



Broads Authority

The Broads - a member of the
National Park family

Sediment Management Strategy

**Action Plan
2010/11**



May 2010

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1. Introduction

The Sediment Management Strategy published by the Broads Authority in 2007 set out the known issues and principles for addressing the task of sediment management. The Strategy also identified for the first time the volume of sediment requiring removal to achieve ideal user waterway specifications and favourable condition for open water bodies. This allowed the Authority to take a proactive, rather than a reactive, approach to the dredging of the navigation area.

This updated Action Plan assumes that the reader is familiar with the Strategy, which is available on the Broads Authority website, and sets out the progress achieved in delivering the objectives of the Strategy in terms of priority, timescales, costs and partnerships involved, and provides information on the Priority Actions for 2010/11.

The Action Plan 2010/11 also identifies the final phase of delivery for the 5 year work programme for sediment removal, disposal and source control needs and reports progress made in the delivery of these projects (Appendix 1).

This Action Plan and its Appendices have been updated to review previous progress and also incorporate any new information with regard to hydrographic survey data.

2. Waterways Specifications

The Waterway Specifications as set out within the Sediment Management Strategy have been reviewed as part of the update process. These are shown on Figure 1, Waterway Specifications 2010/11 Update, and form the basis for specification of future dredging works. Minor amendments have been made to amend the specification for Ranworth Dam and South Walsham Fleet Dyke to ensure consistency with the specifications for the adjoining Broads

To monitor progress in the aim to achieve full compliance with the Waterway Specification, Figure 2 has been updated to take account of the previous years dredging activity. This demonstrates the current level of compliance against the amended Waterways Specifications and it can be seen from a comparison with last year's position that improvements are noted, particularly in the River Chet, between Chet Mouth and Nogdam End and Ranworth Dam.

New survey data completed and reviewed for the River Yare during 2009 shows that over the last 4 years significant siltation has occurred in the River Wensum and the Upper Yare e.g. Surlingham, but to a much lesser degree in the lower reaches. This indicates the major influence of the headwater input at the limit of navigation, as well as the greater proportion of aquatic vegetation and leaf fall, whereas the increases are likely to be due to a combination of factors in the middle reaches.

Figure 1

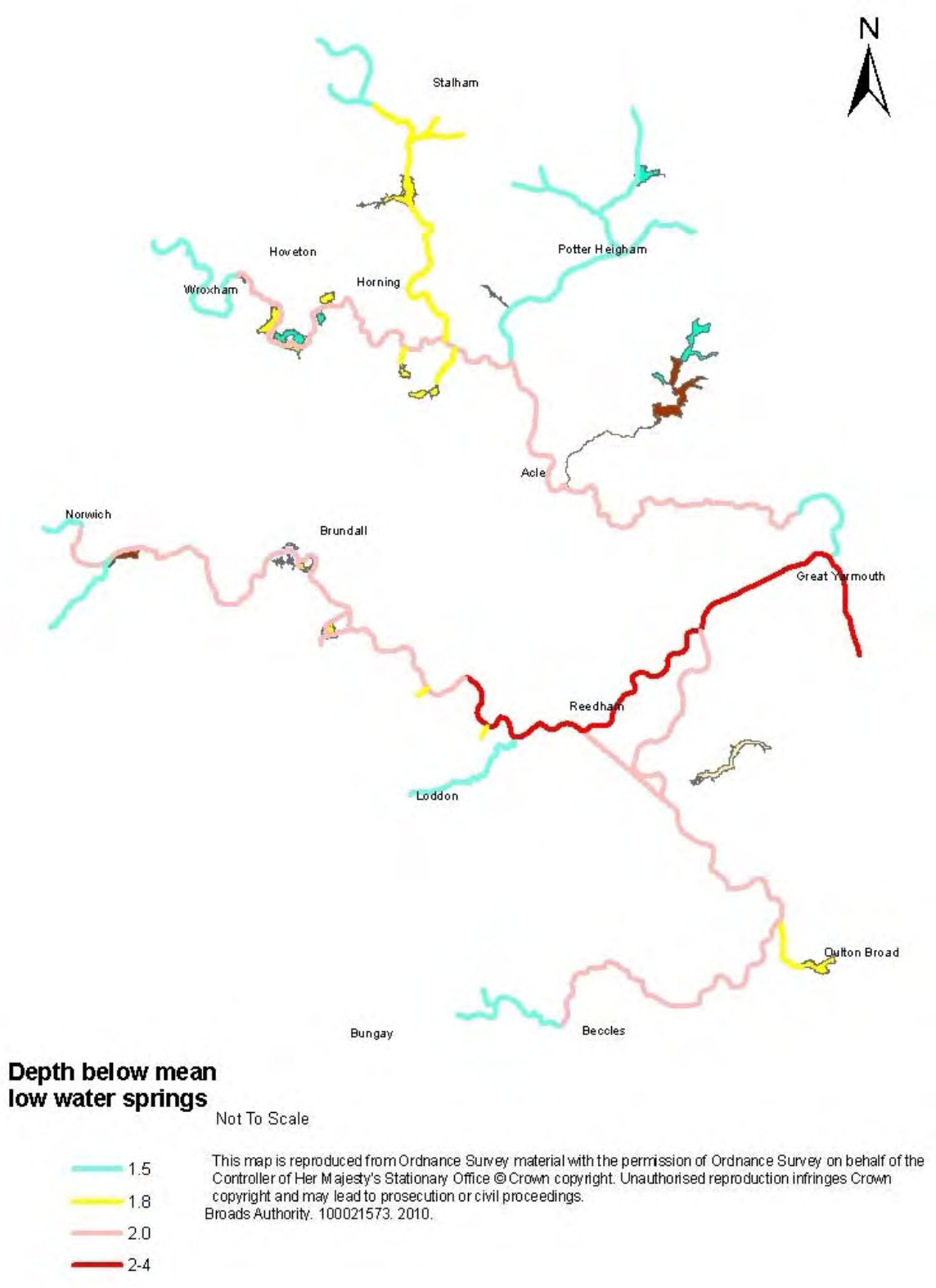
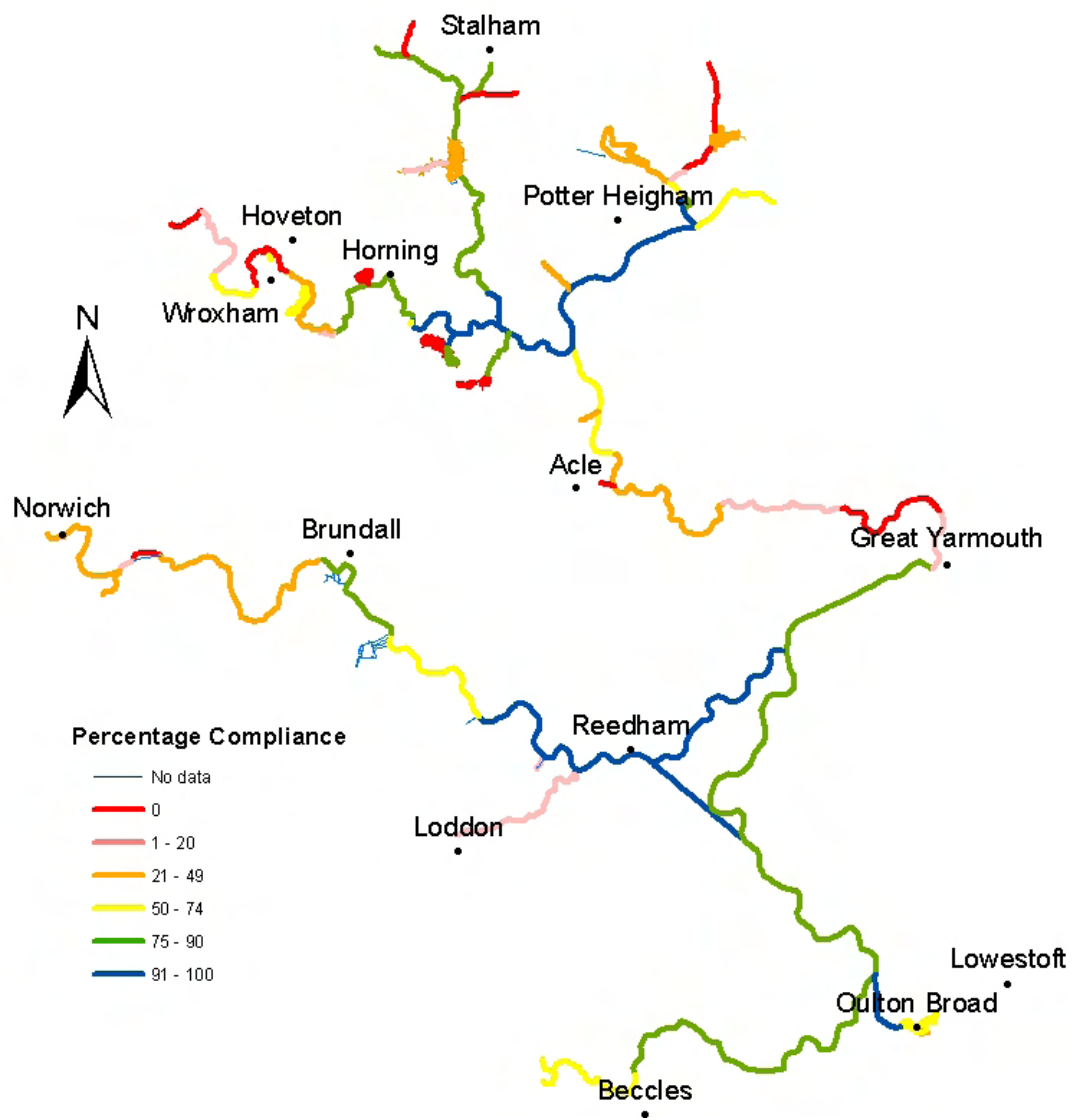


Figure 1. Waterway Specifications 2010/11 Update



Not To Scale

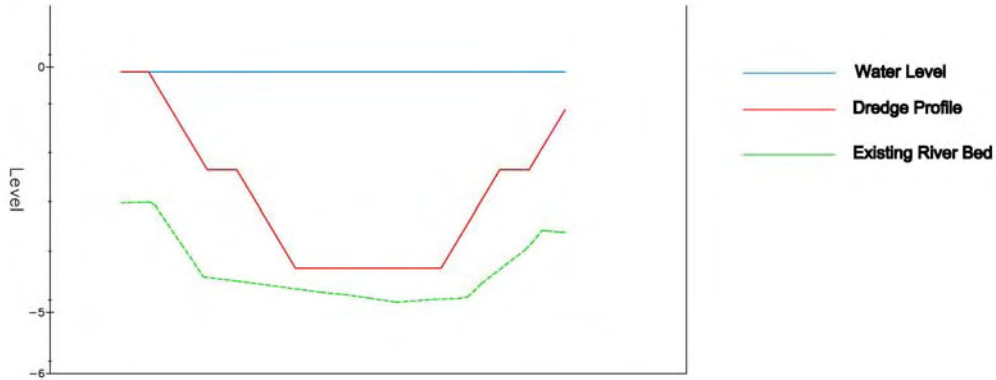
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.
 Brads Authority: 100021573, 2010.

*Figure 2. Waterway Specification Compliance for recreation craft 2010/11
 NB River Yare, New Cut should be shown in 1-20% compliance category*

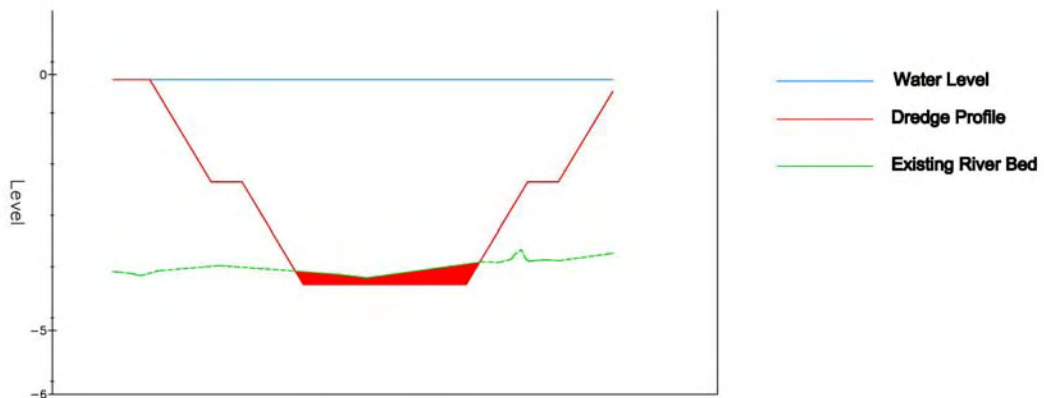
This figure enables easy recognition of areas in need of urgent attention. The compliance percentages have been calculated on the proportion of the design cross sections which achieve the required width, and depth below low water level, so in a river reach of 1km, where cross section have been reviewed at

100m centres, if 6 of the possible 10 sections show the required specification is achieved then the compliance score would be 60%. The agreed design cross sections are shown in full in the Sediment Management Strategy.

