upstream pool depth. The goal should be for restoration of natural processes wherever possible.

## 7.2 A classification of management options for the River Wensum

Table 6.2 provides a reach by reach classification according to the criteria outlined in Figures 6.1 and 6.2. The classification has been checked against an independent classification in the River Wensum fluvial audit, and further verified by assessment against another independent dataset, and against expert assessment of the field photographs. The classification process is able to distinguish natural to modified reaches, verified from three different sources. The MCA analysis should not be seen as static, but should be modified as more information is generated, and can be subject to expert consultation and modification. Thus the weightings and values can be changed according to new or local knowledge in order to fit the classification more closely to the river catchment under study. The weightings chosen are based on expert geomorphologists' experience in the absence of statistically valid relationships between the variables to define weights.

Options for restoration are also given in Table 6.2. These are based on an assessment of the main contributory indices to the naturalness scores and modification scores. Each reach was also checked against the photographs and map-based information on the GIS. The reach status and reach management classes are provided in map formats in Maps 1-3 (Naturalness and Modification) and Maps 1-3 (Reach management type) and all the data are accessible as a layer within the GIS (Appendix 3).

The options for restoration are broad and do not define the precise methods and techniques for activities, such as restoration, levels for weir reduction, timescales for reduced maintenance; these are beyond the scope of this report. A separate design specification programme is needed to establish the appropriate approaches for each site. Where the strategy is examined by the ECON (1999) report this should be referred to directly and the details of these proposals are not repeated in this document. The ECON report, with considered the river from the perspective of fisheries, contains extensive rehabilitation information and summary data on the state of the Wensum. The current survey does not attempt to establish a programme of work or a specific plan for any of the proposed restoration options, which is beyond the scope of the fluvial audit. However, when considered together with the GIS, Table 6.2 provides a basis for developing more detailed schemes.

The prioritising of the restoration options should be guided by catchment scale requirements:

1) Establish a programme for treating the sediment ingress problems identified by this report prior to any physical habitat restoration/rehabilitation or enhancements except where these form part of the sediment source control.
2) Set in place a condition monitoring plan for all semi-natural/natural and recovering reaches.
3) Prioritise the restoration/rehabilitation/enhancement on the basis of linking existing natural/semi-natural reaches first.
4) Seek to improve those reaches closest to semi-natural conditions.
5) Work from upstream to downstream within the catchment. The modelling study supports the option for upstream restoration reducing flood peaks in the lower reaches through attenuation of the hydrograph. Furthermore, as upstream reaches improve, the drift of biota will help colonise the downstream reaches.

6) The removal of mill weirs without the modification of the upstream channel will lead eventually to a narrow channel set within a wider flood channel – a 2-stage channel in effect. There is concern that this might decrease flood travel times. Modelling of the proposed removal of mill structures would be necessary. The restoration options therefore include re-instatement of former channel dimensions and bed levels to retain floodplain functionality. Removal of mill weirs without the modification of the upstream channel may also impact adversely on floodplain habitats/biodiversity.

In terms of the prioritisation of restoration options, it is suggested that semi-natural sections should be targeted first, through linking natural and semi-natural reaches.

Some of the restoration and rehabilitation options are dependent on other actions upstream, either to provide the materials or to ensure that actions are sustainable and will not be adversely impacted from upstream. For example, reaches W304 – W307 are dependent on the weir removal and the proposed actions in reach W51 are dependant on the actions for W50. These issues of dependency are most common where the proposed option is to reduce or remove mill structures and sluices. These dependencies are described within Table 6.2.

The artificial surface drainage networks are cited as a major route of sediment ingress to the main channel, and this should be addressed prior to any physical in-channel works taking place. However, the sustainable land management measures that need to be put in place to address catchment sediment run-off may only be addressed over a longer timescale. Physical restoration objectives will not be met if the silt runoff, supplying tonnes of sediment per storm, are not addressed first. Mitigation is linked to ingress points throughout the system therefore interim measure of silt traps upstream of the ingress points into the river (short term) together with land-use zoning (longer term) are necessary.

The options reported in Table 6.2 and within the GIS are given in order to return the river to a geomorphologically functioning groundwater dominated stream habitat, characteristic of the geographical location. They do not take into account landscape/cultural aspects, neither do they account for any particular set of biota or stakeholder interests. These should be negotiated locally using the outputs of this report to guide the discussions where appropriate. As such there is a conscious effort not to consider mill weirs as constraints on the vision but simply to identify what is necessary to get the Wensum back into favourable condition in terms of physical processes. The options have implications for flood protection, land drainage, floodplain biodiversity and existing instream habitats that should be debated locally. Importantly, the fine-sediment dominated geomorphological regime within the system results in higher levels of active process-based restoration and form mimicry, in recognition that the processes and sediment supply required to replace the gravels and associated morphology are no longer functioning.

It is important that the effect of any proposals on farmland in the Broads ESA and in relation to other agri-environment schemes are taken into account, together with the effect on water levels in the river and floodplain and established land use. There is also the issue of the potential instability of mill structures/buildings once the ground is allowed to dry out around them. The subsequent damage to weakened structures caused by periodic flooding could be significant, as could the downstream damage caused by flood flow debris.

