeable core fill.
Overflow weir	The main spillway is located at the south end of the dam (weir level: 34.88m AOD, weir length: 38.71m) and drains into a bywash channel. Along the toe of the dam the spillway channel is supported by a buried viaduct structure. There is a bridge above the spillway. Auxiliary spillway has a sill 60m long at a nominal level of 35.19m AOD. it is located on the crest of the dam just to the south of the drawoff tower.	As per existing
Construction		0.5m excavation at the base of the new dam. 1.5m drainage mattress with filters to be placed in the excavated area. 2.5m wide filter drain to be placed downstream of the impermeable core along the length of the dam.
Draw off arrangement	The draw-off tower is a wet tower, the superstructure of which is approached by a footbridge from the crest of the dam. There are penstocks at levels of about 34.29 and 33.07 m AOD which admit water into the tower. The 305 mm dia drawoff pipe, which is protected by a strainer, passes from the base of the tower through the scour culvert where it is connected to a 457 mm dia pipe discharging into supply.	As per existing
Wave wall	1.3m high, retro-fitted in 2010.	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Ashford
Dam Type:	Earth Embankment Dam
OS Grid Reference:	
Owner:	Wessex Water

	"Section A"	"Section B"	"Section C"	"Section D"	"Section E"	Quantity:	Unit	Rate	TOTAL (£)	Comments
Volume of Core	9,010.66	3,646.92	3,632.25	2,576.98	709.70	19,576.53	m3	£ 4.96	£ 286,672.35	Total includes a lump sum £189,591.09 (Borrow Pit: excavate topsoil, disposal of topsoil, double handling of excavated topsoil)
Total Rolled Fill Volume (excluding drains)	4,009.93	2,988.71	2,000.21	2,874.03	93.18	11,779.71	m3	£ 11.23	£ 132,297.89	
Volume of RIP RAP Slope protection on upstream slope	2,805.74	1,145.90	1,160.40	814.73	217.14	6,143.91	m3	£ 74.25	£ 456,185.56	
Volume of Upstream Toe			869.07			869.07	m3	£ 30.76	£ 26,729.20	
Volume of RIP RAP Slope protection on upstream toe			758.96			758.96	m3	£ 74.25	£ 56,352.90	
Volume of Downstream Toe			1,448.42			1,448.42	m3	£ 30.76	£ 44,547.75	
Volume of Blanket drain gravel	6,629.70	2,484.25	6,316.59	1,658.75	596.40	17,685.69	m3	£ 45.00	£ 795,856.26	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Mattress Gravel Drain	3,633.79	1,505.33	1,563.32	3,241.53	1,366.48	11,310.46	m3	£ 45.00	£ 508,970.63	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Gravel under Topsoil of downstream slope	879.32	407.43	501.13	312.93	50.04	2,150.84	m3	£ 45.00	£ 96,787.94	Cost includes £10 per tonne for excavating gravel from quarry. (Unit weight: 1.6 tonnes/m3)
Volume of Topsoil for the downstream slope (250mm depth)	439.66	203.71	250.57	156.46	25.02	1,075.42	m3	£ 4.57	£ 4,909.30	
Volume of topsoil to be removed	3,234.04	1,355.54	1,436.33	980.49	237.33	7,243.75	m3	£ 8.75	£ 63,346.55	
Volume of Filter drain downstream of the clay core	2,354.58	966.83	988.55	689.90	180.29	5,180.15	m3	£ 59.40	£ 307,701.20	
Slurry Cut off wall 600mm wide, 1.5m deep (below the core)	110.70	41.48	35.17	27.70	9.96	225.00	m	£ 174.17	£ 39,187.95	
Drawoff tower - Volume of concrete						216.34	m3	£ 208.25	£ 131,864.65	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building
Combined overflow and pipe culvert - Volume of Concrete						712.80	m3	£ 208.25	£ 297,456.07	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 300mm dia						40.00	m	£ 137.50	£ 5,500.00	
Scour valves & actuators						4.00		£ 1,039.50	£ 4,158.00	
Length of Supply Main 450mm dia						40.00	m	£ 254.34	£ 10,173.68	
Draw-off valves & actuators						4.00		£ 4,769.60	£ 19,078.40	
Access ancillaries (hatches, doors, flooring)									£ 56,200.00	£10000 per meter height of dam
Bywash channel Volume of concrete						299.46	m3	£ 208.25	£ 62,363.14	
Spillway Surface Area		815.4056738	1002.735625	626.2223244	100.2051063	2,544.57	m2	£ 35.35	£ 89,960.68	Concrete slabs
Stilling Basin						262.50	m2	£ 208.00	£ 109,477.33	Cost includes: £20800.69 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71
Access Road to Site						52.00	m	£ 240.00	£ 12,480.00	
Crest Road (Gravel: 0.3m depth, 4m wide)						300.00	m3	£ 45.00	£ 42,750.49	Cost includes safety kerbs at £117 per m
Wave wall						250.00	m	£ 87.00	£ 28,275.00	250m long, 1.3m high wave wall (pro rata from £87 for 1m high wall)
Instrumentation									£ 75,000.00	Based on dam length / size
Quality Testing									£ 11,779.71	Based on fill volume
Building services (tower & tunnel)									£ 56,200.00	£10000 per meter height of dam
Diversions & Enabling Works									£ 91,000.00	Based on reservoir area
River Diversion/Drainage									£ 250,000.00	Based on catchment
General & Preliminary Items						20.00	%		£ 834,652.53	