Example Compliant river cross section.



Non – compliant river section



In order to easily monitor changes to waterway compliance, the following table has been developed, which will allow future annual comparisons.

Compliance category	Length (m) 2008	Length (m) 2009	Percentage river length 2008	Percentage river length 2009	Direction of travel
0	32,145	19,937	13%	8%	↓
1-20	37,451	27,045	15%	11%	↓
21-49	30,700	42,130	13%	18%	↑
50-74	35,933	29,575	15%	13%	↓
75-90	57,353	62,939	23%	27%	↑
91-100	36,079	41,344	15%	18%	↑
No data	14,847	13,254	6%	5%	↓
Total	244,508	236,226			

NB please note the reduction to total river length, as previously included non navigation area dykes and channels.

3. Updated Sediment removal and disposal tables

The action tables (Appendix 3 and 4) which collate data within each management unit as identified within the Sediment Management Strategy, for both navigation area and isolated water bodies where relevant have been updated to account for new information .

Dredging works which removed sediment within 2009/10 have been accounted for; new survey information where it exists has also been incorporated. New opportunities for disposal of sediment have also been included as identified by Broadland Environmental Services Ltd (BESL) as part of the development of the Strategic Dredging Disposal Strategy project.

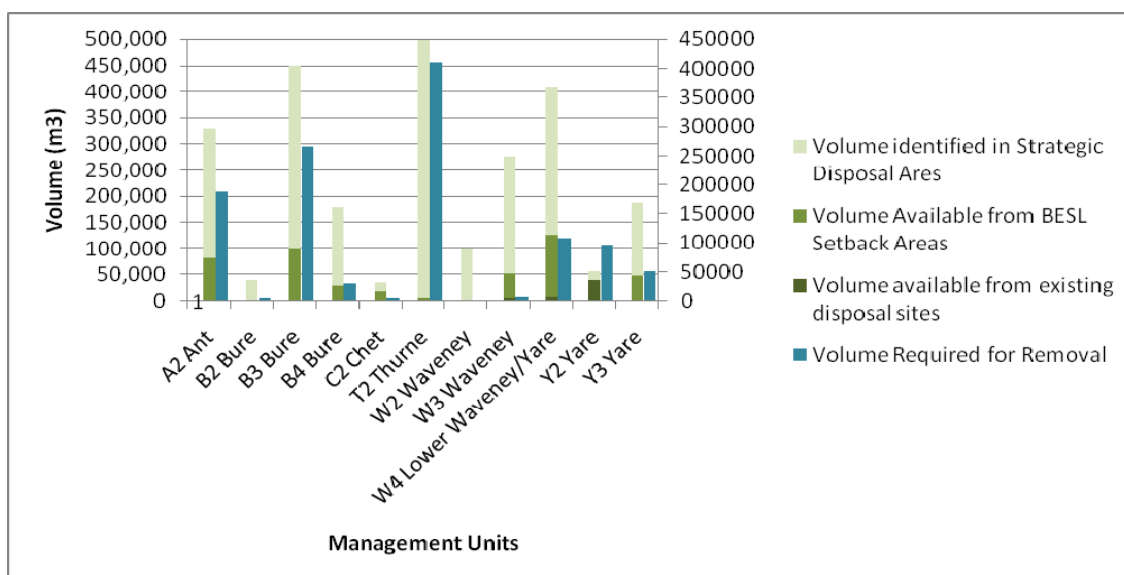


Figure 3. Current total volume for sediment for removal and total existing and potential disposal capacity per management unit

The removal and disposal requirements in each management unit (Figure 3) demonstrates that the present known available capacity for silt disposal continues to be significantly less than the amount requiring removal, but is an improved picture

following on from last year. The Flood Alleviation Project has provided a number of opportunities to beneficially reuse sediment in set back areas, creating new habitat opportunities, and is to be welcomed. Additionally, Phase 1 of the Strategic Dredging Disposal Strategy has identified further potential sites, where further agreements, consents and landowner willingness would be required to develop disposal capacity. This work has significantly narrowed the gap, and the next phase to conclude negotiations will be a key part of this year's priority actions. This issue was brought forward in the priority actions for last year, and details of progress are noted in Appendix 1.

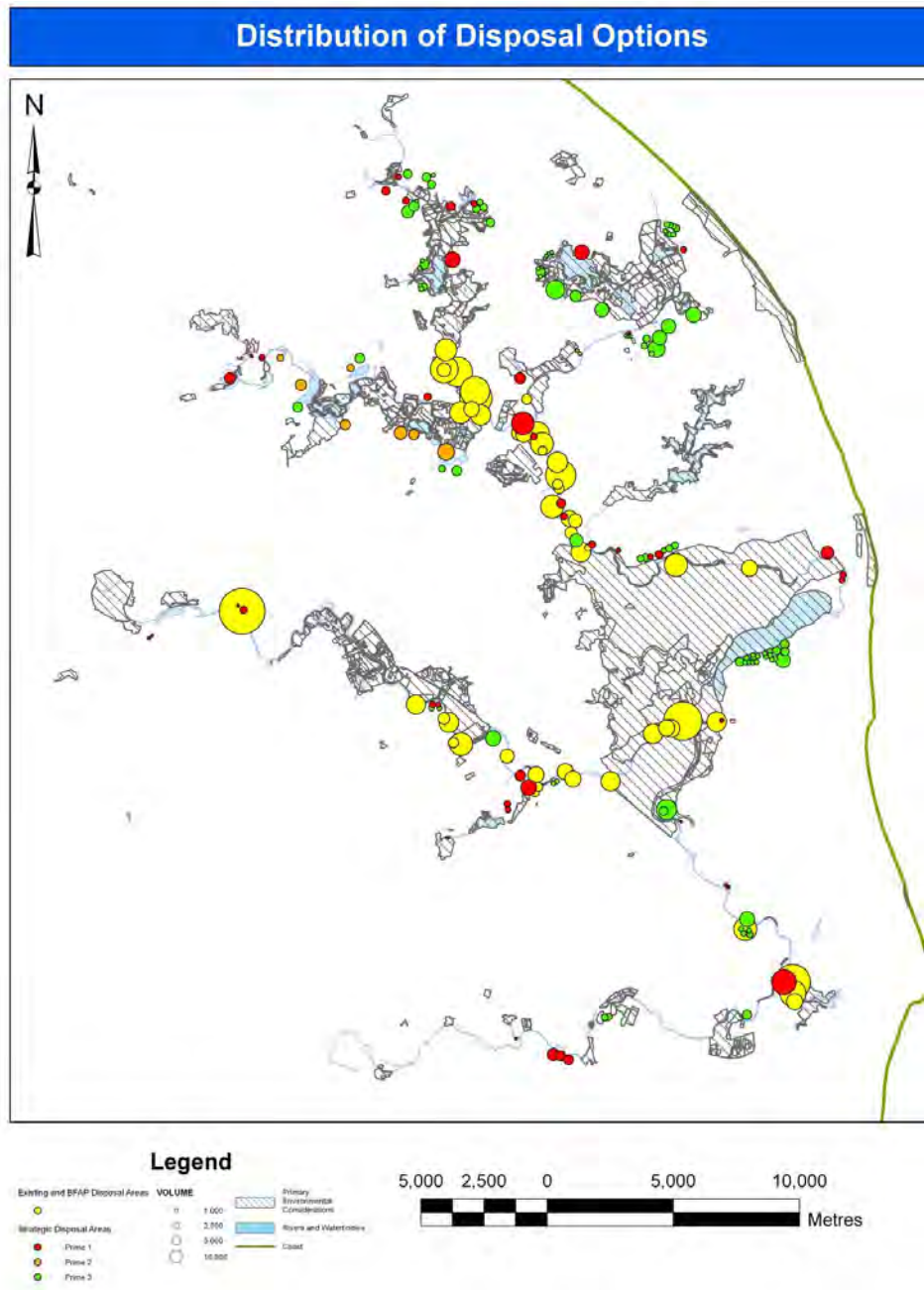


Figure 4 Distribution of Disposal options

Figure 4 also shows disposal opportunities and assists to highlight areas where further strategic disposal sites are likely to be required.

4. The process to prioritise sediment removal

The prioritisation process considers the navigation area and is assessed within the Priority Matrix (Appendix 2b). This table has been updated using the revised data available for the Waterway Specification compliance arising from the sediment removal table. Additionally, the Removal cost scores have been updated to reflect dredging project costs in 2009/10 and finally the score for Unresolved safety incidents reflects those areas where groundings have been reported to Broads Control and recorded within the Broads Authority's Safety Management System.

A new system of prioritisation has been developed for Lakes, as part of the Lake Restoration Strategy, which takes into account the potential for ecological restoration within the context of climate change. Please refer to the Lake Restoration Strategy for more information on this process, and background information <http://www.broads-authority.gov.uk/managing/rivers-and-broads/broads-restoration.html>.

Actions identified in the Lake Restoration Strategy which are relevant to sediment management, such as mud pumping or source control measures will be carried through into the Priority Actions within this Action Plan where appropriate.

5. Dredging outputs

Since the development of the Sediment Management Strategy, the most significant change has been the mechanism by which the Authority procures its dredging works. In establishing the scale of the issue, and the many years over which continued investment will be required in order to achieve the objectives of the Strategy, the Authority took the decision to take direct control of its dredging programme, by bringing the work in house. In the first year of its operation, the Authority achieved a 23% increase in the volume of dredged material removed from the system above the programmed target, with an additional cost saving of £45,000. In 2009/10 the corporate target of 45,000m³ was exceeded, and the target programmed volume removed was 97.5% achieved, and also demonstrated that to achieve the same works with contractors would have been 23% more expensive.

As discussed above, the table shown in Appendix 3 of the Action Plan has been updated using the output information from the dredging programmes of 2009/10, new survey data and recalculations received from BESL where available, to reflect improved confidence in average water levels. From this work it can be seen that the net effect results in an identified backlog of sediment within the navigation area of 1,172,803m³, at an updated estimated cost of £20,971,460 (excluding costs associated with disposal activity). At current output rates, taking account of annual sedimentation it is estimated that it would take 31 years to achieve the full Waterways specification.

Since the publication of the Sediment Management Strategy 191,000m³ of material has been dredged from the navigation system in the last 4 years, from an originally estimated backlog of 1,299,681m³. Thus we should expect to see 1,108,681m³ remaining. But as can be seen from the above figures, the result of the resurvey in the southern Broads has demonstrated the effects of ongoing changes with 64,000m³ of additional material in the system. If this were considered to be all as a result of re-siltation, it gives an annual input of 16,000m³ which is 2/3rds of the maximum inputs estimated by Cranfield University in their original study. However, during this time a number of data gaps have been filled, such as the Upper Yare and Wensum where data was not available at the time of the publication of the Sediment Management Strategy and therefore these changes should also be taken into consideration. In order

to further improve the data, it is intended to complete a comprehensive review of northern system during 2010/11 to update the survey information in accordance with our Hydrographic survey policy.

	Backlog by survey (m3)	Total material dredged (m3)	Backlog by calculation (m3)	Surplus (m3)
2007	1,299,681			
2010	1,172,803	191,000	1,108,681	64,122

6. Impact Assessment

As the removal of sediment for navigation purposes is not directly connected with or necessary to the management of the European site under the EU Habitats Directive (Regulation 48 (1)) the Sediment Management Strategy required a thorough impact assessment to be undertaken to demonstrate that the Strategy would not result in an adverse affect to the integrity of the SSSI, Broadland SPA, SAC and Ramsar site. The key issue advised by Natural England was the impact of dredging on tidal and fluvial flood water level and SAC habitats, and this concern has been addressed by utilising the BESL hydraulic model. The modelling work assessed the impact of sediment removal in main river navigation channels on tidal and fluvial flood water level and SAC habitats. A summary assessment is included at Appendix 5. Following these impact assessments Natural England are of the opinion that the Sediment Management Strategy will not have a significant impact on the integrity of the SSSI, Broadland SPA, SAC and Ramsar.