**Use of the natural channel descriptions in Appendix 2**

The two tables created from the review of scientific and RHS data may be used to support restoration design plans. However it is recommended that specific options are carefully considered and appropriate use made of expert advice on the ground.

**Woody debris and wooded riparian margins**

The review of natural groundwater dominated rivers with low gradients provides targets for restoration. These have been applied within the multi-criteria analysis and are reflected in the options for management. A key missing element and a major cause of excessive weed growth in the channel is the lack of shading provided by a wooded riparian margin. Linked to this is the lack of recruitment of woody debris in the River Wensum – partially due to its removal as part of routine maintenance. This is known to be a major source of habitat diversity in semi-natural chalk stream and rivers, and works to suppress excessive weed growth. Coarse or large woody debris in the form of trees falling into the channel create major increases in physical habitat diversity (German & Sear 2003). However there are legitimate concerns in terms of flood risk management. Clearly, some debris management will still be necessary and retention of coarse woody debris limited to reaches where overbank flooding is both possible and desirable.

Tree lined riparian corridors in natural chalk streams and lowland rivers typically have patches created by tree fall or where locally waterlogged conditions preclude tree growth. These create gaps where light can penetrate the channel (See Figure 6.4). Thus the vision for the riparian corridor under natural conditions is one where excessive macrophyte growth is suppressed, and instead occurs in patches where sufficient light is available. Management of dense wooded sections is envisaged in order to provide a patchwork of light and shade. Active rehabilitation is envisaged to recreate natural channel dimensions prior to riparian woodland development. Thus an important management phase will be during the transition from open, light-dominated channels to shaded, patchy light under a wooded riparian margin.

**Figure 6.4** Woody debris and macrophyte patches in groundwater dominated chalk streams (a) Bere Stream, Dorset and b) Large Spring River, Oregon (photo courtesy of D.Reiser).

The use of woody debris rather than cut timber for the enhancement of chalk streams and rivers is based on the greater diversity benefits provided by the complex structures fallen trees create (German & Sear 2003; Kondolf and others 2003). Where woody debris structures are considered inappropriate or unacceptable for reasons of flood risk management (eg downstream of Fakenham Mill), then simpler fixed log structures could be used that offer lower hydraulic resistance and are immobile. Where debris mobility is considered to represent a flood risk (eg in reaches immediately upstream of bridges and mill structures) then the debris could be fixed in place.

**Channel dimensions**

An important aspect of restoration and rehabilitation projects is the design of the channel dimensions. Two main options are available for the Wensum:

1) Use, wherever possible, locally derived dimensions based on abandoned channels, but note that where these form part of the drainage network, they are likely to have been modified by maintenance and should not be used in these cases.
2) Use of regional regime equations based on semi-natural Norfolk streams draining similar geology and with similar gradients. A guide to these has been undertaken as part of this study, based on data sets provided by Prof Adrian Harvey (1967) and Stephanie Goff (Newson Pers comm.). The equations presented in Figure 6.5 can be used to provide design guidance for the basic dimensions of the bankfull channel. Note that this dataset should be locally augmented by deriving cross-sections from old (unmodified) channels.

The specification of these design criteria (dimensions of the channels) at a site specific level is beyond the scope of this report.

**Mill weir modifications**

Modifications to the grade controls are a major potential route to changing the slope of the channel and reducing the level of ponding upstream of these structures, many of which are no longer functional. For Costessey Mill (W57), Lenwade Mill (W302, W303), Mill Street (W357), Swanton Morley (W405), Bintree Mill (W513), Fakenham Mill (W564) and Sculthorpe Mill (W571) the advice is to reduce or look at options to reduce the level of the mill sluice. At other mill structures the advice is to remove them eg Hellesdon (W50) Taverham (W200) and North Elmham (W501 & W515). There is a proposal to bypass Great Ryburgh Mill (W556). The rationale for these differing approaches is based on the likely gains to the morphology from the removal or modification of the structures. For a number of reaches the indicative restoration option is to partially remove sluices or weirs, although ideally the whole structure would be removed. Partial removal simply reflects the reality of the site concerned.

**Monitoring**

In circumstances where the channel is predominantly natural or semi-natural and modifications are low the proposed actions are generally to protect or conserve and to initiate monitoring. The monitoring programme might reflect the nature of the survey that has been undertaken to date within the fluvial audit, with periodic resurvey (5 yearly) to assess changes to the sediment regime and the condition of the bed sediments.