Total: £ 5,007,915.16

Pre-Construction Surveys						20.00	%		£ 1,001,583.03
Contingency						20.00	%		£ 1,001,583.03
Wessex Water Design & Management						20.00	%		£ 1,001,583.03

Total Capital Expenditure: £ 8,012,664.25

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Otterhead (Lower Lake)
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:

The Otterhead Lakes comprise two reservoirs; the Upper Reservoir and the Lower Reservoir. The volumes of these two reservoirs have been estimated as 3,510m³ and 11,326m³ respectively. Both are currently non statutory reservoirs. However, as the volume of the Lower Reservoir is greater than 10,000m³, it will fall under the Reservoirs Act when the threshold for registration is revised from 25,000m³ to 10,000m³ (Ref Floods and water management Act, 2010).

Both reservoirs are located on the River Otter immediately upstream of the hamlet of Royston Water, approximately 11km south of Taunton. Capacity: 11,326m³, Surface Area: 9,504m².

The left (east) and right (west) embankments are about 40m and 20 long respectively. The crest is approximately 3m wide and the slope of the downstream face is approximately 1v:3h. The upstream face has not been surveyed but appears to be at a similar gradient.

	Existing Dam	Replacement
Crest	207.1mAOD, 3m wide,	3m wide
Upstream face	3 (H) : 1 (V)	4 (H) : 1 (V)
Downstream face	3 (H) : 1 (V)	3 (H) : 1 (V)
Main Spillway / Overflow weir	205.82 mAOD (1.28m below the dam crest level) 4.5m wide Downstream of the weir the spillway comprises inclined concrete slabs with vertical steps approx 150mm in height and 2 to 3m apart in plan. At the base of the spillway there is a form of regulating pond which discharges into the original river channel.	As per existing
Auxiliary Spillway	The auxiliary spillway is approximately 4.5m wide at the dam crest. There are low steps (approx 100mm high) in the slab on the downstream face of the dam.	As per existing
Construction	The composition of the embankment is described in the Frederick Brand Partnership as follows "From available information one can only surmise that the original concept was to use available materials to form a bund. Placing course materials in the centre and finer materials on the outside. The latter is effectively a sandy silty clay seal over a sandy gravel core"	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Otterhead (Lower Lake)
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