Additionally, it is recognised that there may be other local issues which would require a further site specific assessment. Any such assessment will be identified during the development of each annual work programme, in consultation with Natural England and the Environment Agency, and prepared accordingly. During the development works involved in the Duck Broad island creation project concern was raised regarding the potential impacts on fisheries. As a result an Impact Assessment was completed and Appendix 5 has been updated accordingly.

7. Sediment Strategy

Following publication of the original Strategy a number of legislative, economic, technical and operational developments have occurred. Therefore a revised and updated Strategy will be prepared in consultation during the period of this Action Plan, to guide future actions following the expiry of the original 5 year Action Plan in 2011.

8. Priority Actions 2010/11

The 2010/11 Priority Actions table, in this section of the Plan, collates the top priority actions that will be undertaken in the coming year, from the longer term 5 year Work Programme (Appendix 1).

Both tables demonstrate the multi-task approach, including actions for the following areas:

- (i) Maintenance dredging projects
- (ii) Strategic disposal sites
- (iii) Sediment source control measures
- (iv) Research and monitoring projects
- (v) Information management systems

Based on the original Strategy objectives for each project, the 5 year Work Programme reports on previous progress, identifies partnership working, establishes approximate costs for the delivery of projects and highlights the priority of each task.

The Work Programme will continue to be reviewed annually, to monitor and report on the progress of delivery, and ensure actions are appropriately prioritised, given changing circumstances and the ability to progress works.

2010/11 Priority Actions

(i) Maintenance dredging projects

Project	Progress Report	Partnerships ¹	Indicative Cost
Lake restoration programme 2010/11 Open water bodies	Projects include; Ormesby East Arm mudpumping Upton Little Broad (dependant upon feasibility study)	Defra grant	£10,000 £264,000
Feasibility studies to prepare lake restoration schemes	Geobag dewatering feasibility tests at Upton Little Broad	BA – Gen a/c	£3,000
	Hoveton Great Broad		£4,000
Navigation dredging programme 2010/11	Projects include: R.Yare, Cantley Mooring Basin R. Thurne, Heigham Sound (Phase 1 - May 2010 20m x 20m island) R. Ant, How Hill to Barton Broad R. Bure,,Slaughter House Yard – Mautby Marsh Mill R Bure,, Acle Bridge – Thurne Mouth R Yare, Thorpe River Green R. Bure, Acle – Stokesby Haddiscoe Cut Oulton Broad	All BA Nav expenditure	<i>Total volume forecast 46,000m3</i>
Consult interested parties on Annual Plans	Ongoing via regular updates to Navigation Committee, and publication to website.		

¹ See Glossary

(ii) Strategic disposal sites

Project	Progress Report	Partnerships	Indicative Cost
Identify, secure and construct key strategic locations for disposal need 10/11 and beyond	Phase 2 of Strategic dredging Disposal Strategy to be delivered including site specific technical feasibility, and securing consents/sites etc. Purchase of land	BESL/NPS BA Gen a/c Nav expenditure	£25,000 £60,000
Work with landowners in key strategic locations to identify other reuse opportunities	Ongoing	BESL	In house

(iii) Source Control Measures

Project	Progress Report	Partnerships	Indicative Cost
Decrease sediment input from river banks; Assess the impact of removal of piling on sediment input from Broadland rivers	Trial and monitoring ongoing, early results indicate low levels of erosion in majority of area	BESL	nil
Erosion protection projects to be developed where opportunities arise and funding exists	Goose grazing Boat wash Bank side vegetation management and enhancement Soft bank protection Survey and monitor existing techniques Ongoing maintenance of soft protection	Gen a/c Nav a/c Gen & Nav a/c Gen a/c Gen & Nav a/c Gen a/c	£subject to budgets
Work in priority areas to reduce inputs of diffuse nutrient and sediment pollution from agricultural land to water courses	Ongoing. 2 SSSI and 2 non- SSSI lake inflows investigated. Risk managed by 1-1 advice to domestic septic owners in the Alderfen catchment. Other advice and site investigations to be carried upon following the monitoring report production in early 2011.	Gen a/c EA/NE	
Support the EA and NE in the development of Diffuse Water Pollution Plans in the Broadland Rivers catchments	Evidence has been provided on catchment sediment inputs and potential remedies	EA/NE	£0

Strategic river corridor tree and scrub management to encourage healthy reed growth to resist erosion	Ongoing, annual Broads Authority programme of tree and scrub clearance carried out. EA flood defence maintenance vegetation clearance works also complete on flood embankments.	BA Nav a/c, BESL and landowners	Works completed in house and with volunteers
Control speed and thus boat wash through patrolling to published Best Value targets	Ongoing, including series of Super Safety days	BA Nav a/c	Works completed in house and with volunteers
Develop policies within Local Development Frameworks to ensure that water quality measures, e.g. Sustainable Urban Drainage are installed in new developments	Core Strategy now adopted, and Development Policies Development Plan Document is currently out to consultation for comment.	Water Quality Partnership	Works completed in house

(iv) Research and monitoring projects

Project	Progress Report	Partnerships	Indicative Cost
Update hydrographic survey to collate settlement rates data	Annual rolling programme of hydrographic surveys underway in partnership work with BESL Programme of surveys for isolated water bodies to be undertaken using hydro acoustic equipment or bathymetric survey equipment as required. Bathymetric survey undertaken for Hoveton Great Broad. Awaiting final volumetric outputs and report. Comprehensive resurvey of northern broads required	BESL Nav a/c Gen a/c Nav expenditure	£10,000 Included with feasibility study costs £20,000
Collate evidence in change in bank erosion rates as a result of the change in the strategic flood management	Monitoring using hydrographic survey and site monitoring currently ongoing.		
Undertake assessment of vulnerable banks and verify with surveys to identify programme of erosion protection	Ongoing, annual assessment of bank condition in BFAP project area Survey of other areas required, no further progress but identified as potential volunteer project		

(v) Information management and awareness raising

Strategy Objective: Influence wider legislation and policy for sustainable and integrated management on a catchment scale

Project	Progress Report	Partnerships	Indicative Cost
<p>Develop a GIS database of river corridor bank structure and vegetation type to support planning decisions and mitigation works</p> <p>Implement Environmental Standard Operating Procedures to deliver best practice for works in the Broads</p> <p>Assess Environmental Impact and test project plans against Article 4.7 of the WFD as a routine element of delivery of SMS actions</p>	<p>Existing data sources to be collated and ground-truthed in a trial river to establish methodology</p> <p>ESOPs developed and on BA website. Rolling programme of awareness raising within the Authority works teams. Share with partners operating in the Executive Area</p> <p>Develop a standard Impact Assessment protocol to follow for sites where required</p>	<p>BESL BA Gen a/c?</p>	<p>GIS officer time</p> <p>£0</p>
<p>Develop a GIS Database of current and historic dredging</p>	<p>Spreadsheet developed to capture all relevant information with regard to dredging works, where data is known. GIS development is ongoing in 2010/11.</p>	<p>BA Gen a/c</p>	<p>£30,000 (GIS officer time)</p>

9. Glossary

AINA	Association of Inland Navigation Authorities
AW	Anglian Water
BA	Broads Authority
BESL	Broadland Environmental Services Ltd
BW	British Waterways
EA	Environment Agency
IDB	Internal Drainage Board
NE	Natural England
NWT	Norfolk Wildlife Trust
NSBA	Norfolk and Suffolk Boating Association
Ramsar	The Convention on Wetlands signed in Ramsar, Iran in 1971
SAC	Special Areas of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

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Appendix 1

5 Year Work Programme for

Sediment Management Actions

(i) Maintenance dredging projects

Strategy Objective: Define Waterway Specifications, and hence the dredging requirement, and having done so, evaluate and minimise the environmental impact

Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Develop Waterway Specifications with users to identify minimum requirements	Completed. Appropriate Assessment completed	NSBA, BESL, BA NE, BA, Halcrow	£3,000	N
Develop Lake Restoration Strategy and feed sediment removal requirements into the programme for isolated and open water bodies	Lake Restoration Strategy complete, and sediment removal requirements updated accordingly.	BA, NE, EA		G
Lake Restoration Strategy programme 06/07, and 07/08	Mud pumping at Barnby Broad, and Little Broad - Completed			
Lake restoration programme 08/09 Open waterbodies	Dredging at Norton's Broad, Mautby Decoy, Buckenham channels and Calthorpe Broad - Completed.		Final cost £53,000	G
Lake restoration programme 09/10 Open water bodies	Dredging completed at Burntfen Broad - Completed Ormesby East Arm (Year 1 set-up of project completed)	Landowner Trinity Broads Partnership	£35,000 £109,000	G G G
Lake restoration programme 10/11	Projects include Ormesby East Arm Upton Little Broad		£10,000 £264,000	G G

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
11/12 onwards open water bodies	Filby Broad (south west) Rollesby Broad Lily Broad Ormesby Little Broad Ormesby Great Broad (remaining priority areas) Hoveton Great Broad Fritton Lake Wheatfen Broad & Channels Strumpshaw Broad Cockshoot Dyke Hudson's Bay (partial) Round Water Woolner's Carr Progress of projects will depend on budget availability and partnerships arrangements		£156,000 £48,000 £234,000 £150,000 £900,000 £360,000 £15,000 £30,000 £6,000 £12,000 £6,000 £6,000	G G G G G G G G G G G G G
Surveys to establish necessity and volume of sediment removal	Snape's Water Devil's Hole	Landowners	In-house	N
Feasibility studies to prepare lake restoration schemes 08/09	Mautby Decoy, Upton Little, Burntfen, Norton's, Fritton - Completed		£28,000	G
Feasibility studies to prepare lake restoration schemes 10/11	Hoveton Great Broad & Upton Little Broad geobag trials- ongoing		£3,000 £4,000	G
Develop Standard Operating Procedures to deliver best practice for maintenance dredging	Completed- on BA website	BA, IDB, EA, NE	£500 Completed in-house	G

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Develop Standard Operating Procedures to deliver best practice for maintenance dredging	Data gathering for dredging disposal guidance for private mooring owners underway		In-house and volunteer resource	

(i) Maintenance dredging projects (continued)

Strategy Objective: Define Waterway Specifications, and hence the dredging requirement, and having done so, evaluate and minimise the environmental impact

Strategy Objective: Balance sediment inputs with future planned dredging (following removal of the sediment backlog)

Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Dredging requirement calculated, with total volumes produced, from hydrographic survey	Completed. Yearly dredging works to be undertaken to exceed estimated maximum annual inputs until such time as backlog is cleared.		Nil	
To complete an updated hydrographic survey for the northern broads, to update the Strategy with accurate data	Survey specification in preparation	BESL	£20,000	N

Shading indicates Priority project for 2010/11

(i) Maintenance dredging projects (continued)

Strategy Objective: Adopt a risk based approach to planning works and target and prioritise expenditure

Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Develop and prioritise Dredging plan using agreed priority matrix	Completed, to be updated annually, consulted upon and published via Committee reports and Web site.	Nil		
Dredging programme 06/07	Completed projects: R. Bure, Shoal removal at St Benets R. Ant, Mouth – Ludham Bridge, Phase 1 Haddiscoe Cut Phase 1 Haddiscoe Cut, Phase 2 R. Waveney, Beccles – Geldeston demob R. Bure, Water Injection trial R. Yare, Surlingham bends South Walsham Fleet Dyke Phase 1 Lower Yare shoal removal		£44,000 £74,000 £117,000 £74,000 £7,000 £40,000 £50,000 £146,000 £ 5,000 45,400m3	N
Dredging programme 07/08	Completed projects: Lower Yare shoal removal Haddiscoe Cut, Phase 3 South Walsham Fleet Dyke Phase 2 R. Ant, Mouth – Ludham Bridge, Phase 2 Upton Dyke bar removal Hardley Dyke Oulton Broad bar removal Horning Church bends		Removed (m ³) 4,000 13,284 13,152 12,407 370 477 534 1392 45,616m3	N