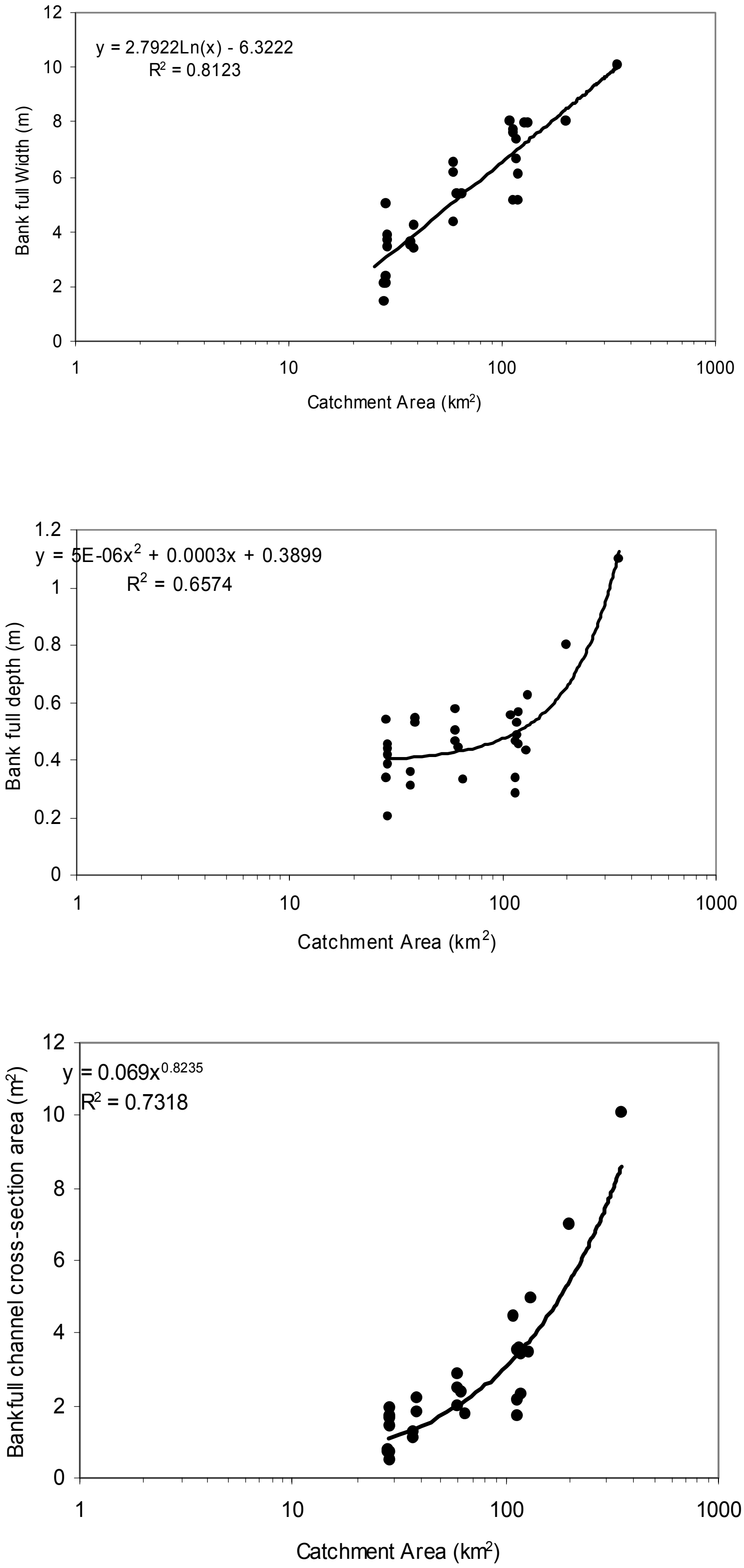


**Figure 6.5** Regime equations for semi-natural Norfolk groundwater streams.

**Table 6.2** Classification of reaches on the River Wensum. Restoration options are given along with the sediment source and sediment sink scores. Data is visualised in Maps 1-3 (Naturalness and Modification) and Maps 1-3 (Reach management type) and as a layer in the GIS (Appendix 3). The reaches go from upstream to downstream in sequence. ORSU (Off River Spawning Unit) is a fisheries term referring to a backwater that supports fish fry in floods. CWD (Coarse Woody Debris). See section 5.3 for explanation of the sediment source and sink scores.

