

**Progress in Implementing the Sediment Management Strategy**  
Report by the Rivers Engineer

**Summary:** This report provides members with a summary of the most up to date analysis of hydrographic survey data available and the draft dredging programme for 2018/19.

**1 Background**

- 1.1 The Sediment Management Strategy was adopted in 2007 with the overall goal of achieving a balance of sediment inputs and outputs whilst also reducing a backlog of sediment. A desk study undertaken by Cranfield University estimated a maximum annual sediment input of 24,000m<sup>3</sup>; therefore the Sediment Management Strategy included an action plan with an annual target of sediment removal of 50,000m<sup>3</sup> in order to reduce the backlog.
- 1.2 The Sediment Management Strategy introduced waterways specifications (ideal navigation cross sections) and these are compared to hydrographic survey data to assess the distribution and total volume of accumulated sediment. The first complete hydrographic survey was undertaken in 2005 and since then regular surveys have been undertaken on a programme to cover the entire navigation area within a 5 year period.
- 1.3 Since 2007 the officers have had the opportunity to review data from repeated surveys to monitor progress and identify where improvement has been needed.
- 1.4 In April 2014 a new methodology for assessing waterway specification compliance was proposed and supported by the Navigation Committee. This involved changing from an assessment of regular cross sections to comparing the entire surface areas of the surveyed river bed with the specification profile. Also this included assessing the volume and distribution of 'economically dredgable' sediment along with that which is simply non-compliant. 'Economically dredgable' refers to sediment which has accumulated at least 300mm depth within the specification profile and this is an amount that can be removed efficiently by conventional dredging equipment.
- 1.5 Other improvements have been made to the method of surveying to gain better coverage and also to the modelling of the data particularly to more accurately define the river edge.

## 2 Hydrographic Surveys

- 2.1 Hydrographic surveys are programmed to cover one main river system each winter and to include localised pre and post dredge surveys as required. The following table shows record of main river surveys undertaken to date.

	Last Surveyed	Previous survey
<b>Ant</b>	2013	2009
<b>Bure</b>	2016	2011
<b>Chet</b>	2015	2013
<b>Thurne</b>	2013	2006
<b>Waveney</b>	2015	2009
<b>Yare</b>	2014	2009

Table 1: Hydrographic survey dates

- 2.2 The survey work is generally undertaken in the winter months when aquatic plants and boat traffic are at a minimum.

## 3 Waterway specification compliance summary

- 3.1 Table 2 summarises the waterway specification compliance assessment based on the latest available hydrographic survey data.

	Non-Compliant Volume (m3)	Economically Dredgable Volume (m3)	Non-compliant bed area (%)	Economically Dredgable bed area (%)
<b>Ant</b>	145,558	101,418	53%	20%
<b>Bure</b>	256,031	202,284	33%	16%
<b>Chet</b>	10,469	7,205	47%	18%
<b>Thurne</b>	421,066	268,092	81%	16%
<b>Waveney</b>	141,390	112,189	17%	5%
<b>Yare</b>	239,657	221,787	17%	12%
<b>TOTAL</b>	<b>1,214,170</b>	<b>912,975</b>	<b>41%</b>	<b>15%</b>

Table 2: Waterway specification compliance summary 2017

- 3.2 These figures show that there is an estimated 1.2 million cubic metres of accumulated sediment within specification depths of the Broads waterways. Of this approximately 900,000 cubic metres is a significant accumulation that is considered to be economically dredgable.
- 3.3 Compliance figures were last reported using the same methodology in 2014. The total sediment volumes from the most recent data are higher than the volumes calculated and reported in 2014. Officers have investigated this and can report that the increase is largely due to improvements in data accuracy rather than physical changes in the waterways. Since 2010 more accurate surveys have given a better representation of sediment levels particularly in

some of the shallowest areas. The following table provides a comparison of the compliance summaries from 2017 and 2014.

	Non-Compliant Volume (m3)		Economically Dredgable Volume (m3)		Non-compliant bed area (%)		Economically Dredgable bed area (%)	
	2014	2017	2014	2017	2014	2017	2014	2017
<b>Ant</b>	144,669	145,558	101,614	101,418	53%	53%	20%	20%
<b>Bure</b>	242,048	256,031	199,689	202,284	29%	33%	15%	16%
<b>Chet</b>	11,953	10,469	10,019	7,205	38%	47%	23%	18%
<b>Thurne</b>	423,549	421,066	276,075	268,092	80%	81%	35%	16%
<b>Waveney</b>	79,448	141,390	65,949	112,189	8%	17%	4%	5%
<b>Yare</b>	135,874	239,657	115,605	221,787	14%	17%	7%	12%
<b>TOTAL</b>	<b>1,037,541</b>	<b>1,214,170</b>	<b>768,952</b>	<b>912,975</b>	<b>37%</b>	<b>41%</b>	<b>17%</b>	<b>15%</b>

Table 3: Comparison of 2017 and 2014 Waterway specification compliance

3.4 The most significant differences in estimated sediment volumes are those for the rivers Yare and Waveney. For these rivers the 2014 assessment was based on survey data from 2009 and some localised areas 2006, which had a very low density of data points. The most recent surveys undertaken on these rivers (2014 and 2015) have provided a much better coverage of data points and therefore a much more accurate assessment of the sediment volumes, as illustrated in the figure below for Rockland Broad.