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Dredging programme 08/09	<p>Completed projects:</p> <p>Oulton Broad bar removal and North Bay</p> <p>Haddiscoe Cut Final phase</p> <p>R. Ant u/s Ludham Bridge</p> <p>R. Thurne, u/s Martham Ferry and/or Heigham Sound Phase 1</p> <p>R. Bure, Belaugh – Horstead Phase 1 (Wroxham Bridge – Caen meadow)</p> <p>R. Yare, Thorpe River Green</p> <p>R. Yare, Shoal removal at Five Mile/Seven Mile bends, Phase 1</p> <p>R. Bure Thurne Mouth – Horning Church</p> <p>South Walsham Fleet Dyke</p>		<p>Removed (m³)</p> <p>19,325</p> <p>9,549</p> <p>8,728</p> <p><i>Nil, project carried forward</i></p> <p><i>As above</i></p> <p><i>As above</i></p> <p>2,707</p> <p>9,086</p> <p>1,316</p> <p>50,710</p>	<p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p>
		Total		
Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Dredging programme 09/10	<p>Projects include:</p> <p>R. Ant u/s Ludham Bridge cont.</p> <p>Heigham Sound Phase 1 (Duck Island 20 x 20 trial starts May 2010)</p> <p>R. Yare, Thorpe River Green</p> <p>R. Bure, Ranworth Dam</p> <p>R. Bure, Malthouse Broad Phase 1</p> <p>Upton Dyke (phase one)</p> <p>R. Chet</p> <p>R. Yare, Cantley mooring basin</p> <p>R. Bure, Thurne Mouth Shoals</p> <p>R. Bure, Acle to Thurne Mouth (continues 10/11)</p> <p>Haddiscoe Cut</p>		<p>Removed</p> <p>5,859m³</p> <p>0,000m³</p> <p>0,000m³</p> <p>14,199m³</p> <p>15,605m³</p> <p>2,375m³</p> <p>6,069m³</p> <p>620m³</p> <p>820m³</p> <p>2,964m³</p> <p>708</p>	<p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p> <p>N</p>
		Total		

Shading indicates Priority project for 2010/11

			49,219m3	
Project	Report on Progress	Partnerships	Indicative Cost £	Funding G = Gen a/c N = Nav a/c
Dredging programme 10/11	Proposed projects include: R.Yare, Cantley Mooring Basin R. Thurne, Heigham Sound (Phase 1 - May 2010 20m x 20m island) R. Ant, How Hill to Barton Broad R. Bure,,Slaughter House Yard – Mautby Marsh Mill R Bure,, Acle Bridge – Thurne Mouth R Yare, Thorpe River Green R. Bure, Acle – Stokesby Haddiscoe Cut Oulton Broad Total Forecast		Target volumes 1,000m3 1,000m3 4,000m3 20,000m3 3,000m3 3,000m3 3,000m3 3,000m3 8,000m3 46,000m3	N
Draft dredging programme 11/12 12/13	Potential projects include: R. Bure Salhouse – Wroxham R. Bure, Horning Church – Salhouse Breydon Water Phase 1(subject to transfer) South Walsham Broad (Phase 1) R. Bure Mautby Marsh – Herringby Hall R. Chet Phase 2 Limekiln Dyke R. Bure, Belaugh – Horstead Phase 1 (Wroxham Bridge – Caen meadow) R Bure Herringby Hall – Stokesby Womack Water R. Bure, Coltishall Common – Horstead Mill R. Bure, Caen Meadow to Jubys Farm Acle Dyke Thurne Dyke R. Thurne, u/s Martham Ferry R. Waveney, Beccles – Burgh St Peter R. Ant, Stalham Dyke R. Thurne, Hickling Broad channel NB. These projects would equate a 4 year	Subtotal	1,529 713 41,000 60,000 3,130 6,000 1,854 3,882 118,108 2,144 4,878 2,234 580 6,824 1,500 6,879 474 5,080 22,800	N

Shading indicates Priority project for 2010/11

	programme if completed in full	Total	171,501	
Trial and monitor novel sediment management techniques	Water Injection Dredging trial completed, conclusions reported via Navigation Committee and Broads Forum			
Dredging decision making framework (see Strategy Document) to be adopted, and supported by survey data	Ongoing			
Consult interested parties on Annual Plans	Ongoing via regular updates to Navigation Committee, and publication to website.			

(ii) Strategic disposal sites

Strategy Objective: Maximise beneficial reuse of dredged sediment

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Work with BESL to identify further reuse opportunities within Broadland Flood Alleviation Project, info to be mapped and quantified, EA and BESL supportive of the works	Opportunities (see Disposal Table) in set back & retained area mapped for all compartments, as part of Strategic dredging Disposal Strategy. Dredging disposal utilising set back sites throughout the dredging programme in close consultation	BESL, BA		
Identify key strategic locations for disposal need	Disposal tables have been reviewed, and management units are being subdivided to project scale. Priority sites are broadly identified as; Haddiscoe Cut 'The Mud'- planning permission received, not currently required Thurne Mouth – negotiations stalled South Walsham Fleet Dyke – no long term	EA Landowners	Costs include Officer time and feasibility work £5,000	N

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
	opportunities, set back utilised Ant Mouth – temporary site secured for dredging project, inc St Benets. Oulton Broad – Jensen’s Island deferred Oulton Broad – Dutch Tea Gardens set back design agreed, and planning permission granted R. Thurne, Hickling Broad – island creation trial agreed Cell 8 developed, Postwick Tip	Land owner/BESL SWT BESL NWT/NT/EA/ BESL	£78,000	N
Purchase and Construction of strategic disposal sites 08/09	Haddiscoe Cut ‘The Mud’, purchase not required Jensen’s Island – project deferred Upper Thurne strategic disposal site, options appraisal report produced, negotiations underway.	EA SWT NT/NE	£30,000 £76,000	N G/N
Identify, secure and construct key strategic locations for disposal need 08/09	R. Bure u/s Wroxham Bridge, project deferred R. Bure, Thurne Mouth, negotiations failed R. Waveney, Long Dam, negotiations failed All dredging projects completed utilising BESL set back areas during 08/09			N N N
Undertake Strategic disposal site project to review all opportunities and constraints within the Broads area.	Project brief developed and awarded to consultant. GIS model developed, Phase 1 completed reported May 2009.	BESL	£7,000	G
Identify, secure and construct key strategic locations for disposal need 10/11	Priorities and opportunities identified through the project discussed above, Phase 2 to include technical feasibility, and securing consents/sites etc. Appointment of land agent underway.	BESL/NPS	£25,000	G
Work with landowners in key strategic locations to identify other reuse opportunities	Ongoing			

Shading indicates Priority project for 2010/11

(iii) Source Control Measures

Strategy Objectives: Reduce sediment load to the waterways through partnership working

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Reduce resuspension of sediment where possible by enforcing speed limits and enhancing under keel clearance.	Ongoing	BA		N
Support work of Catchment Sensitive Farming Officers in appraising all catchments in the Broads	Ongoing	BA, EA, NE		
Work in priority areas to reduce inputs of diffuse nutrient and sediment pollution from agricultural land to water courses	Ongoing. 2 SSSI and 2 non- SSSI lake inflows investigated. Risk managed by 1-1 advice to domestic septic owners in the Alderfen catchment. Other advice and site investigations to be carried upon following the monitoring report production in early 2011.	NE,EA,NFU,ID B.	£2,500	G
Support the EA and NE in the development of Diffuse Water Pollution Plans in the Broadland Rivers catchments	Evidence has been provided on catchment sediment inputs and potential remedies	EA/NE	£0	
Continue to investigate and reduce the source of ochre input to the Brograve catchment	Reporting of progress ongoing via Upper Thurne Working Group. Delivery of the IBD Water level management Plan yet to be initiated	IDB, Cranfield, BA, EA, NE,		G
Decrease sediment input from river banks; Assess the impact of removal of piling on sediment input from Broadland rivers	Trial and monitoring ongoing	BESL		

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Erosion protection projects to be developed where opportunities arise and funding exists	Goose grazing Boat wash Vegetation management Soft bank protection Survey and monitor existing techniques Ongoing maintenance of soft protection			G N G/N G G/N G
Strategic river corridor tree and scrub management to encourage healthy reed growth to resist erosion	Ongoing, annual Broads Authority programme of tree and scrub clearance carried out	BA, BESL and landowners	Works completed in house and with volunteers	N
Control speed and thus boat wash through patrolling to published Best Value targets	Ongoing, and supported by series of Super Safety Days	BA	Works completed in house and with volunteers	N
Investigate the use of biomarkers to identify the sources of organic matter in bed substrates	MSc complete.	Cranfield University		
Develop policies within Local Development Frameworks to ensure that water quality measures, e.g. Sustainable Urban Drainage are installed in new developments	Core Strategy now adopted, and Development Policies Development Plan Document is currently out to consultation for comment.	Water Quality Partnership		
Assess inputs of sediment and pollutants from urban areas and deliver improvements	Project to be scoped	Water Quality Partnership		

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Problem of diffuse sediment pollution from highways.	Ongoing work to identify sites with mud on the road and those that connect with watercourses and work with farmers and Highways to address the problem areas. Issue has been raised as part of the Water Framework Directive River Basin Management Plan development, for highways authorities to consider.	Water Quality Partnership		
Investigate role of the role of rond areas for deposition of sediment during floods	Project advertised to students, currently no progress.	BESL, BA		G
Investigate the role of new proposed wash land areas as natural sinks and disposal sites for sediment	Project to be scoped, currently no further progress.	BESL, BA		
Identify areas where informal moorings are causing bank-side erosion; awareness raising and direct prevent mooring at such locations	Project to be scoped and staff/volunteer resource to be identified			N

(iv) Research and monitoring projects

Strategy Objectives: Identify sources and volume of sediment entering the Broads

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Sediment inputs and gaps in information identified through Desk Study	Completed	BA, Cranfield University		

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Monitor suspended sediment loads in the headwaters of the River Wensum	Review 12 month turbidity data within the River Wensum to assess sediment in the river under different sluice operation scenarios. – Completed	EA, NE, BA		G
Monitor suspended sediment load within and from headwaters at mills.	New Mills research results demonstrated very low levels, no further research required	EA, NE, BA	£10,000	G
Update hydrographic survey to collate settlement rates data	Annual rolling programme of hydrographic surveys underway in partnership work with BESL Programme of surveys for isolated water bodies to be undertaken using hydro acoustic equipment or bathymetric survey equipment as required. Bathymetric survey undertaken for Hoveton Great Broad. Awaiting final volumetric outputs and report. Comprehensive resurvey of northern broads required		£10,000 £20,000	G/N N
Collate evidence in change in bank erosion rates as a result of the change in the strategic flood management	Monitoring using hydrographic survey and site monitoring currently ongoing.	BESL		
Undertake assessment of vulnerable banks and verify with surveys to identify programme of erosion protection	Ongoing, annual assessment of bank condition in BFAP project area Survey of other areas required, no further progress but identified as potential volunteer project	BESL		
Update bank erosion estimates with recent data to refine sediment budget	Monitoring of bank erosion during trial piling removal in 2007- 09 currently shows minimal erosion rates, no further work required at this time	BESL		

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Assess Environmental impact of delivery of Sediment Management Strategy	Appropriate Assessment complete following modelling of the Upper Thurne system. Options appraisal report produced for dredging of Heigham Sound, submitted to NE and partners. Further impact assessment completed for the dredging of Heigham Sound taking into account risks to fisheries	BA, BESL, NE		
Assess inputs of sediment and pollutants from urban areas and deliver improvements	Scope project and find partner support	WQP - AW, EA		
Extend partnership networks outside BA area in priority catchment to develop sediment focused and diffuse pollution approaches via appointment of a temporary officer	Scope project and find partner support	ESW, NT, EA, NE	£30,000	

(v) Information management and awareness raising

Strategy Objective: Influence wider legislation and policy for sustainable and integrated management on a catchment scale

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Work with Dredging Industry Network to lobby Government on emerging legislation	Regular meetings are attended, facilitated by AINA and supported by Defra. A Best Practice guide has been published, with Ministerial and Regulator support. Recent consultation on Waste Management Regulations exemption responded to, and secured continuing exemption for bank side disposal process.	AINA, IDDNN, BA		

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Work with Partners to seek a sustainable approach to sediment disposal	Includes work with Natural England and Environment Agency to ensure that Favourable Condition Status of waterbodies requiring sediment removal can be met without unreasonable constraints. These issues under consideration as part of the strategic dredging disposal sites project.	EN, EA, BA		
Develop a GIS Database of current and historic dredging	Spreadsheet developed to capture all relevant information with regard to dredging works, where data is known. GIS development is ongoing in 2010/11.	BA	£30,000	G/N
Undertake GIS based assessment of disposal opportunities	Completed in 2009, as part of strategic dredging disposal project.	BA	£8,000	G
Develop a Register for the publication/ promotion of reuse of dredged material within wider construction projects	Completed	BA		
Disseminate principles of Sediment Management Strategy via conferences/and publications to a wider audience	SedNet Conference, Reading, June 2006 PIANC seminar, October 2006 Natural England report on achievement of PSA targets, November 2006 AINA WFD Conference, September 2007 Anglian River Basin Liaison Panel June 2008	BA		
Feed results of desk based study of sediment inputs into the Catchment Sensitive Farming Appraisal	Completed			

