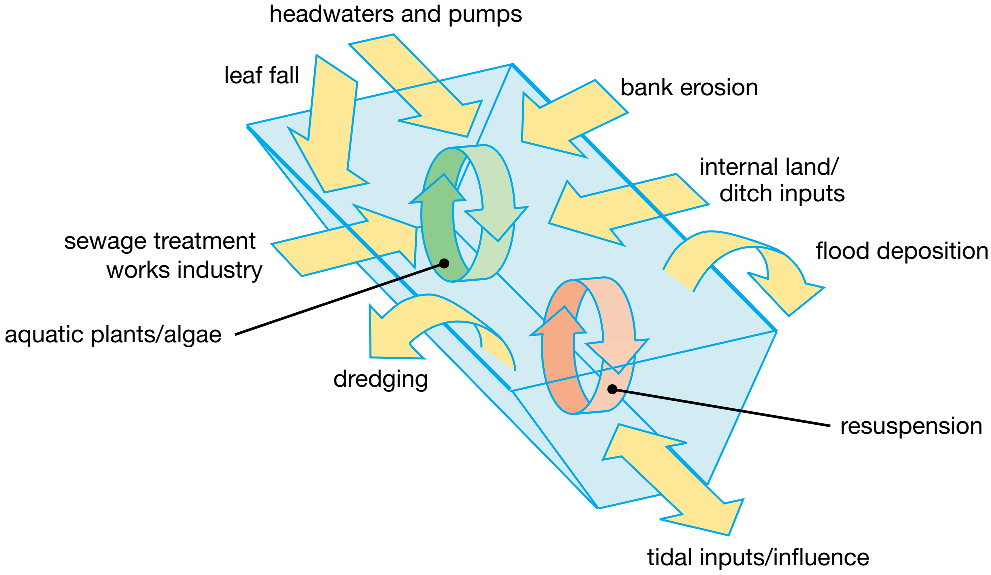
3 Baseline data

3.1 Sediment input/sources/processes

A ‘Desk based study of the Sediment Inputs to the Broads Catchment’ has been completed by Cranfield University on behalf of the Broads Authority (Executive summary at Appendix 3). This work began by identifying a conceptual model of sediment inputs, processes and outputs (Figure 3).

Figure 3
Sediment inputs, outputs and processes model
Cranfield University, SEA Environmental Decisions Ltd



Main sediment inputs

For ease of assessment the Broads area was split into management units (Appendix 4). Sediment inputs vary between each unit dependent upon the processes operating across the river catchment. Across the catchment, the dominant sediment inputs are from headwaters (mainly from agricultural sources), highways, and bank erosion (Figure 4), with the balance varying across time and space.

In the case of the headwater inputs, the conclusions of the desk based study provide the Authority with a clear justification for its support of land management policies and initiatives, such as Catchment Sensitive Farming and Environmental Stewardship schemes. Through their aims to tackle diffuse pollution, these help to improve water quality and reduce the level of sediment entering the system.

Bank erosion is a key sediment source that was recognised following investigations in the 1980s (Hey et al) and, whilst many initiatives have been undertaken by the Authority in the past (for example the introduction of Speed Limit byelaws to reduce wash), further measures including enforcement patrols and speed limit compliance monitoring are identified. Erosion protection measures have also been installed over extensive areas, and scrub clearance and riverbank restoration programmes have been carried out with the support of landowners. All of these are important to prevent bank erosion and consequently reduce sediment inputs. Source control options are discussed further in Section 7.

Bank erosion

Broads Authority

Figure 4
A summary of estimated annual sediment sources and losses
Cranfield University, SEA Environmental Decisions Ltd, Broads Authority, Great Yarmouth Port Authority

		cubic metres
Inputs (maximum)	Headwaters	12,000
	Internal catchment	800
	Ochre - Upper Thurne	640
	Bank erosion	9,280
	Tidal inputs	Unknown
	Algae and plants	Unknown
	STW	1,256
	Industry	360
	Total maximum inputs	**24,300**
Outputs (maximum)	Dredging 2002-06	-42,500
	Tidal output	Unknown
Deposition in the Broads[1] (indicator)		16,931

[1] Sediment deposition, measured from sediment cores, indicates sedimentation rates in broads. Deposition is similar to inputs providing further support for these estimated input rates.

Figure 4 indicates the relative importance of the current estimated annual sediment inputs (White et al, 2006). Sediment derived from headwater areas and bank erosion appear to be the major sources, although the magnitude of tidal and algal inputs is currently unknown. Sediment deposition, measured from sediment cores, in broads connected to the river network indicates lower sedimentation than estimated total sediment input rates. This is expected as river channel sedimentation is not included in the deposition estimate. However, the comparable rates of sedimentation and inputs support the validity of these estimates.