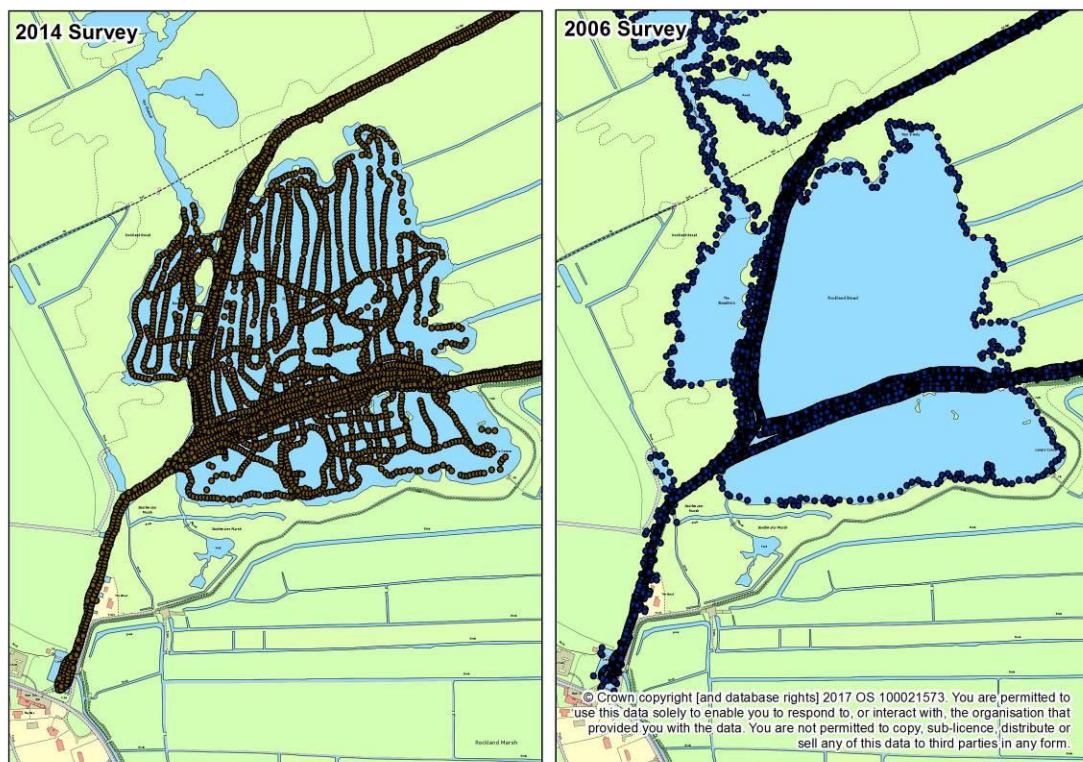
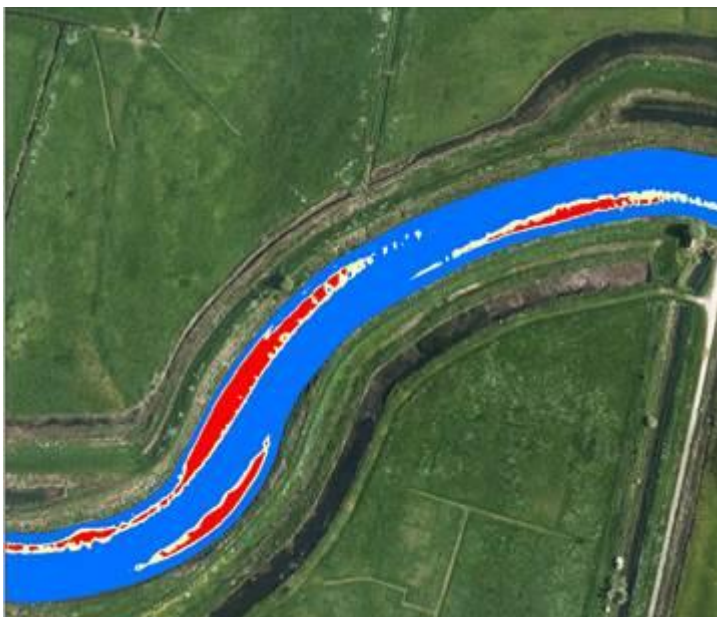