Shading indicates Priority project for 2010/11

Project	Report on Progress	Partnerships	Indicative Cost	Funding G = Gen a/c N = Nav a/c
Publish and distribute Strategy Document on the web and between partners and interested parties	Completed, Action Plan also circulated and published to website.			N
Develop a GIS database of river corridor bank structure and vegetation type to support planning decisions and mitigation works	Existing data sources to be collated and ground-truthed in a trial river to establish methodology	BESL		G /N
Implement Environmental Standard Operating Procedures to deliver best practice for works in the Broads	ESOPs developed and on BA website. Rolling programme of awareness raising within the Authority works teams. Share with partners operating in the Executive Area			
Assess Environmental Impact and test project plans against Article 4.7 of the WFD as a routine element of delivery of SMS actions	Develop a standard Impact Assessment protocol to follow for sites where required			N

Shading indicates Priority project for 2010/11

Appendix 2

- a) Key to Priority Matrix**
- b) Priority Matrix for sediment removal
in navigation area**

KEY	Score	Comment
Navigation Area¹		
Waterways Specification compliance		
< 30%	3	Cross sections analysis to identify % cross sections passing Digital Terrain model, for required depth below ALWS
31 - 65%	2	
>65%	1	
Disposal suitability (without treatment)		
AGRI - Class A	3	Sediment Characterisation survey checked to ensure suitability for disposal options, which can then be developed as required.
EXEMPTION - Class B	2	
LANDFILL - Class C	1	
Level of boat use		
320 - 800	3	Information from 2006 boat census data, average number of boat movements per day
160-320	2	
0-160	1	
Type of boat use		
Events	3	Information on boat use taken from Rivers and Broads Strategy data
Cruising	2	
Casual/access	1	
Cost/m3		
<£15/m3	3	Cost estimate based on likely dredging technique, disposal opportunity, travelling distance
£15-£20/m3	2	
£21-£40/m3	1	
Unresolved safety incidents		
More than 30	3	Incidents reported and logged on Safety Management System incident reporting log, where the solution required is dredging works, and the issue is not yet resolved.
20-30	2	
less than 20	1	

Other projects within the Work Programme are prioritised based on: Urgency, cost savings, sustainability and partnership delivery.

¹ Navigation Area is the area that the Broads Authority has jurisdiction over as a navigation authority, and where public rights of navigation exist.

Management Unit	Chainage	Sub section	Waterway Specification compliance	Disposal suitability	Level of use	Type of boat use	Removal Cost per m3	Unresolved safety incidents	Total Score	Comments
B3	Ch 35,000 Ch 39,000	Salhouse - Wroxham Viaduct Bridge	3	3	3	3	2	1	15	Investigating island creation/strengthening at Salhouse Spit for beneficial reuse and external funding opportunity, design works planned 10/11
W4	Ch 500 - Ch 6,375	Breydon main channel	2	3	2	3	3	2	15	marking at Bure Mouth and Turntide Jetty could assist. Additional post installed by GYPC 08/09 and being monitored
B3	Ch 22,000 Ch28,000	Thurne Mouth - Horning Church	1	3	3	3	3	1	14	Dredging completed 08/09, shoals and navigation hazards removed 09/10 . Resurvey required
B3	Ch 17,000 Ch 22,000	Acle Bridge - Thurne Mouth	2	3	3	3	3	0	14	Disposal arranged for BESL set back site, works started 2009/10 , and programmed for 2010/11 dredging to complete
B4	Ch 0 - Ch 5,000	Slaughter House Yard - Mautby Marsh Mill	3	3	2	2	3	1	14	Dredging programmed for 2010/11
B3	Ch 28,000 Ch 35,000	Horning Church - Salhouse	1	3	3	3	3	0	13	Strategic disposal site required, works to be completed when set back opportunity arises
B3		South Walsham Outer and Inner Broad	3	3	2	2	2	1	13	Strategic disposal site required, Inner Broad is not navigation area
B4	Ch 5,000 - Ch 10,000	Mautby Marsh Mill - Herringby Hall	3	3	2	2	3	0	13	Strategic disposal site required
C2	Ch 0 - Ch5500	Loddon - Chet Mouth	3	3	1	2	3	1	13	Dredging Chet Mouth to Nogdam End completed winter 09/10 . Phase 2 to be completed once further piling removal is completed.
T2	Ch 0 - Ch 8,000	Thurne Mouth to Martham Ferry	1	3	3	2	3	1	13	Strategic disposal site required.
W3		Oulton Broad	2	3	2	3	3	0	13	Maintenance dredging completed 08/09 for bar removal and North Bay. Long term strategic disposal site required, but set back areas at Oulton Dyke, and Dutch Tea Gardens in partnership with BESL will be available for dredging works programmed for 2010/11.
A2	Ch1400 - Ch7000	Barton Broad - Ludham Bridge	1	3	2	2	3	1	12	Dredging u/s Ludham Bridge completed 09/10 . How Hill - Barton Broad works programmed 2010/11
A2		Limekiln Dyke	3	3	1	2	3	0	12	Disposal site required.
A2		Barton Broad	1	3	2	3	2	1	12	Specification refined in accordance with Barton Broad Waterspace Management Plan. Shoal removal to take place at appropriate opportunity
B2	Ch 43,000 Ch 46,000	Jubys Farm - Coltishall	3	3	1	2	3	0	12	Strategic disposal site required
B3	Ch 39,000 Ch 41,000	Wroxham Viaduct Bridge - Caen Meadow	3	3	3	1	2	0	12	Planned dredging deferred pending securing of disposal site.
B4	Ch 14,000 Ch 17,000	Stokesby - Acle Bridge	2	3	2	2	3	0	12	Dredging programmed for 2010/11
B4	Ch 10,000 Ch 14,000	Herringby Hall - Stokesby	2	3	2	2	3	0	12	Strategic disposal site required

Highlighting shows projects programmed for 10/11

T2		Heigham Sound									Groundings reported at junction with Meadow Dyke, island creation trial underway for beneficial reuse opportunity, and other disposal options also under investigation. Phase 2 programmed for 2011/12 if trial successful.
T2		Womack Water	3	3	1	2	2	1	12		
W4	Ch 0 - Ch 3,853	Haddiscoe Cut	3	3	1	1	3	1	12		Strategic dredging disposal site required.
A2	Ch 0 - Ch1400	Ludham Bridge-Ant Mouth	2	3	1	2	3	1	12		Dredging completed 07/08, 08/09, 09/10 , and also programmed for 2010/11. Resurvey will then be required to programme further work.
B2	Ch 46,000 Ch 48,000	Coltishall Common - Horstead Mill	1	3	2	2	3	0	11		Dredging completed 08/09
B2	Ch 41,000 Ch 43,000	Caen Meadow - Jubys Farm	3	3	1	1	3	0	11		Strategic disposal site required
B2		Caen Meadow - Jubys Farm	2	3	1	2	3	0	11		Strategic disposal site required
B3		Malthouse Broad	1	3	2	2	3	0	11		Dredging completed 09/10
B3		Upton Dyke	3	3	1	1	3	0	11		Initial works completed 09/10 and Phase 2 programmed 10/11
B3		South Walsham Fleet dyke	1	3	2	2	3	0	11		Dredged 07/08, completed 08/09
B3		Ranworth Dam	1	3	2	2	3	0	11		Dredging completed 09/10
B4		Acle Dyke	3	3	1	1	3	0	11		Total clearance required, but public staithe has been lost.
T2		Martham Dyke	3	3	1	1	3	0	11		
T2		Thurne Dyke	3	3	1	1	3	0	11		
T2	Ch 8,000 - Ch 10,000	Martham Ferry to West Somerton	2	3	1	2	3	0	11		Dungeon Corner requires shoal removal, possible partnership opportunity with BESL under investigation
W2	Ch 30,000 Ch 35,000	Geldeston - Beccles	2	3	1	2	3	0	11		Dredged 05/06
W2	Ch 30,000 Ch 19,000	Beccles - Burgh St Peter	1	3	2	2	3	0	11		Aldeby - Burgh St Peter dredged 05/06 Shoals at Boathouse Hill and Beccles Yacht Station require removal, possible partnership opportunity with Waveney District Council.
W3		Oulton Dyke	1	3	2	2	3	0	11		Shoal removal completed 08/09
W4	Ch 5,000 - Ch 8,000	Upper Seven Mile House - Reedham	1	3	1	3	3	0	11		Shoals at 5 Mile Bends and downstream removed 08/09
W4	Ch 500 - Ch 8,000	St Olaves - Breydon Water	1	3	1	2	3	1	11		Strategic disposal site required, Water Injection dredging trial completed 09/10
W4	Ch 0 - Ch 5,000	Breydon Water-Upper Seven Mile House	1	3	1	3	3	0	11		Further shoals at 5 mile bends removed 08/09, requires resurvey.
Y3	Ch 8,000 - Ch17,000	Cantley - Reedham	1	2	1	3	3	1	11		Strategic disposal site required
A2		Sutton Dyke	3	3	1	1	2	0	10		Strategic disposal site required
A2	Ch12,000 Ch7000	Wayford Bridge - Barton Broad	1	3	2	2	2	0	10		Strategic disposal site required
B3		Wroxham Broad	1	3	2	3	1	0	10		Private broad
B3		Salhouse Broad	3	3	1	1	2	0	10		Strategic disposal site required, investigation underway. Possibility of island creation/ strengthening under investigation
B3		Hoveton Little Broad	3	3	1	1	2	0	10		Strategic disposal site required
T2		Waxham Cut	3	2	1	1	3	0	10		Strategic disposal site required
T2		Meadow Dyke	3	2	1	2	2	0	10		Complete clearance required, strategic dredging disposal site required.

Highlighting shows projects programmed for 10/11

T2		Hickling Broad channels only, estimated	2	3	1	3	1	0	10	Parish Staithe requires urgent dredging, disposal opportunity investigations underway
T2		Hickling Broad, outside channel	2	3	1	3	1	0	10	Strategic disposal site required
W2		Geldeston Dyke	2	3	1	1	3	0	10	Dredging undertaken 2005/06
W3	Ch 8,000 - Ch 19,000	Burgh St Peter - St Olaves	1	2	2	2	3	0	10	
Y3		Langley Dyke	3	2	1	1	3	0	10	Disposal site required.
Y3		Hardley Dyke	3	2	1	1	3	0	10	Bar at entrance dredged 07/08,
A2		Smallburgh Canal	3	3	1	1	1	0	9	Previously dredged in partnership with EA for land drainage purposes.
A2		Stalham Dyke	1	3	2	1	2	0	9	Stalham Staithe requires shoal removal
A2		Turkey Broad	1	3	1	1	2	1	9	Strategic disposal site required, shallow water buoys improved
A2		NW & D Canal	3	3	1	1	1	0	9	Private canal
B2		Bridge Broad	2	3	1	1	2	0	9	Strategic disposal site required
B3		Cockshoot Dyke	2	3	1	1	2	0	9	Strategic disposal site required
T2	Ch 10,000 Ch 10,450	Somerton Boat Dyke	2	3	1	1	2	0	9	Strategic disposal site required
T2		Duck Broad channel	1	3	1	2	2	0	9	Strategic disposal site required, island creation trials underway
T2		Candle Dyke	1	3	1	2	2	0	9	Strategic disposal site required
T2		Horsey Mere	3	2	1	2	1	0	9	Strategic disposal site required
Y2		Rockland Broad channel + dykes	3	1	1	2	2	0	9	Dredged 2004
Y2		Old River Yare	3	1	1	2	2	0	9	Very low use, no public moorings
Y3	Ch17,000 - Ch25,000	Brundall - Cantley	1	1	1	3	2	1	9	Disposal to Postwick Tip as required
A2		Tylers Cut	1	3	1	1	2	0	8	Strategic disposal site required
T2		Catfield Dyke	1	3	1	1	2	0	8	Strategic disposal site required
Y2	Ch 24500 - Ch30500	Postwick - Brundall	2	1	1	2	2	0	8	Disposal to Postwick Tip as required
Y2		Thorpe Old River	3	1	1	2	1	0	8	Silt build up at both railway bridges require dredging, works planned for 10/11
Y2		Rockland Broad outside channel, Estimated	3	1	1	1	2	0	8	Not required for navigation, but may be needed to remove mercury contamination.
Y2		Bishops Bridge - Postwick	2	1	1	2	2	0	8	Bishops Bridge - Carrow Bridge dredged 00/01
Y2		Surlingham Broad channels	3	1	1	1	2	0	8	Use by unpowered craft only
Y2		New Mills - Bishops Bridge	2	1	1	2	2	0	8	Dredged 00/01
Y2		Bargate Water + dykes	3	1	1	1	2	0	8	Strategic disposal site required