Throughout the Broads system sediment has been accumulating at a rate far in excess of natural sedimentation for at least the past 100 years. Nutrient enrichment, changes in agricultural practices, intensive boating activity in the mid-late 20th century and the decline in traditional bankside management, have all resulted in a backlog of sediment to be removed.

Sediment outputs

The dredging output volume has been prepared from a review of the last 50 years of dredging records and current programmes. These show that current dredging (approximately 42,500 m^3 for 2006, 1989-2006 average of 46,000 m^3 per year)) is exceeding maximum sediment annual inputs of 24,000 m^3. However, the backlog of sediment still contained within the system means that enhanced levels of dredging will need to be continued until such time as the backlog is cleared (see Section 6) and a balance between inputs and outputs is restored.

Whereas dredging volumes are assessed, this study does not attempt to quantify tidal outputs. Sediment movement within estuaries is complex and there is no sediment transport model available for the Broads. In any event, sediment movement is likely to be episodic, relying on increased energy through storms or surge tides.

Conclusion

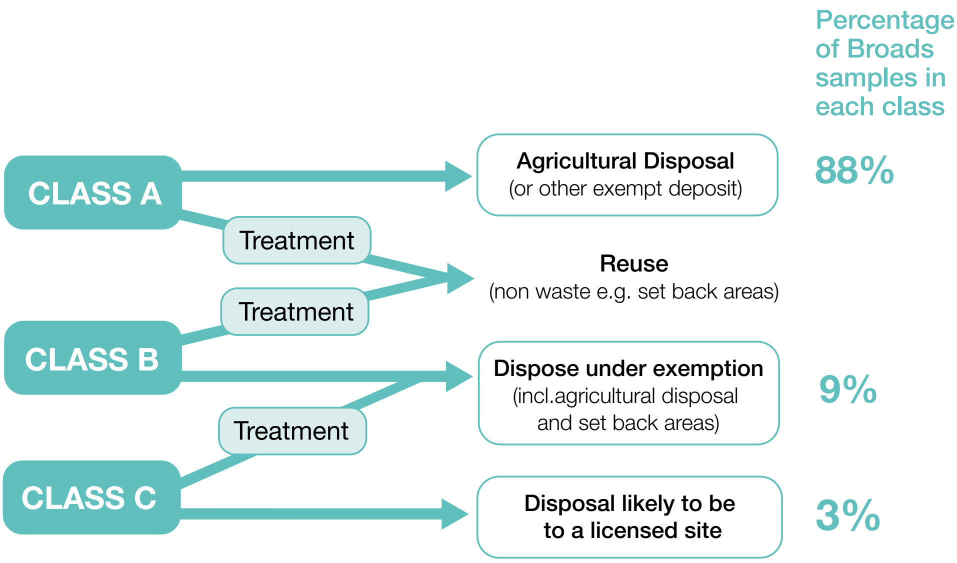
Overall, the range of semi-quantative sediment inputs and outputs indicates that the objective to balance sediment inputs by outputs should be achievable and is currently exceeded. The major barrier to delivery of Waterway Specifications is the existing accumulated sediment already within the system.

3.2 Sediment characterisation survey

The sediment characterisation survey was undertaken in 2004. A total of 66 samples were taken at approximately 2 km intervals throughout the Broads representing a wide range of bed materials (see Figure 6). The samples were analysed for contaminants, nutrients and physical characteristics. More recent survey information is routinely updated into the Sediment Characterisation database.

In the future, material may need to be resampled in order to accurately characterise it as inert, non-hazardous or hazardous waste. In addition, due to expected changes in the legislation, the A, B, C classification and the disposal routes shown in Figure 5 may no longer be appropriate (Beckwith 1998).