Figure 1: Distribution of survey points in Rockland Broad 2014 and 2006

- 3.5 For the example of Rockland Broad, the estimated total non-compliant volume outside the channel based on 2006 survey data was 49,164m<sup>3</sup>. With a greater coverage the 2014 survey data indicates a non-compliant volume of 122,129m<sup>3</sup>.
- 3.6 The most reliable comparisons between the 2014 and 2017 assessments can be made for the rivers Chet and Bure. Both of these rivers had comprehensive surveys to the Broads Authorities specification both before and since 2014.
- 3.7 The assessment of the River Chet shows a reduction in sediment volumes and the percentage of the bed with significant accumulations since 2014. With recent dredging work covering a significant proportion of this river this is an expected improvement. The Chet however has a high siltation rate so further work is planned.
- 3.8 The assessment of the River Bure indicates sediment volumes and non-compliant bed areas have increased slightly since the last survey was undertaken in 2011. Relative to the size of the Bure navigation the increase in assessed sediment volumes is not significant. However, the Authority has removed approximately 146,000m<sup>3</sup> of sediment through dredging since the 2011 survey; therefore a significant reduction in the non-compliant volume was expected.
- 3.9 Confidence in the survey and the modelling of the Bure data is good, as this is routinely verified by manual checks. Confidence is also good in the accuracy of dredging, as this is checked manually and picked up by pre-and post-dredge surveys. The following figures provide a good illustration of our well targeted dredging on the Bure, with red and white areas indicating non-compliance.



*Figure 2: Pre dredge survey, River Bure near Doles Pump*



*Figure 3: Aerial showing dredger on site, River Bure near Doles Pump*



*Figure 4: Post dredge survey, River Bure near Doles Pump*

- 3.10 It is likely that the River Bure, particularly the lower reaches, has a very high siltation rate and that the general balance of inputs and outputs as suggested by the Cranfield University study (as stated in the Sediment Management Strategy) do not fit the River Bure. To understand the sediment dynamics for the River Bure and elsewhere would require further work. However, through our work on the ground we can clearly see the effectiveness of our dredging and have some understanding of return periods. For example between 2011 and 2014 the Authority removed approximately 60,000m<sup>3</sup> of sediment from the lower Bure and we are currently returning to dredge some of the same bends.
- 3.11 The River Ant does not give a good basis for comparison as the 2014 and 2017 assessments are essentially based on the same data.

3.12 The assessment of the River Thurne is also predominantly based on the same data as in 2014; however there has been a reduction in the non-compliant volumes picked up by post-dredge surveys following recent dredging work on Hickling and also there have been a more accurate survey undertaken of Horsey Mere since 2014.

#### 4 Future dredging programme

4.1 Analysis of the hydrographic survey data enables a detailed assessment of the dredging requirements in individual management units to be undertaken to the extent that precise areas and quantities of economically removable sediment can be identified.

4.2 However, Waterway Specification Compliance is not the sole deciding factor in determining where dredging operations should be programmed. Issues such as availability of disposal sites, the level and type of boat use in particular areas, the cost of sediment removal per cubic metre and unresolved safety incidents are also considered by officers in developing the future dredging programme. Table 4 sets out the proposed dredging programme for the financial year 2018/19.

Dredge Area	Estimated volume (m <sup>3</sup> )
<b>River Bure</b> Three Mile House to Marina Keys	8,000
<b>River Bure</b> Marina Keys to bure Mouth (Plough dredging)	10,000
<b>River Bure</b> Horning	2,000
<b>River Bure</b> Belaugh to Coltishall	6,000
<b>River Waveney</b> Near Short Dam Level	6,000
<b>River Waveney</b> Near Stanley Carrs	5,000
<b>River Chet</b> Pyes Mill to Loddon	4,000
<b>Waxham Cut</b>	9,000
<b>TOTAL</b>	50,000

*Table 4 Proposed Dredging Programme for 2018/19*

#### 5 Conclusions

5.1 The following conclusions can be drawn from analysis of the most recent hydrographic data and comparisons with figures reported in 2014:

1. Surveys undertaken before 2010 did not gather sufficient data to provide an accurate assessment of sediment volumes. All navigation areas have now been surveyed more accurately.
2. Reliable comparisons cannot be made of 2014 and 2017 estimated sediment volumes for the rivers Yare and Waveney. For these rivers, data available in 2014 was from surveys undertaken before 2010.
3. Reliable comparisons can be made of 2014 and 2017 estimated sediment volumes for the rivers Bure and Chet where full accurate surveys have been repeated.
4. The mapping of hydrographic data has provided an extremely useful tool enabling very well targeted dredging which is removing hazardous shoals in priority areas.
5. Comparable volume calculations may suggest a higher siltation rate than assumed in the Sediment Management Strategy.

5.2 As can be seen from Table 4 the proposed dredging programme for 2018/19 will achieve the Authority's manageable target of removing 50,000m<sup>3</sup>. The ongoing programme of hydrographic survey and modelling will continue to provide more accurate and comparable information which officers can use to accurately target and monitor the Authority's dredging activities. Members' comments are welcomed.

Background papers: Sediment Management Strategy 2007

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Broads Plan Objectives: NA1

Appendices: None