Appendix 3

Sediment Removal Tables

- a) For Navigation Area**
- b) Isolated Water Bodies**

Management Unit	Chainage	Sub section	Waterway Specification (depth below average low water level)	Waterway Specification Compliance % cross sections passing DTM	Volume to be Removed (m3) Mar 2010	Contamination of sediment potentially restricting works (excl. nutrients)	Use (level of boat traffic from 2006 census, daily average number of boat movements)	Protected sites & species for consideration	Costs (£/m3) based on 2008/09 or 2009/10 project costs where possible, includes Dredging & Transportation	Total cost per section (£) for dredging and transportation	Comments
<p>Note 1: There will be no sediment removal within Natura 2000 waterbodies if it is likely to have a significant adverse effect on the ability of the site to support designated features. All sediment removal from protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas</p>											
Y2	Ch39000- Ch37000	New Mills - Bishops Bridge	1.5m	40%	6,590	Mercury, Copper, PAH, Zinc	Unknown, assumed low use	Yare Broads & Marshes SSSI / Depressed Mussel	£25.00	164,750	Survey completed May 2009
Y2	Ch37000- Ch30000	Bishops Bridge - Postwick	2m	32%	24,103	Mercury, Copper, PAH, Zinc	18		£25.00	602,575	Survey completed May 2009
Y2		Thorpe Old River	1.5m	0%	8,549	Mercury, Copper, PAH, Zinc	Unknown, assumed low use		£25.00	213,725	Survey completed May 2009, Programmed for Summer 2010, disposal to Postwick Tip
Y2		Old River Yare	1.5m	25%	2,432	Mercury, Copper, PAH, Zinc	Unknown, assumed low use		£17.00	41,344	Survey completed May 2009
Y2	Ch 24500 - Ch30000	Postwick - Brundall	2m	35%	32,153	Mercury, Copper, PAH, Zinc	131		£17.00	546,601	Survey completed May 2009, Disposal at Postwick Tip required
Y2		Bargate Water + dykes	1.8m	Sections required	10,354	Mercury, Copper	Unknown, assumed low use		£17.00	176,018	Disposal at Postwick Tip required
Y2		Surlingham Broad channels	1.5m			Mercury, Copper	Unknown, assumed low use		£17.00	0	Survey required
Y2		Rockland Broad channel + dykes	1.8m	Sections required	12,356	Mercury, Copper	Unknown, assumed low use		£17.00	210,052	Disposal at Postwick Tip required
Y2		Rockland Broad outside channel	1.5m	0%		Mercury, Copper	None - dredging req'd to remove contamination only	Aquatic plants	£17.00	0	Disposal at Postwick Tip required, not required for navigation
Y2 Sub total					96,537					£1,955,065	
Y3	Ch15,000- Ch25,000	Brundall - Cantley	2m	70%	5,921	Mercury, Copper, Zinc	141	Yare Broads & Marshes, Cantley Marshes SSSI Depressed mussels	£17.00	100,657	Survey completed May 2009, Disposal at Postwick Tip may be required but site specific sediment sampling should be undertaken
Y3	Ch 8,000 - Ch15,000	Cantley - Reedham	2m - 4m	Recreation 96% Commercial 21%	40,604	Low levels of Mercury, Copper, Zinc	148		£15.00	609,060	Site specific sampling for heavy metals to be undertaken, but compliance failure only due to shipping channel requirements, so low priority unless coasters return
Y3		Langley Dyke	1.8m	Sections required	2,338	Low levels of Mercury, Copper, Zinc	Unknown, assumed low use		£10.00	23,380	Assumes sidcasting
Y3		Hardley Dyke	1.8m	Sections required	3,160	Low levels of Mercury, Copper, Zinc	Unknown, assumed low use		£10.00	31,600	Assumes sidcasting, bar removed 07/08
Y3 Sub total					52,023					£764,697	

Management Unit	Chainage	Sub section	Waterway Specification (depth below average low water level)	Waterway Specification Compliance % cross sections passing DTM	Volume to be Removed (m3) Mar 2010	Contamination of sediment potentially restricting works (excl. nutrients)	Use (level of boat traffic from 2006 census, daily average number of boat movements)	Protected sites & species for consideration	Costs (£/m3) based on 2008/09 or 2009/10 project costs where possible, includes Dredging & Transportation	Total cost per section (£) for dredging and transportation	Comments
<p>Note 1: There will be no sediment removal sediment within Natura 2000 waterbodies if it is likely to have a significant adverse effect on the ability of the site to support designated features. All sediment removal from protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas</p>											
C2	Ch 0 - Ch5500	Loddon - Chet Mouth	1.5m	13%	6,000	Low levels of Mercury, Copper, Zinc	61		£9.79	£58,740	Phase One Completed early 2010. Disposal to River Chet Setback areas. Phase two awaiting BESL piling removal. Resurvey required.
W4	Ch 0 - Ch 5,000	Breydon Water- Uppen Seven Mile House	2m - 4m	Recreation 100% Commercial 80%	6,487	Low levels of Mercury, Copper, Zinc	118		£12.24	79,401	Survey updated May 2009, Dredging undertaken 07/08, and 08/09
W4	Ch 5,000 - Ch 8,000	Upper Seven Mile House - Reedham	2m - 4m	Recreation 92% Commercial 8%	8,066		118		£12.24	98,728	Survey updated May 2009
W4 Yare Sub total					14,553					£178,129	
W2	Ch30,000 Ch35,000	Geldeston - Beccles	1.5m	64%	1,174		Unknown, assumed low use	Depressed river mussel, Aquatic plants	£12.50	14,675	Assumes local tip site at Geldeston Dyke, waterway specification ammended to 1.5m
W2	Ch30,000 Ch 19,000	Beccles - Burgh St Peter (inc above)	2m	88%	474		175		£12.50	5,925	
W2		Geldeston Dyke	1.5m	50%	722		Unknown, assumed low use	Depressed river mussel, Aquatic plants	£12.50	9,025	Assumes local tip site at Geldeston Dyke
W2 Sub total					2,370					£29,625	
W3	Ch 8,000 - Ch 19,000	Burgh St Peter - St Olaves	2m	86%	1,498	Low levels of Mercury, Copper, Zinc	191		£12.50	18,725	
W3		Oulton Dyke	1.8m	100%	0		204		£8.00	0	Assumes sidescasting
W3		Oulton Broad	1.8m	57%	6,620	Mercury, Lead, Zinc	204		£7.61	50,378	Assumes local tip site at Oulton Dyke, dredging carried out 08/09 and further works planned for 10/11. Re survey required
W3 Sub total					8,118					£69,103	
W4	Ch 0 - Ch 3,853	Haddiscoe Cut	2m	95%	6,000	Low levels of Mercury, Copper, Zinc	88		£10.34	62,040	Assumes tip site at The Mud, dredging undertaken annually. Resurvey required
W4	Ch 500 - Ch 8,000	St Olaves - Breydon Water	2m	75%	4,402	Low levels of Mercury, Copper, Zinc	87		£12.24	53,880	Shoals removed 08/09, resurvey required
W4	Ch 500 - Ch 6,375	Breydon main channel	2m - 4m	Recreation 85% Commercial 0%	82,797		162		£5.00	413,985	Assumes water injection Dredging, compliance failure due to shipping channel depth requirement.
W4 Waveney Sub total					93,199					£529,905	
TOTAL Dredging in Southern Rivers					272,800	m3				£3,585,264	

Management Unit	Chainage	Sub section	Waterway Specification (depth below average low water level)	Waterway Specification Compliance % cross sections passing DTM	Volume to be Removed (m3) Mar 2010	Contamination of sediment potentially restricting works (excl. nutrients)	Use (level of boat traffic from 2006 census, daily average number of boat movements)	Protected sites & species for consideration	Costs (£/m3) based on 2008/09 or 2009/10 project costs where possible, includes Dredging & Transportation	Total cost per section (£) for dredging and transportation	Comments
<p>Note 1: There will be no sediment removal sediment within Natura 2000 waterbodies if it is likely to have a significant adverse effect on the ability of the site to support designated features. All sediment removal from protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas</p>											
B2	Ch 41,000 Ch43,000	Caen Meadow - Jubys Farm	1.5m	50%	580		129	Aquatic plants	£8.00	4,640	
B2	Ch43,000 Ch46,000	Jubys Farm - Coltishall Common	1.5m	17%	1,184		129		£8.00	9,472	
B2	Ch46,000 Ch48,000	Coltishall Common - Horstead Mill	1.5m	0%	2,234		129		£8.00	17,872	
B2		Bridge Broad	1.5m	50%	1,497		Unknown, assumed low use	Aquatic plants	£15.00	22,455	recalculation required
B2 Sub total					5,495					£54,439	
B3	Ch 17,000 Ch22,000	Acle Bridge-Thurne Mouth	2m	64%	1,450		324		£7.79	11,296	Dredging undertaken 2009/10. Resurvey required
B3	Ch 2,000 Ch28,000	Thurne Mouth - Horning Church	2m	100%	0	Low levels of Mercury, Copper, Zinc	475		£10.29	0	Dredged 08/09, and shoals removed 09/10. Re survey required
B3	Ch28,000 Ch35,000	Horning Church - Salhouse	2m	79%	713	Low levels of Mercury, Copper, Zinc	603		£11.00	7,843	
B3	Ch35,000 Ch39,000	Salhouse - Wroxham Viaduct Bridge	2m	25%	1,529		678		£15.00	22,935	
B3	Ch39,000 Ch41,000	Wroxham Viaduct Bridge - Caen Meadow	1.5m	0%	3,882		129		£15.00	58,230	recalculation required due to changed specification required
B3		Wroxham Broad	1.8m	66%	24,183		Unknown, assumed med use		nil (private broad)	0	recalculation required
B3		Salhouse Broad	1.8m	0%	12,481		Unknown, assumed low use		£15.00	187,215	recalculation required
B3		Hoveton Little Broad	1.8m	0%	89,549		Unknown, assumed low use		£15.00	1,343,235	recalculation required
B3		Cockshoot Dyke	1.8m	50% estimated	260		Unknown, assumed low use		£15.00	3,900	
B3		Ranworth Dam	1.8m	100%	0	Low levels of Mercury, Copper, Zinc	Unknown, assumed med use		£6.96	0	Using localised disposal site, works completed 09/10, resurvey required
B3		Malthouse Broad	1.8m	90%	15,000	Low levels of Mercury, Copper, Zinc	Unknown, assumed med use		£10.39	155,850	Using localised disposal site. Main channel compliant but more sediment needs to be removed from edges for full compliance. Survey required.
B3		South Walsham Outer and Inner Broad	1.8m	0%	112,904		Unknown, assumed med use		£15.00	1,693,560	recalculation required
B3		South Walsham Fleet dyke	2m	90%	932		Unknown, assumed med use		£10.04	9,357	Dredging completed 08/09, needs resurvey