		Quantity:	Unit	Rate	TOTAL (£)	Comments
Total Rolled Fill Volume	720.00	720.00	m3	£ 11.23	£ 8,086.32	
Volume of Beaching Slope protection on upstream slope	167.79	167.79	m3	£ 74.25	£ 12,458.05	
Volume of Topsoil for the downstream slope (250mm depth)	92.20	92.20	m3	£ 4.57	£ 421.00	
Volume of topsoil to be removed	360.00	360.00	m3	£ 8.75	£ 3,148.20	
Volume of excavation		3,318.00	m3	£ 11.23	£ 37,264.46	
Slurry Cut off wall 600mm wide, 2m deep (below the core)		72.00	m	£ 165.00	£ 11,880.00	
Drawoff tower - Volume of concrete		38.28	m3	£ 208.25	£ 57,562.64	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71 and a standard rate of £41,586.40 for a small building *
Combined overflow and pipe culvert - Volume of Concrete		258.38	m3	£ 208.25	£ 107,822.08	Cost includes: 0.15 tonnes of reinforcement per m3 of concrete at £1,393.71
Length of Scour Pipe 450mm dia		39.75	m	£ 254.34	£ 10,110.09	
Scour valves & actuators		4.00	No.	£ 4,769.60	£ 19,078.40	
Length of Supply Main 150mm dia		39.75	m	£ 78.67	£ 3,127.21	
Spillway Surface Area		28.46	m2	£ 35.35	£ 1,045.08	Concrete slabs
Stilling Basin		11.25	m3	£ 208.25	£ 4,694.72	Cost includes: £892.00 for formwork and 0.15 tonnes of reinforcement per m3 of concrete at £1393.71 *
Access ancillaries (hatches, doors, flooring)					£ 61,000.00	£10000 per meter height of dam
Crest Road (Gravel: 0.3m depth, 4m wide)		72.00	m3	£ 45.00	£ 10,260.00	Cost includes safety kerbs at £117 per m
Instrumentation					£ 25,000.00	Based on dam length / size
Access Road to Site		80	m	£ 240.00	£ 19,200.00	
Quality Testing					£ 720.00	Based on fill volume
Building services (tower & tunnel)					£ 61,000.00	£10000 per meter height of dam
Diversions & Enabling Works					£ 53,000.00	Based on reservoir area
General & Preliminary Items		20	%		£ 101,375.65	

Total:	£	608,253.92
---------------	---	------------

Pre-Construction Surveys		20	%		£ 121,650.78
Contingency		20			£ 121,650.78
Wessex Water Design & Management		20	%		£ 121,650.78

Total Capital Expenditure:	£	973,206.26
-----------------------------------	---	------------

APPENDIX D – COST ESTIMATION SHEETS CONVERTED GRAVEL PITS

Valuation of dams

Front Sheet

Calcs by: HP
Checked by: JPT

Client:	Wessex Water
----------------	--------------

Converted Gravel Pits

Summary: (Figures rounded to the nearest 1000)

Dam	Reservoir Capacity (m3)	Embankment Height (m)	Perimeter (m)	Construction Cost	Additional Costs	Estimated Total Capital Expenditure
Blashford Lake	520,000.00	3.00	3,000	£310,000	£186,000	£495,000
Ivy Reservoir	120,000.00	2.00	2,000	£296,000	£178,000	£473,000
Ellingham	100,000.00	3.00	1,000	£498,000	£299,000	£796,000

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Blashford Lake
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 Category C reservoir formed at the site of an abandoned gravel pit, **Blashford lake** has a usable capacity of 0.52Mm³. a low embankment was built on the narrow strip of land between Blashford and Snails to create a raised part of the reservoir. The raised embankment increases the depth of the reservoir to about 6m. TWL: 20.5m OD. The lake has no catchment area.

	Existing Dam	Replacement
Embankment	the embankment has a crest length of about 130m and has a nominal level of 23m OD. Although it is irregular in both width and line.	3m high rolled clay embankment, 3m crest. Length: 130m
Upstream face	the internal face of the gravel pit was reconstructed to create a uniform slope with a gradient of 1 in 3. Beaching material, comprising 'unsaleable', oversize gravel was used to face the slope in the uppermost 2.5m to protect against wave action.	2.5 (H) : 1 (V) - Beeching
Downstream face	the downstream slope is graded at 1 in 2 toward the Snails Lake waterline, which normally lies about 2m below that of Blashford Lake.	2.5 (H) : 1 (V) - Topsoil
Overflow	Blashford lake overflows into Ivy lake via a 200m long pipe. Both ends are submerged and the pipe is buried as it crosses the divide between the lakes.	As per existing
Inlet and Outlet Pipework	There are no fixed facilities for pumping water into the Lake. There are no watercourses draining into the Lake. It is wholly fed by groundwater and by direct rainfall. Water can be drawn from the lake via an intake located some 140 m from the north-western shoreline and 8 m below full supply level. The intake feeds Lakes Pumping Station, which is situated alongside Ivy Lane, where raw water is supplied to the Treatment Works. The capacity of the pumps in the Station is 25,000 m ³ /day. There is no scour facility.	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Blashford Lake
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