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| **Langor Drain** | | | | | | | |
| W1080 | Damaged | Restoration | Fix sediment ingress points. | 68.25 | 0 | 45 | 45 |
| W9999 | | | No access. | 16.5 | 0 | | |
| W1081 | Damaged | Restoration | Fix sediment ingress points. Augment bed levels with gravels. | 68.25 | 8 | 45 | 45 |
| W1082 | Damaged | Assist natural recovery | Augment bed levels with gravels. | 45.75 | 0 | 18 | 9 |
| W1083 | Damaged | Assist natural recovery | Restore sinuous planform using upstream reaches as analogues. Re-establish wooded riparian margins and augment bed with gravels. | 45.75 | 0 | 18 | 9 |
| W1084 | Damaged | Restoration | Fix sediment ingress points. Engineer re-meandering of channel and augment bed with gravels. | 71.25 | 8 | 54 | 45 |
| **Guist Drain** | | | | | | | |
| W1070 | Damaged | Restoration | Fix sediment ingress points. | 62 | 8 | 45 | 45 |
| W1071 | Degraded | Enhancement | Fix sediment ingress points. Opportunity for Major channel restoration. Re-cut sinuous channel along former course or use downstream reach 1070 as analogue for planform. Restore gravel beds and woody debris to channel + wooded riparian margin. | 68.25 | 12 | 45 | 45 |
| **River Tat** | | | | | | | |
| W2005 | Severely degraded | Rehabilitation | Fix upstream sediment ingress points. Restore natural channel form by re-cutting a new course using local planform analogues and channel dimensions based on regional regression curves. Establish tree lined riparian margins to supply CWD and shade out macrophytes. Establish wet woodland on floodplain. | 51.75 | 18 | 22.5 | 28.5 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W2004 | Damaged | Assist natural recovery | Assist natural recovery – recruit CWD into suitable areas. Re-occupy course of old channel through Pynkney Park. Use old river course to provide dimensions for remaining site. Re-introduce gravels deposited on banks where dredgings exposed. | 24.75 | 0 | 9 | 9 |
| W2003 | Severely degraded | Rehabilitation | Fix sediment ingress to reach. Re-occupy old course of River Tat linking up to lower end of Reach 2004. Establish CWD recruitment and floodplain woodland. Link to reach 2002. | 23.5 | 16 | 45 | 45 |
| W2002 | Severely degraded | Rehabilitation | Fix sediment ingress to reach. Re-occupy old course of River Tat linking up to lower end of Reach 2003. Establish CWD recruitment and floodplain woodland. Link to reach 2001. | 61.25 | 16 | 45 | 45 |
| W2001 | Degraded | Rehabilitation | Re-establish bed levels relative to upstream old-channel using dredged gravels on banks. Re-establish channel dimensions based on upstream old channels. Re-establish wooded riparian margin to manage macrophytes and provide CWD recruitment. | 35.25 | 12 | 22.5 | 22.5 |
| W2000 | Recovering | Conserve and monitor | River Tat: Remove embankment from south bank and use material to restore cross-section profiles. Establish monitoring programme. Cessation of maintenance regime. | 24.75 | 16 | 18 | 9 |
| **River Wensum** | | | | | | | |
| W1064 | Degraded | Enhancement | Fix sediment ingress throughout upper reaches by establishing riparian buffers and wooded riparian corridor. Re-grade bank profiles to provide margins. Raise bed levels with gravel. Recruit CWD to enhance habitat diversity. Re-direct field drainage ditches into channel via reedbed filters. Potential to recreate channel line to original planform as shown in the aerial photographs. | 77.25 | 12 | 54 | 45 |
| W1063 | Damaged | Assist natural recovery | Fix sediment ingress points. Pump-out existing fine sediments through reach after upstream ingress points have been fixed. Re-introduce gravels from banks where present in dredged spoil to reduce river width. Recruit CWD in channel. Cessation of maintenance. | 39.5 | 8 | 31.5 | 22.5 |
| W1062 | Recovering | Assist natural recovery | Fix sediment ingress points. Recruit CWD into channel to create scour pools and riffles. Push in trees to establish patches of light. Cessation of maintenance. | 32.25 | 16 | 31.5 | 22.5 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W1061 | Severely degraded | Enhancement | Fix sediment ingress points. Remove conifer plantation and establish wet woodland. Re-cut meandering channel at higher level and utilize straight channel as ORSU. Push in trees to create habitat diversity and patches of light. | 68.25 | 16 | 54 | 45 |
| W1060 | Degraded | Enhancement | Fix sediment ingress points. Options constrained by irrigation reservoir. Use instream modifications to reduce channel width and raise bed levels where possible. Use of CWD to improve habitat diversity. | 73.25 | 12 | 45 | 45 |
| W1059 | Semi-natural | Protect and monitor | Cessation of maintenance. Initiate monitoring programme. | 28.5 | 0 | 18 | 9 |
| W1058 | Damaged | Assist natural recovery | Establish some shading and introduce some CWD to create scour pools. | 41.25 | 0 | 22.5 | 22.5 |
| W1057 | Damaged | Assist natural recovery | Channel is modified but retains a gravel bed. Establish some riparian woodland to provide shaded pockets. | 39.75 | 0 | 9 | 9 |
| W1056 | Damaged | Assist natural recovery | Fix sediment ingress point. Re-connect old-meanders and retain cut-off as ORSU. Increase bed elevations with gravels to connect to bed elevations upstream and downstream. See ECON 1999 report for detail. | 34.75 | 0 | 31.5 | 22.5 |
| W1055 | Damaged | Assist natural recovery | Fix sediment ingress point. Reduce maintenance regime. Encourage channel narrowing and woody debris recruitment. | 35.5 | 0 | 31.5 | 22.5 |
| W1054 | Degraded | Rehabilitation | Fix sediment ingress point. Reduce maintenance regime. Encourage channel narrowing and woody debris recruitment. | 60.25 | 12 | 55 | 45 |
| W1053 | Severely degraded | Rehabilitation | Fix sediment ingress point. Reduce maintenance regime. Encourage channel narrowing and woody debris recruitment using embankment material and thereby reconnect to floodplain. Raise bed elevations using dredgings where present. Reconnect old meander line, as shown on historic OS mapping. Use hard-bed dimensions from old meander and bed elevation to guide rehabilitation. | 57.25 | 16 | 45 | 45 |
| W1052 | Recovered | Conserve and monitor | Establish monitoring programme. Cessation of maintenance regime. | 23.5 | 16 | 22.5 | 22.5 |