Figure 5
Percentages of Broads sediment within sediment quality classes, as developed by British Waterways, and likely disposal routes for these classes

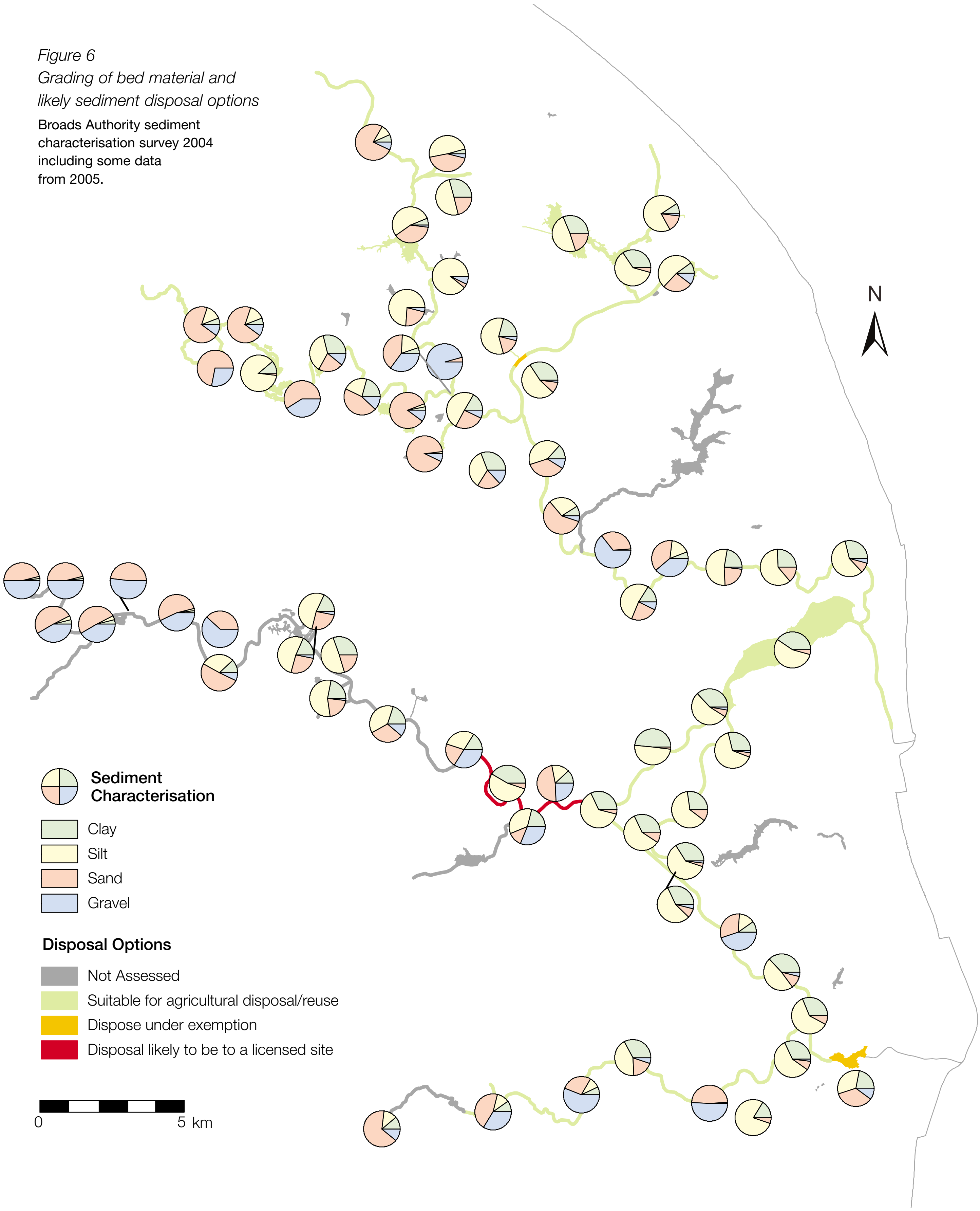


Spreading dredgings to agricultural land at Hickling

ADAS

Figure 6
Grading of bed material and likely sediment disposal options

Broads Authority sediment characterisation survey 2004 including some data from 2005.



3.3 Hydrographic survey

[1] BESL - Broadland Environmental Services Ltd

In order to assess the current condition of the rivers and broads, a complete hydrographic survey of the area was undertaken for the first time during 2005. The works were completed by BESL[1] using boat mounted transducers (Appendix 5) and have been used to provide a baseline condition for comparison with future monitoring surveys.

The depths of isolated waterbodies have been separately assessed using various techniques, including hydrographic survey (Trinity Broads and Fritton Lake undertaken by Northumbrian Water in 2006), lead line (Barnby, Little, Upton Little Broads commissioned by the Broads Authority in 2005-06) and expert knowledge from site managers and owners. These data are not complete for all isolated waterbodies and will be updated as further surveys are undertaken.

Repeat surveys will be completed, with one river valley completed annually, programmed over a 5-year period to cover the entire system. The information will be used to update the Removal Tables (Action Plan), provide monitoring for waterway specification (Section 4) compliance and discharge the Broads Authority obligations under the Broads Safety Management System hydrographic surveying policy.

BESL