	Quantity:	Unit	Rate	TOTAL (£)	Comments
Total Rolled Fill Volume	4,095.00	m3	£ 11.23	£ 45,990.95	Dam Length (130m) x Cross-sectional area of the embankment *
Volume of Beaching Slope protection on upstream slope	262.53	m3	£ 74.25	£ 19,492.61	Dam Length (130m) x surface area of the upstream face *
Volume of Topsoil for the downstream slope (250mm depth)	249.70	m3	£ 4.57	£ 1,139.87	Dam Length (130m) x surface area of the downstream face x 0.25m *
Volume of topsoil to be removed	1,170.00	m3	£ 8.75	£ 10,231.65	Dam Length (130m) x footprint of the embankment *
Length of Supply Main 450mm dia	300	m	£ 254.34	£ 76,302.60	*
Valves & actuators	2		£ 4,769.60	£ 9,539.20	*
Access Road to Site	208	m	£ 240.00	£ 49,920.00	*
Quality Testing				£ 4,095.00	Based on fill volume
Diversions & Enabling Works				£ 41,000.00	Proportional to reservoir area
General & Preliminary Items	20	%		£ 51,542.38	

Total: £ 309,254.26

Pre-Construction Surveys	20	%		£ 61,850.85
Contingency	20	%		£ 61,850.85
Wessex Water Design & Management	20	%		£ 61,850.85

Total Capital Expenditure: £ 494,806.81

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Ivy Lake Reservoir
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
Category C reservoir formed at the site of an abandoned gravel pit, Ivy Lake is a raised reservoir with a TWL of 20.8m OD and a usable capacity of 0.12Mm³. The Lake has no catchment area.

	Existing Dam	Replacement
Embankment	A low embankment, about 2m high, was built on the narrow strip of land between the lake and Dockens Water to create the raised reservoir. The embankment has a crest length of about 200m, although it is irregular in both width and line.	3m high rolled clay embankment. 2.5 (H) : 1 (V) Upstream slope 2.5 (H) : 1 (V) downstream slope
Overflow	Two overflows: the service overflow and auxiliary spillway. <u>The service overflow</u> is a lightly reinforced concrete structure in the form of a broad crested weir which as a 2.75m wide spill weir set at 20.8m OD. <u>The Auxiliary weir</u> is a reinforced grass structure comprised of cast in situ grasscrete panels with edge beams. there is a thin wedge of granular fill downstream of the grasscrete, as it passes on the natural valley floor. the channel is 10.2m wide and is set about 100mm higher than the service overflow.	As per existing
Inlet and Outlet Pipework	There are no streams draining into the Lake. It is wholly fed by groundwater, direct rainfall, spillage from Blashford Lake, and water pumped from the River Avon that is gravity fed via pipeline from Ellingham Pound. Water can be drawn from the Lake via 700 / 600 mm ductile iron pipework. The intake has an invert level of 13.5 m OD and is located 140 m from the north-west shore. The intake feeds Lakes Pumping Station, which is situated alongside Ivy Lane, where raw water is supplied to the Treatment Works. The capacity of the pumps in the Station is estimated to be 25,000 m ³ /day, when the reservoir level is at Full Supply Level. There is no scour facility.	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Ivy Reservoir
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

	Quantity:	Unit	Rate	TOTAL (£)	Comments
Total Rolled Fill Volume	3,200.00	m3	£ 11.23	£ 35,939.20	Dam Length (200m) x Cross-sectional area of the embankment *
Volume of Beaching Slope protection on upstream slope	269.26	m3	£ 74.25	£ 19,992.42	Dam Length (200m) x surface area of the upstream face *
Volume of Topsoil for the downstream slope (250mm depth)	256.10	m3	£ 4.57	£ 1,169.10	Dam Length (200m) x surface area of the downstream face x 0.25m *
Volume of topsoil to be removed	1,000.00	m3	£ 8.75	£ 8,745.00	Dam Length (200m) x footprint of the embankment *
Length of Supply Main 600mm dia	100	m	£ 452.79	£ 45,279.30	*
Valves and Actuators	2	No.	£ 24,837.91	£ 49,675.82	*
Access Road to Site	172	m	£ 240.00	£ 41,280.00	*
Quality Testing				£ 3,200.00	Based on fill volume
Diversions & Enabling Works				£ 41,000.00	Proportional to reservoir area
General & Preliminary Items	20	%		£ 49,256.17	