| W1051 | Severely degraded | Rehabilitation | Fix sediment ingress points. Connect levels with reaches 1052 & 1050. | 49 | 16 | 45 | 45 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W1050 | Severely degraded | Rehabilitation | Fix sediment ingress point. Re-establish a smaller, higher level meandering channel. Use spoil to partially infill former course. | 51.75 | 16 | 32.5 | 28.5 |
| W1004 | Recovering | Assist natural recovery | Fix sediment ingress point. See Econ 1999 report for restoration options, which promote reconnection to line of old channel. | 30 | 8 | 32.5 | 22.5 |
| W1003 | Damaged | Restoration | Fix sediment ingress point. Re-cut new sinuous channel with appropriate dimensions and bed on valley gravels. Fill in the artificial channel. Establish riparian vegetation and wooded riparian margin. | 61.25 | 0 | 54 | 45 |
| W1002 | Recovering | Assist natural recovery | Look to restore channel dimensions and bed levels. Tie this in with mill weir restoration in reach 1000. | 27.5 | 16 | 22.5 | 22.5 |
| W1001 | Damaged | Restoration | Fix sediment ingress points. Dredge silts from ponded reach. Look at options for restoration of gravel bed if height of mill weir is reduced. | 61.25 | 0 | 45 | 45 |
| W1000 | Damaged | Assist natural recovery | Fix sediment ingress points. Dredge silts from ponded reach. Look at options for restoration of gravel bed if height of mill weir is reduced. | 27.5 | 8 | 31.5 | 22.5 |
| W571 | Degraded | Rehabilitation | Look at options for reducing the level of the mill weir as this provides benefits for upstream channel gradients and dimensions. Dredge silts from channel prior to removal or reduction in height of mill. | 49.75 | 12 | 19 | 9 |
| W570 | Recovering | Assist natural recovery | Use woody debris structures to create scour pools and enhance instream habitat. | 26.25 | 16 | 22.5 | 22.5 |
| W569 | Severely degraded | Rehabilitation | Fix sediment ingress points. Remove fine sediments. Reduce water levels by lowering levels at Fakenham Mill. Re-use dredged materials to restore bed elevation and reduce channel width. Use woody debris structures to enhance instream habitat. | 59.25 | 16 | 45 | 45 |
| W568 | Severely degraded | Enhancement | Fix sediment ingress points. Remove fine sediments. Reduce water levels by lowering levels at Fakenham Mill. Re-use dredged materials to restore bed elevation and reduce channel width. Use woody debris structures to enhance instream habitat. | 80.25 | 16 | 54 | 45 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W567 | Degraded | Rehabilitation | Fix sediment ingress points. Reduce water levels by lowering level at Fakenham Mill. Re-use dredged materials to restore bed elevation and reduce channel width. Re-occupation of the old meander has been undertaken within Sculthorpe Fen. See ECON 1999 report for details (Hempton Moor floodplain). Use woody debris structures to enhance instream habitat. | 36.75 | 16 | 31.5 | 22.5 |
| W566 | Degraded | Rehabilitation | Former mill pond of Gogg's Mill. Channel narrowed naturally since mill removed. Reduce water levels by lowering levels at Fakenham Mill. Re-use dredged materials to restore bed elevation and reduce channel width. Use woody debris structures to enhance instream habitat. | 41.75 | 16 | 22.5 | 22.5 |
| W565 | Degraded | Rehabilitation | Fix sediment ingress points. Reduce water levels by lowering levels at Fakenham Mill. Remove fine sediments. Use log structures to enhance in-stream habitat diversity. Re-use dredged materials to reduce channel width. | 35.25 | 16 | 41.5 | 22.5 |
| W564 | Recovering | Assist natural recovery | Fakenham Mill pond. Reduce water levels at mill structure/flume. Remove fine sediments. Use dredged materials to create low-flow channel within existing flood protection channel. Use fixed low level log structures to increase physical habitat diversity. | 31.75 | 16 | 14 | 9 |
| W563 | Degraded | Rehabilitation | Downstream scour pool of mill. Enhance channel margins. | 35.25 | 12 | 22.5 | 22.5 |
| W562 | Damaged | Assist natural recovery | Fix sediment ingress points. Gravel-augmentation to raise bed levels and use of dredgings to reduce channel width to create low-flow channel. Use of fixed log structures to enhance instream habitat. | 40.75 | 8 | 31.5 | 22.5 |
| W561 | Damaged | Assist natural recovery | Use of dredged material to formalize width reduction. Use of gravel dredgings to augment gravel bed. Use of in-stream woody debris structures to augment physical habitat. Reduce channel maintenance. | 36.75 | 8 | 22.5 | 22.5 |
| W560 | Damaged | Assist natural recovery | Reduce maintenance to encourage channel narrowing. Utilise dredgings to reduce channel width. Use of gravel dredgings to augment gravel bed levels. | 36.75 | 8 | 18 | 9 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W559 | Damaged | Assist natural recovery | Reduce maintenance to encourage channel narrowing. Utilise dredgings to reduce channel width. Use of instream debris structures near Pensthorpe to increase instream habitat diversity. | 36.75 | 8 | 22.5 | 22.5 |
| W9997 | | | No access. | 16.5 | 0 | | |
| W558 | Degraded | Rehabilitation | Fix sediment ingress points. Re-occupy former river course. Use dredged material to reduce channel width to match dimensions of old channel. Use gravel dredgings to raise bed levels. | 36.75 | 16 | 31.5 | 22.5 |
| W557 | Recovering | Assist natural recovery | Augment with gravels and reduce width using old dredgings where *Glyceria* beds and berms have formed. Work after downstream water levels have been established following restoration and by-pass of Great Ryburgh Mill. | 25.5 | 12 | 22.5 | 22.5 |
| W556 | Degraded | Rehabilitation | Fix sediment ingress points. Opportunity for substantial channel restoration around Gt Ryburgh Mill. Requires integration schemes on Reaches 553-556. Aim to recreate bed levels, channel dimensions and gravel-bed throughout the reach, based on bypassing Gt Ryburgh Mill, using levels in old channel in reach 553. Use of dredgings to reduce width. Use of dredged gravels to re-establish gravel bed. Use of old channel as design guide. Opportunity for floodplain restoration. Some flood protection constraints to be considered. Example of this type of restoration is the River Restoration Centre demonstration site on the River Cole. | 54 | 12 | 45 | 45 |