Management Unit	Chainage	Sub section	Waterway Specification (depth below average low water level)	Waterway Specification Compliance % cross sections passing DTM	Volume to be Removed (m3) Mar 2010	Contamination of sediment potentially restricting works (excl. nutrients)	Use (level of boat traffic from 2006 census, daily average number of boat movements)	Protected sites & species for consideration	Costs (£/m3) based on 2008/09 or 2009/10 project costs where possible, includes Dredging & Transportation	Total cost per section (£) for dredging and transportation	Comments
<p>Note 1: There will be no sediment removal sediment within Natura 2000 waterbodies if it is likely to have a significant adverse effect on the ability of the site to support designated features. All sediment removal from protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas</p>											
B3		Upton Dyke	2m	25%	2,459		Unknown, assumed low use		£5.91	14,533	Bar removed at Dyke mouth Jan 2010, cost assumes side casting option on the dyke bank
B3 Sub total					265,342					£3,507,953	
B4	Ch 0 - Ch 5,000	Slaughter House Yard - Mautby Marsh Mill	2m	0%	17,009		162		£11.00	187,099	Water Injection dredging completed 06/07, needs resurvey
B4	Ch 5,000 - Ch 10,000	Mautby Marsh Mill - Herringby Hall	2m	10%	3,130		162		£11.00	34,430	Assumes local tip site available
B4	Ch10,000 - Ch14,000	Herringby Hall - Stokesby	2m	38%	2,144		162		£11.00	23,584	Assumes local tip site available
B4	Ch14,000 - Ch17,000	Stokesby - Acle Bridge	2m	40%	1,925		162		£11.00	21,175	Assumes local tip site available
B4		Acle Dyke	2m	0%	6,824		Unknown, assumed low use		£11.00	75,064	Assumes local tip site available
B4 Sub total					31,032					£341,352	
A2	Ch12,000 - Ch7000	Wayford Bridge - Barton Broad	1.8m	90%	184		272	Aquatic plants	£16.50	3,036	
A2	Ch1400 - Ch7000	Barton Broad - Ludham Bridge	1.8m	85%	4,000	Low levels of Mercury, Copper, Zinc	302	Aquatic plants	£6.85	27,400	Dredging undertaken 07/08, and 08/09, and currently ongoing 09/10. Resurvey required.
A2	Ch0 - Ch1400	Ludham Bridge - Ant Mouth	1.8m	100%	142	Low levels of Mercury, Copper,	302	Aquatic plants	£9.36	1,329	Dredging completed 08/09
A2		NW & D Canal	1.5m	0%	7,008		Unknown, assumed low use	Aquatic plants	nil (private water)	0	
A2		Tylers Cut	1.5m	75%	1,961		Unknown, assumed low use	Aquatic plants	£15.00	29,415	
A2		Smallburgh Canal	1.5m	Not surveyed, estimated	1,000		Unknown, assumed low use	Aquatic plants	£11.00	11,000	
A2		Sutton Dyke	1.8m	0%	13,793		Unknown, assumed low use		£16.50	227,585	
A2		Stalham Dyke	1.8m	78%	5,080		Unknown, assumed med use		£16.50	83,820	

Management Unit	Chainage	Sub section	Waterway Specification (depth below average low water level)	Waterway Specification Compliance % cross sections passing DTM	Volume to be Removed (m3) Mar 2010	Contamination of sediment potentially restricting works (excl. nutrients)	Use (level of boat traffic from 2006 census, daily average number of boat movements)	Protected sites & species for consideration	Costs (£/m3) based on 2008/09 or 2009/10 project costs where possible, includes Dredging & Transportation	Total cost per section (£) for dredging and transportation	Comments
<p>Note 1: There will be no sediment removal sediment within Natura 2000 waterbodies if it is likely to have a significant adverse effect on the ability of the site to support designated features. All sediment removal from protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas</p>											
A2		Barton Broad	1.8m	25%	100,000		302	Ant and Broads Marshes SSSI Aquatic plants	£16.50	1,650,000	
A2		Turkey Broad	1.5m	Sections required	52,090		Unknown, assumed low use		£16.50	859,485	
A2		Limekiln Dyke	1.8m	20%	1,854		Unknown, assumed low use		£12.00	22,248	
A2 Sub total					187,112					£2,915,318	
T2	Ch 0 - Ch 8,000	Thurne Mouth to Martham Ferry	1.5m	94%	257		425		£11.00	2,827	Assumes local tip site available
T2	Ch 8,000 - Ch 10,000	Martham Ferry to West Somerton Drainage Mill	1.5m	50%	6,879		122		£11.00	75,669	Assumes local tip site available
T2	Ch 10,000 - Ch 10,450	Somerton Boat Dyke	1.5m	50%	48		122		£15.00	720	
T2		Horsey Mere	1.5m	25%	29,855	Ochre	Unknown, assumed low use	Upper Thurne Broads & Marshes, Aquatic plants	£27.00	806,085	Based on Catfield Pilot costs, recalculation required
T2		Waxham Cut	1.5m	0%	6,690	Ochre	Unknown, assumed low use	Upper Thurne Broads & Marshes,	£11.00	73,590	Assumes local tip site available, recalculation required
T2		Hickling Broad channels only, estimated	1.5m	37%	22,800	Low levels of Mercury, Copper, Zinc	109	Prymnesium Algae	£27.00	615,600	Based on Catfield Pilot costs, recalculation required
T2		Hickling Broad, outside channel	1.3m	inc above	321,230		109	Upper Thurne Broads & Marshes, Aquatic plants, Prymnesium Algae	£27.00	8,673,210	Based on Catfield Pilot costs, recalculation required

Management Unit	Chainage	Sub section	Waterway Specification (depth below average low water level)	Waterway Specification Compliance % cross sections passing DTM	Volume to be Removed (m3) Mar 2010	Contamination of sediment potentially restricting works (excl. nutrients)	Use (level of boat traffic from 2006 census, daily average number of boat movements)	Protected sites & species for consideration	Costs (£/m3) based on 2008/09 or 2009/10 project costs where possible, includes Dredging & Transportation	Total cost per section (£) for dredging and transportation	Comments
Note 1: There will be no sediment removal sediment within Natura 2000 waterbodies if it is likely to have a significant adverse effect on the ability of the site to support designated features. All sediment removal from protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas											
T2		Catfield Dyke	1.5m	estimated	2,350		Unknown, assumed low use		£15.00	35,250	Assumes local tip site available
T2		Deep/Deep Go Dyke	1.5m	40%	696	Low levels of Mercury, Copper,	109		£15.00	10,440	Assumes local tip site available
T2		Heigham Sound	1.5m	60%	11,665	Low levels of Mercury, Copper, Zinc	109	Upper Thurne Broads & Marshes, Aquatic plants Prynnesium	£15.00	174,975	Assumes local tip site available, recalculation required
T2		Duck Broad channel	1.5m	83%	609	Low levels of Mercury, Copper, Zinc	109	Prynnesium Algae	£15.00	9,135	Assumes local tip site available, recalculation required
T2		Candle Dyke	1.5m	100%	22	Low levels of Mercury, Copper, Zinc	109	Upper Thurne Broads & Marshes, Aquatic plants	£15.00	330	Assumes local tip site available
T2		Meadow Dyke	1.5m	0%	543		Unknown, assumed low use	Upper Thurne Broads & Marshes, Aquatic plants	£15.00	8,145	Assumes local tip site available
T2		Martham Dyke	1.5m	estimated	1,000		Unknown, assumed low use		£11.00	11,000	Assumes local tip site available
T2		Womack Water	1.5m	38%	4,878		Unknown, assumed low use		£11.00	53,658	Assumes local tip site available
T2		Thurne Dyke	1.5m	estimated	1,500		Unknown, assumed low use		£11.00	16,500	Assumes local tip site available
T2 Sub total					411,022					£10,567,134	
TOTAL Dredging in Northern Rivers					900,003	m³				£17,386,196	

	Volume (m ³)	Estimated Costs	
Hickling	321,230	8,673,210	
Other Northern Rivers	578,773	8,712,986	Total estimated costs for
Total Northern Rivers	900,003	17,386,196	Navigation Area
Southern Rivers	272,800	3,585,264	
Isolated waterbodies	371,000	2,253,000	
Total	1,543,803		Total estimated cost for sediment removal in the Broads

£20,971,460

Note there are a number of areas where resurveys, or recalculations are required. These are indicated by highlighting.

Total volume for navigation area only **1,172,803** **£23,224,460.49**

NB These are dredging costs only, and do not include disposal, monitoring, source control etc.

Appendix 4

Disposal, recovery and reuse table for navigation area

Management Unit	Capacity (m ³) Assumes 15m3 per linear metre within set back and retain piles			BFAP solution within 'Bankside'	Contamination(1)	Protected sites (2)	Beneficial Reuse	Estimated Costs (£/m3) for construction	Comments
	Agri potential as identified by SDDS	Bankside	Landfill						
Note 1 -Sediment contaminants and likely disposal routes: A - agricultural disposal, B - dispose under exemption, C - dispose to a licenced site									
Note 2 - No disposal of sediment arising from sediment management operations on Natura 2000 sites if it is likely to have a significant adverse effect on the ability of the site to support designated features. All disposal to protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas									
Y2 River Yare Newmills to Brundall	15,696	0	40,000		Mercury Copper, PAH, Zinc C	Yare Broads & Marshes SSSI	Subject to sediment quality	£8.00	Approx capacity Postwick Tip
Y3 River Yare Brundall to Reedham	140,383	47,750	N/A		Mercury Copper, Zinc C		Subject to sediment quality	£2.50	C12, 19, 20,22 per SDDS
							sub total	£439,375	
C2 River Chet	16,840	18,000	N/A		A		Rond creation, flood bank raising	£1.50	C21,22 per SDDS
							sub total	£27,000	
W2 River Waveney Geldeston to Burgh St Peter	97,951	0	N/A		A	Geldeston Meadows, Stanley & Alder Carrs, Barnby Broad & Castle Marshes SSSI	Rond creation, flood bank raising	£3.50	
W3 River Waveney Burgh St Peter to St Olaves	223,982	48,000	5,000		A & B	Spratts Water & Marshes SSSI	Rond creation, flood bank raising, habitat creation	£2.50	C22,28,29 per SDDS

Management Unit	Capacity (m ³) Assumes 15m3 per linear metre within set back and retain piles BFAP solution within 'Bankside'			Contamination(1)	Protected sites (2)	Beneficial Reuse	Estimated Costs (£/m3) for construction of temporary works/restoration	Comments
	Agri potential as identified by SDDS	Bankside	Landfill					
Note 1 -Sediment contaminants and likely disposal routes: A - agricultural disposal, B - dispose under exemption, C - dispose to a licenced site								
Note 2 - No disposal of sediment arising from sediment management operations on Natura 2000 sites if it is likely to have a significant adverse effect on the ability of the site to support designated features. All disposal to protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas								
W4 Haddiscoe Island	280,069	119,500	7,000		Halvergate Marshes, Breydon Water SSSI	Habitat creation	£3.00	C34, 35, 11 Yare per SDDS
						sub total	£478,500.00	
B2 River Bure	38,935	0	N/A	A		Bank raising	£1.50	
B3 River Bure	350,770	99,000	N/A	A	Bure Broads & Marshes, Upton Broad & Marshes SSSI	Rond creation, flood bank raising	£1.50	C1,3,5,9, 37 per SDDS
B4 River Bure	149,371	29,750					£1.50	C9,11 (B),37 per SDDS
						sub total	£193,125.00	
A2 River Ant	247,827	81,250	N/A	A	East Ruston Common, Broad Fen, Ant Broads & Marshes SSSI	Bank raising , agricultural benefit , Rond creation	£1.50	C3,5 per SDDS
						sub total	£121,875.00	

Management Unit	Capacity (m ³) Assumes 15m3 per linear metre within set back and retain piles BFAP solution within 'Bankside'			Contamination(1)	Protected sites (2)	Beneficial Reuse	Estimated Costs (£/m3) for construction of temporary works/restoration	Comments
	Agri potential as identified by SDDS	Bankside	Landfill					
Note 1 -Sediment contaminants and likely disposal routes: A - agricultural disposal, B - dispose under exemption, C - dispose to a licenced site								
Note 2 - No disposal of sediment arising from sediment management operations on Natura 2000 sites if it is likely to have a significant adverse effect on the ability of the site to support designated features. All disposal to protected nature conservation sites will be subject to consultation and agreement with Natural England, in addition to routine assent, consent and permissions. Most SSSIs listed are also Special Areas of Conservation &/or Special Protection Areas								
T2 River Thurne	491,475	5,750	N/A	Ochre A & B	Upper Thurne Broads & Marshes, Ludham, Potter Heigham Marshes, Shallam Dyke Marshes SSSI	Bank raising Agricultural benefit Rond creation	£8.00	C5,6 per SDDS
						sub total	£46,000.00	
Overall	2,053,299	449,000	52,000					

Total Available Capacity (m3) 501,000
Total potential capacity (m3) 2,554,299

Total Cost of Temporary works £1,305,875

Total cost for the temporary works associated with disposal. Note this does not include costs associated with land purchase/lease, or environmental monitoring.