Total:	£ 295,537.01
---------------	--------------

Pre-Construction Surveys	20	%		£ 59,107.40
Contingency	20	%		£ 59,107.40
Wessex Water Design & Management	20	%		£ 59,107.40

Total Capital Expenditure:	£ 472,859.22
-----------------------------------	--------------

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Ellingham Intake Pond
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

Dam details:
 The reservoir is located in a worked out sand and gravel pit with natural ground to the north, west and east. The dam separates the reservoir from Ellingham Lake to the south. Ellingham Intake Pond has no natural catchment area but is filled by pumping from an intake on the River Avon at Ibsley. The dam is 170m long with a maximum height of 9m. Capacity 100,000m³. Surface area: 2.4 hectares. the lake has no natural catchment area and is filled by pumping from an intake on the River Avon.

	Existing Dam	Replacement
Embankment	4 - 5m wide at an Elevation of 22.6m AOD.	3m high rolled clay embankment. 2.5 (H) : 1 (V) Upstream slope 2.5 (H) : 1 (V) downstream slope
Upstream face	3.5 (H) : 1 (V). Protected by flint beaching above about 19.5m AOD.	2.5 (H) : 1 (V)
Downstream face	3 (H) : 1 (V)	2.5 (H) : 1 (V)
Cutoff	a bentonite cement slurry cut off trench was installed through the crest of the embankment along the dam and for a short distance on the west and east sides of the reservoir. The depth of the cut off is generally 7.7m and 9m measured from the embankment level. The cut off wall is 0.8m wide and is located 2.0m from the downstream edge of the crest. its top is at 21.9m AOD.	as per the existing arrangement.
Overflow weir	the overflow is situated at the east end of the embankment. This takes the form of a 4m wide channel protected with cellular concrete blockwork.	As per existing
Construction	the basic construction material is mechanically compacted Bracklesham sand excavated from the floor of The Pound.	3m high rolled clay embankment. 2.5 (H) : 1 (V) Upstream slope 2.5 (H) : 1 (V) downstream slope
Inlet and outlet Pipework	On the east side of the reservoir there is a 900mm diameter high level outlet pipe.	As per existing

Valuation of dams

Calcs by: HP
Checked by: JPT

Reservoir Name:	Ellingham Intake Pond
Dam Type:	Converted Gravel Pit
OS Grid Reference:	✂
Owner:	Wessex Water

	Quantity:	Unit	Rate	TOTAL (£)	Comments
Total Rolled Fill Volume	5,355.00	m3	£ 11.23	£ 60,142.01	Dam Length (170m) x Cross-sectional area of the embankment *
Volume of Beaching Slope protection on upstream slope	343.30	m3	£ 74.25	£ 25,490.34	Dam Length (170m) x surface area of the upstream face *
Volume of Topsoil for the downstream slope (250mm depth)	326.53	m3	£ 4.57	£ 1,490.60	Dam Length (170m) x surface area of the downstream face x 0.25m *
Volume of topsoil to be removed	1,275.00	m3	£ 8.75	£ 11,149.88	Dam Length (170m) x footprint of the embankment *
Slurry Cut off wall 800mm wide	720.00	m	£ 165.00	£ 118,800.00	*
Valves & actuators	2.00	No.	£ 24,837.91	£ 49,675.82	*
Length of Supply Main 900mm dia	40	m	£ 1,567.50	£ 62,700.00	*
Access Road to Site	161	m	£ 240.00	£ 38,640.00	*
Quality Testing				£ 5,355.00	Based on fill volume
Diversions & Enabling Works				£ 41,000.00	Proportional to reservoir area
General & Preliminary Items	20	%		£ 82,888.73	

Total: £ 497,332.37

Pre-Construction Surveys	20	%		£ 99,466.47
Contingency	20	%		£ 99,466.47
Wessex Water Design & Management	20	%		£ 99,466.47

Total Capital Expenditure: £ 795,731.79