| W555 | Damaged | Restoration | Fix sediment ingress points. Re-cut former channel along old parish boundary to link up levels. | 62 | 8 | 45 | 45 |
| W554 | Recovering | Assist natural recovery | Re-cut channel to follow old course marked as a boundary. Connect levels with reaches 553 and 555. | 57.75 | 16 | 18 | 9 |
| W553 | Severely degraded | Rehabilitation | Fix sediment ingress points. Re-occupation of former channel upstream of Sennowe Bridge and connection through to reach 556 following the old parish boundary where this follows the former channel line. | 54 | 12 | 36.5 | 28.5 |
| W9998 | | | No access. | 16.5 | 0 | | |
| W552 | Degraded | Enhancement | Constrained by lakes – connection may have value ( see ECON 1999). Maintain low levels of maintenance. | 41.75 | 16 | 22.5 | 22.5 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W551 | Damaged | Enhancement | Fix sediment ingress points. Reduce ponding by reducing water levels at Bintree Mill. Channel narrowing using dredgings and formalizing existing narrowing by reeds Bed level raising using gravel dredgings where available. | 59.25 | 8 | 45 | 45 |
| W550 | Degraded | Rehabilitation | Fix sediment ingress points. Reduce ponding by reducing levels at Bintree Mill. Reconnect channel to reedbed on the floodplain by removing low dredging embankment and using material to narrow channel where *Glyceria* has already formed berms. Augment gravels using dredged gravel material. (see ECON 1999). Establish wooded riparian margin for CWD recruitment. | 59 | 12 | 45 | 51 |
| W513 | Degraded | Rehabilitation | Pump out/dredge silts from channel. Remove/reduce levels at Bintree Mill. Use dredgings to restore channel dimensions. Augment with gravels to restore bed elevation to match downstream and upstream floodplain gravel-levels. | 29.75 | 8 | 4.5 | 10.5 |
| W512 | Recovered | Conserve and monitor | Reduce dimensions of channel and tie into downstream bed elevations and upstream water levels following reduction in mill level. | 22.75 | 12 | 4.5 | 4.5 |
| W511 | Recovered | Conserve and monitor | Maintain as wet backwater. | 18.75 | 12 | 4.5 | 4.5 |
| W510 | Semi-natural | Protect and monitor | Develop and implement monitoring programme. Some opportunity to increase instream diversity through construction of woody debris structures. | 23.25 | 8 | 22.5 | 22.5 |
| W509 | Damaged | Rehabilitation | Fix sediment ingress points. Where present, use old dredgings to encourage narrowing of channel and enhance gravels to raise levels of river bed. Use of woody debris structures to enhance instream habitat. | 70.25 | 8 | 45 | 51 |
| W508 | Semi-natural | Protect and monitor | Develop and implement monitoring programme. | 24.75 | 8 | 4.5 | 10.5 |
| W507 | Degraded | Enhancement | Fix sediment ingress points. Installation of instream structures to enhance flow diversity. Channel narrowing. | 68.25 | 12 | 45 | 45 |
| W506 | Degraded | Rehabilitation | Fix sediment ingress points. Installation of instream structures to enhance flow diversity. Channel narrowing. | 65.25 | 12 | 45 | 51 |
| W505 | Degraded | Rehabilitation | Channel narrowing & gravel augmentation once mill weir removed. | 23.75 | 8 | 4.5 | 4.5 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W504 | Degraded | Rehabilitation | Channel narrowing & gravel augmentation once mill weir removed. | 28.25 | 8 | 22.5 | 22.5 |
| W503 | Degraded | Rehabilitation | Channel narrowing & gravel augmentation once mill weir removed. | 33.25 | 8 | 32.5 | 28.5 |
| W502 | Degraded | Rehabilitation | Channel narrowing & gravel augmentation once mill weir removed. Establish floodplain connectivity to support reedbed. | 33.75 | 8 | 9.5 | 10.5 |
| W515 | Damaged | Restoration | Fix sediment ingress points. Remove mill weir. | 59.25 | 8 | 45 | 45 |
| W501 | Degraded | Rehabilitation | Remove mill weir. | 40.25 | 0 | 22.5 | 22.5 |
| W500 | Damaged | Assist natural recovery | Gravel augmentation and assist narrowing. Reduce maintenance. | 29.75 | 8 | 22.5 | 22.5 |
| W407 | Recovering | Assist natural recovery | Formalise narrowing of the channel using dredgings from bank. Augment gravels to create run/riffle and raise water levels. Install woody debris structures to scour pools. Establish patchy wooded riparian margin. Important to monitor silt/sand input from Blackwater/Wendling beck. | 27.75 | 16 | 19 | 9 |
| W406 | Degraded | Rehabilitation | Improve in channel structure with wood structures. Augment gravels to form a run/riffle habitat with structures to create scour pools. | 39.75 | 12 | 22.5 | 22.5 |
| W405 | Degraded | Rehabilitation | Reduce level of weir. | 44.75 | 12 | 22.5 | 22.5 |
| W404 | Degraded | Rehabilitation | Fix sediment ingress points. Desilt river bed, while retaining existing gravels. Use dredgings to reduce channel width and establish emergent riparian communities. Establish patchy riparian woodland and debris recruitment. Augment bed levels by using dredged gravels from banks. Reduce low embankments (dredgings) so as to enable reconnection with the floodplain. | 64.25 | 12 | 45 | 45 |
| W403 | Damaged | Monitor | Establish monitoring programme. | 31.75 | 8 | 9 | 9 |
| W402 | Damaged | Monitor | Establish monitoring programme. | 30.75 | 8 | 9 | 9 |
| W401 | Damaged | Restoration | Fix sediment ingress points. Remove embankments and use material to narrow channel and raise bed elevations. Establish run/glide habitat. Use woody debris structures to establish scour pools and flow/morphological diversity. | 64.25 | 8 | 54 | 45 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W400 | Damaged | Restoration | Fix sediment ingress points. Remove embankments and use material to narrow channel and raise bed elevations. Desilt channel then establish run-glide habitat using gravel augmentation. Use woody debris structures to establish scour pools and flow/morphological diversity. Establish patchy wooded riparian margin. Use dimensions from old course of Wensum to inform design. Re-occupy old course (see ECON 1999). Ensure STW not discharging solids. | 64.25 | 8 | 50 | 45 |
| W359 | Damaged | Restoration | Fix sediment ingress points. Remove embankments and use material to narrow channel and raise bed elevations. Desilt channel then establish run-glide habitat using gravel augmentation. Use woody debris structures to establish scour pools and flow/morphological diversity. | 64.25 | 8 | 50 | 45 |