Appendix 5

Assessment against Regulations 48 of the Habitats Regulations

Appendix 5

SUMMARY OF ENVIRONMENTAL IMPACT OF THE DELIVERY OF THE SEDIMENT MANAGEMENT STRATEGY

Impact Assessment for sediment removal from the navigated main river channels as proposed in the Sediment Management Strategy Action Plan 2007-2011

1 Impact Assessment

The Sediment Management Strategy provides a justification and process for holistic sediment management across the Broads catchment, as well as setting out the actions required to remove the backlog of sediment that restricts navigation and hinders lake restoration efforts. The strategy uses a prioritised process, which focuses on mitigating impacts to ensure projects do not have adverse impact on the habitats and species in addition to seeking opportunities to beneficially reuse sediment and restore historic disposal sites.

Investigations have been undertaken to inform the development of the impact assessment, as required for the EU designated site under the Habitats Regulations, of the navigation related elements of the Sediment Management Strategy.

The complete delivery of the Strategy is being considered within the impact assessment, although in reality the annual sediment removal set out within the Action Plan only delivers a fraction of the overall sediment removal requirement as laid out in the Sediment Management Strategy. This impact assessment therefore accounts for the maximum impact if all the sediment removal activity were it to take place at one time within each management unit¹. Under current financial and operational constraints this is clearly not possible as set out in the investment scenarios in the strategy.

Natural England and the Broads Authority were of the opinion that the navigation related dredging aspects of the strategy are not directly connected with or necessary to the management of the European site (Regulation 48(1) of the Habitats Directive). Natural England was unable on the information provided in the Strategy presented in 2007, to confirm that sediment removal will ensure favourable condition and that the adjacent SAC/SPA/Ramsar will be maintained or achieved into the longer term. Natural England was also of the view that the works may represent a *significant* effect to the nature conservation value of the site for the following reason, thus further investigations were required.

¹ Management Unit used for the Strategy divide the Broads Rivers into units as described in the Sediment Management Strategy (2007)

- The combined impact of this scheme, in combination with the Broads Flood Alleviation Project, on the availability of fresh water to the Broads SAC and Broadland SPA/Ramsar site. Likely impacts were thought to include changes in hydrology of the Broads system, in terms of water level and saline penetration.

The Authority agreed with Natural England's advice and as competent authority has undertaken collation of evidence to determine if there is a likely *significant* effect to the nature conservation value of The Broads with technical support provided by BESL modellers.

- 1 Following extensive and impact assessment and consultation with Natural England and other interested parties, Natural England have provided representation on in-combination impact of changes in hydrology and saline penetration. Natural England and the Broads Authority are of the opinion that on both issues the scheme would not result in adverse affect to the integrity of the Broads SAC or the Broadland SPA and Ramsar site.

2 Methods of Assessment of Impacts

The assessment has been split in the two stages:

- A. Assessment of the isolated Broads, this is outlined in Table 1.
- B. Assessment of the navigated river sections has involved running the BESL hydraulic model for three areas of the Broads. These areas were where the impacts of salt tide incursion are most likely to be exacerbated, based on previous modelling scenarios run by BESL. The modelling was undertaken during 2007 and 2008, to assess the impact of sediment removal in main river navigation channels on tidal and fluvial flood water level and SAC habitats and SPA/Ramsar species. Detailed water level modelling reports are available upon request.
- C. Assessment of the volume of sediment to be removed per linear metre was used to provide comparison of the volumes per linear metre removed in modelled river management units that showed no significant impact on water level, with volumes per linear meter in other un-modelled management units to determine if modelling was required.
- D. In addition to modelling the high risk sections or sections where volume removal is high, the Upper Thurne was also modelled to assess the water levels in a variety of scenarios, as this is a sensitive location with proposed navigation related dredging occurring within the SAC/SPA area.
- E. In addition to the water level modelling for key sections, Cranfield University have developed the BESL model in the Upper Thurne area to assess any impact of salt incursion as a result of dredging in addition to the water level modelling. These results demonstrate that there

would be no significant impact based on existing water level modelling (see section 3).

3 Assessment of Impacts

Assessment of the isolated Broads concluded that the works are necessary for the nature conservation of each site (Table 1).

Assessment of the navigated main river channels concluded that the modelling work undertaken shows that the water levels in key sections are not significantly altered by the removal of sediment in accordance to the waterways specifications set out in the Sediment Management Strategy (2007), as modified 2008. Assessment of the lower Bure confirmed that there would be no significant change in tidal volume and hence saline penetration as a result of delivering the all the dredging identified in the Sediment Management Strategy in full.

4 Site Specific Impact Assessment

As outlined within the Strategy document, whilst the impact assessment for the Strategy provides the overall assessment of Broads-wide impact of the delivery of the Strategy, there may be other local issues which would require a site specific impact assessment to be carried out. This site specific impact assessment may be either in respect of dredging or disposal plans. Any such assessments will be identified during the development of each annual work programme, in consultation with Natural England, and prepared accordingly.

The dredging and reed bed island recreation works undertaken at Duck Broad in June 2010 highlighted the requirement for a comprehensive site Impact Assessment, both in terms of potential terrestrial and aquatic impacts. The list below is representative of the structure of such an assessment.

Table 1. Example format of a Site Specific Impact Assessment for Protected Area Interest Features

1. Introduction and Site Detail

Introduction

Project proposal

Designated sites

- Sites of Special Scientific Interest (SSSI)
- European Designated Sites (SPA/SAC)

2. Potential Impacts (from silt removal and the dredging disposal operation) and Mitigation on Site Interest Features

Introduction

List of relevant Site Interest Features

- Calcareous fens with *Cladium mariscus* and species of the *Carex davalliana*
 - Impact 1 – Destruction/Degradation of fen through trampling by workmen or mobilisation of plant
 - Impact 2 – Degradation of the interest feature through oil spill
- Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation
 - Impact 1 – Saline Intrusion through river bed from silt removal
 - Impact 2 – Release of nutrients from disturbed sediments
 - Impact 3 – Geotextile bag materials breaking down and altering water quality of water
 - Impact 4 – Water interchange between Duck Broad and Heigham Sound being affected by island re-creation
 - Impact 5 – Loss of open water habitat
- Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.*
 - Impact 1 – Saline Incursion from silt removal
 - Impact 2 – Detrimental impact on surrounding features from deposited dredgings
- Desmoulin's whorl snail (*Vertigo moulinsiana*)
 - Impact 1 – Destroying populations
- Otter (*Lutra lutra*)
 - Impact 1 – Disturbing populations or destroying habitats
 - Impact 2 – Destroying/Disturbing Holts
 - Impact 3 – Affecting water quality and therefore fish populations
 - Impact 3 – Engineering structure causing injury or death to otters
- Bittern (*Botaurus stellaris*)
 - Impact 1 – Disturbing populations or destroying habitat
 - Impact 2 – Disturbance during works
 - Impact 3 – Affecting water quality and therefore fish populations
 - Impact 4 – Recreation of additional favourable habitat
- Winter Visiting Birds
 - Impact 1 - Disturbance to over-wintering wildfowl
 - Impact 2 – Affecting water quality and therefore aquatic plant diversity and abundance
- Resident Wildfowl
 - Impact 1 - Disturbance to wildfowl
 - Impact 2 – Affecting water quality and therefore aquatic plant diversity and abundance

3. Water quality and Reed Island Regeneration Monitoring Plan

4. Summary

5. Assessment

6. References

In addition to the Protected Site Interest Features requiring impacts to be identified and mitigated against, the issue of potential negative impacts upon fisheries was also a cause of concern. To this end, an addition Impact Assessment was drawn up to reflect the potential impacts the works would have on general fish health and coarse fish species populations, themselves not Interest Features under the Habitats Regulations 2010, but of local fishery and ecological importance.

Table 2. Example format of an Impact Assessment for the potential for *Prymnesium parvum* to cause negative effects on fish health and fishery well-being.

1. Background to *Prymnesium parvum* ecology in Upper Thurne

2. Environmental Consequences

Impact 1

There is a release of a significant amount of available phosphorus from the sediment due to the dredging works

Assumptions that need to be satisfied to realize the impact above

- Phosphorus is present in elevated concentrations in the surface sediment of the dredge area
- The phosphorus is in a readily releasable form
- The dredging causes a significant release of soluble phosphorus
- Phosphorus is not re-adsorbed onto particulate matter and iron oxides contained in the sediment

Impact 2

An increase in available phosphorus results in an increased *Prymnesium parvum* population density

Assumptions that need to be satisfied to realize the impact above

- *Prymnesium* is present in Heigham Sound at the time of the works
- Works occur at time of high *Prymnesium* density
- *Prymnesium* responds to increased nutrient
- Other algal species will not be in competition with *Prymnesium* for available nutrients
- Disturbance by dredging is sufficient to cause phosphorus increase across whole site

Impact 3

An increase in *Prymnesium parvum* density will result in fish deaths

Assumptions that need to be satisfied to realize the impact above

- *Prymnesium* population density is sufficiently high to release enough toxin to affect fish
- *Prymnesium* will release toxin if population levels are stimulated
- Fish are in the area
- Fish will die from the toxin

3. Summary

4. Water quality Monitoring Plan

5. Summary

6. Assessment

Table 1 Assessment against Regulation 48 of the Habitats Regulations for sediment removal from open waterbodies as proposed in the draft Sediment Management Strategy Action Plan 2007-2011

Site	Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> -type vegetation	Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp	SPA birds	Otter (<i>Lutra lutra</i>).	Desmoulin's whorl snail (<i>Vertigo moulinsiana</i>).	Conclusion with regard to Regulation 48
Little Broad	Works assented by Natural England and now completed.					
Buckenham Channels ¹	Works assented by Natural England and now completed.					
Barnby	Works assented by Natural England, now completed					
Filby Broad (south west), Rollesby (10% of area), Lily (10% of area), Ormesby Little (10% of area)	Further measures to reduce nutrient concentration, particularly phosphorus are necessary for conservation management of the site. Recent research indicates that sediment nutrient input is significant. Currently site supports poor or no aquatic plants. Sediment removal will create conditions to allow plant growth through lowering nutrient input. Records show plants occurred in past. Palaeolimnology study is planned for 2007.	As for 'Natural eutrophic lakes'	Avoid impacts by undertaking works in the summer.	Temporary displacement from a small proportion of the site does not represent a significant impact. Likely to enhance aquatic plants and therefore fishery having a beneficial impact on otter populations.	Non-intervention margin (2-20m) will be retained thereby avoiding any impact to mollusc habitat.	Necessary for conservation management
Ormesby (10% of area)	Further measures to reduce nutrient concentration, particularly phosphorus are necessary for conservation management of the site. Resent research indicates that sediment nutrient input is significant. In recent years site has supported good aquatic plants, however populations are unstable. Sediment removal will create conditions for more stable plant growth through lowering	As for 'Natural eutrophic lakes'	Avoid impacts by undertaking works in the summer.	Temporary displacement from a small proportion of the site does not represent a significant impact. Likely to enhance aquatic plants and therefore fishery having a	Non-intervention margin (2-20m) will be retained thereby avoiding any impact to mollusc habitat.	Necessary for conservation management

	nutrient input. Records show plants occurred in past. Palaeolimnology study completed 2007.			beneficial impact on otter populations.		
Wheatfen channels	Poor or no aquatic plants. Sediment removal will create conditions to allow plant growth. Records show more and greater diversity of plants occurred in past.	Not designated feature	Avoid impacts by undertaking works in the summer.	Temporary displacement from a small proportion of the site does not represent a significant impact. Likely to enhance aquatic plants and therefore fishery having a beneficial impact on otter populations.	Non-intervention margin (2-20m) will be retained thereby avoiding any impact to mollusc habitat.	Necessary for conservation management
Hoveton Great	Poor or no aquatic plants. Sediment removal will create conditions to allow plant growth. Palaeolimnology and records show abundant and diverse plants occurred in past.	Not designated feature	Avoid impacts by undertaking works in the summer.	Temporary displacement from a small proportion of the site does not represent a significant impact. Likely to enhance aquatic plants and therefore fishery having a beneficial impact on otter populations.	Non-intervention margin (2-20m) will be retained thereby avoiding any impact to mollusc habitat.	Necessary for conservation management
Calthorpe	Works assented by Natural England and now completed.					

Notes:

1. All sites will be subject to detailed pre-project feasibility study, prior to project initiation. Feasibility study will include site specific Appropriate Assessment if the project is likely to have a significant impact on the site and is not necessary for conservation of site features.
2. The works described above have been identified as required to improve the biological quality of the habitat and in many case required to meet Governments PSA target for SSSIs.

¹ Dyke clearance using mud pump