| W358 | Damaged | Restoration | Fix sediment ingress points. Restore former channel dimensions and re-establish gravel bed and former bed levels. | 76.25 | 8 | 55 | 45 |
| W357 | Damaged | Restoration | Fix sediment ingress points. Desilt reach. Reduce water levels at mill weir. Narrow channel and raise bed levels. Re-establish gravel bed through channel. Establish patchy wooded riparian corridor. | 68.25 | 8 | 55 | 45 |
| W356 | Damaged | Restoration | Remove sluice and associated structures. | 27.75 | 8 | 19 | 9 |
| W355 | Damaged | Restoration | Remove structures and permit to silt up as a backwater channel. | 85.25 | 8 | 45 | 45 |
| W354 | Recovered | Conserve and monitor | Remove Mill structures and monitor channel. | 22.75 | 12 | 4.5 | 4.5 |
| W351 | Degraded | Rehabilitation | Reduce channel width using old dredgings from the bank. Develop patchy wooded riparian margins. Augment channel bed levels with gravel. Install woody debris structures to enhance instream habitat. Reduce maintenance. Lower reach will benefit from removal of sluice structures on Lyng mill. | 29.75 | 8 | 4.5 | 10.5 |
| W310 | Degraded | Rehabilitation | Fix sediment ingress points. Monitor changes following sluice removal. | 23.25 | 12 | 36.5 | 22.5 |
| W309 | Damaged | Rehabilitation | Reduce width in lower reach and augment bed levels with gravel.<br>Encourage woody debris structures and establish patchy wooded riparian margin. | 48.75 | 12 | 9 | 9 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W308 | Damaged | Rehabilitation | Fix sediment ingress points. River requires narrowing and reduction in maintenance regime. Gravel bed could be replaced and woody debris structures installed to create habitat diversity. | 33.5 | 8 | 31.5 | 22.5 |
| W307 | Damaged | Rehabilitation | River requires narrowing and reduction in maintenance regime. Gravel bed could be replaced and woody debris structures installed to create habitat diversity (only relevant if Lenwade Mill level reduced). | 29.5 | 8 | 22.5 | 22.5 |
| W306 | Damaged | Restoration | Fix sediment ingress points. River requires narrowing and reduction in maintenance regime. Gravel bed could be replaced and woody debris structures installed to create habitat diversity (only relevant if Lenwade Mill level reduced). | 30.5 | 8 | 31.5 | 22.5 |
| W305 | Damaged | Assist natural recovery | River requires narrowing and reduction in maintenance regime. Gravel bed could be replaced and woody debris structures installed to create habitat diversity (only relevant if Lenwade Mill level reduced). | 53.75 | 0 | 22.5 | 22.5 |
| W304 | Damaged | Assist natural recovery | River requires narrowing and reduction in maintenance regime. Gravel bed could be replaced and woody debris structures installed to create habitat diversity (only relevant if Lenwade Mill level reduced). | 41.75 | 0 | 22.5 | 22.5 |
| W303 | Severely degraded | Rehabilitation | Fix sediment ingress points. Reduce level of Lenwade Mill sluice. Reduce maintenance. | 41.75 | 0 | 54 | 45 |
| W302 | Damaged | Assist natural recovery | Reduce level of Lenwade Mill sluice. Reduce maintenance. | 59.25 | 27 | 22.5 | 22.5 |
| W301 | Semi-natural | Protect and monitor | Fix sediment ingress points. Initiate monitoring. Replace fishery enhancement weirs with CWD structures. | 35.25 | 8 | 31.5 | 22.5 |
| W300 | Semi-Natural | Protect and monitor | Initiate monitoring – replace fishery enhancement weirs with debris structures. | 29.5 | 0 | 19 | 9 |
| W210 | Damaged | Assist natural recovery | Fix sediment ingress points. Establish riparian patchy wooded margin and reduce maintenance to allow woody debris to influence channel processes. | 36.75 | 0 | 32.5 | 22.5 |
| W209 | Semi-natural | Protect and monitor | Establish riparian patchy wooded margin and reduce maintenance to allow woody debris to influence channel processes. | 25.5 | 0 | 27.5 | 22.5 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W208 | Damaged | Assist natural recovery | Reduce maintenance regime to allow narrowing. Use downstream course as a guide to channel dimensions. Remove embankments. | 36.75 | 0 | 22.5 | 22.5 |
| W207 | Damaged | Assist natural recovery | Restore old course of Wensum along north bank downstream of Attlebridge following a boundary (refer to the GIS database). Use dimensions from old channel to narrow existing channel and retain as anastomosed (multi-channel) with wet woodland floodplain. Establish patchy wooded riparian margins. Remove embankments. | 39.75 | 0 | 22.5 | 22.5 |
| W206 | Damaged | Assist natural recovery | Narrow existing channel and raise bed levels using dredged materials where possible. Establish patchy wooded riparian margins. Option exists to create an anastomosed (multi-channel) river system along the possible former course of old River Wensum channels in the floodplain (refer to the GIS database). Remove embankments. | 39.75 | 8 | 22.5 | 22.5 |
| W205 | Semi-natural | Protect and monitor | Initiate monitoring. | 29.5 | 8 | 27.5 | 22.5 |
| W204 | Damaged | Assist natural recovery | Fix sediment ingress points. Remove embankments and narrow where possible. | 30.5 | 8 | 32.5 | 22.5 |
| W203 | Damaged | Assist natural recovery | Desilt reach. Narrow channel dimensions and augment gravel bed. Establish wet woodland /riparian margins (see ECON 1999) | 41.75 | 0 | 31.5 | 22.5 |
| W202 | Damaged | Assist natural recovery | Fix sediment ingress points. Desilt reach. Remove embankments, narrow channel and establish wet woodland on floodplain/riparian margins. Raise bed levels once mill level removed. (see ECON 1999) | 25.5 | 0 | 9 | 9 |
| W201 | Degraded | Rehabilitation | Fix sediment ingress points. Remove Taverham Mill Sluice. Augment gravel bed. | 40.75 | 27 | 32.5 | 22.5 |
| W200 | Damaged | Assist natural recovery | Fix sediment ingress points. Remove Taverham Mill sluice. Augment gravel bed. | 29.5 | 0 | 36.5 | 22.5 |
| W61 | Damaged | Assist natural recovery | Narrow channel using former dredgings. Augment bed levels with gravels. Establish patchy wooded riparian margin. | 36.75 | 0 | 27.5 | 22.5 |
| W60 | Damaged | Assist natural recovery | Desilt, narrow channel using former dredgings. Augment bed levels with gravels. Establish patchy wooded riparian margin. | 40.75 | 0 | 27.5 | 22.5 |
| W59 | Degraded | Rehabilitation | Desilt, narrow, remove embankments, augment bed levels. | 16.5 | 8 | 19 | 9 |

| Reach code | Reach satus | Reach Management Class | Indicative restoration options | Naturalness | Modification | Sediment source score | Sediment sink score |
|---|---|---|---|---|---|---|---|
| W58 | Degraded | Rehabilitation | Monitor changes with reduced mill weir levels. | 45.75 | 12 | 22.5 | 22.5 |
| W57 | Severely degraded | Rehabilitation | Reduce level of Costessey Mill weirs | 48.75 | 27 | 22.5 | 22.5 |
| W56 | Degraded | Rehabilitation | Fix sediment ingress points. Take action to narrow the dimensions of the channel. | 63.25 | 12 | 45 | 45 |
| W55 | Damaged | Restoration | Fix sediment ingress points. Take action to narrow the dimensions of the channel and augment gravel bed. Establish debris recruitment and wooded riparian margin. | 63.25 | 8 | 45 | 45 |
| W54 | Damaged | Restoration | Fix sediment ingress points. Take action to narrow the dimensions of the channel and augment gravel bed. Establish debris recruitment and wooded riparian margin. | 48 | 8 | 55 | 45 |
| W53 | Damaged | Restoration | Fix sediment ingress points. Take action to narrow the dimensions of the channel and augment gravel bed. Establish debris recruitment and wooded riparian margin. | 60 | 0 | 50 | 45 |
| W52 | Damaged | Restoration | Fix sediment ingress points. Take action to narrow the dimensions of the channel. with material derived from removal of embankments. Augment gravel bed to restore bed levels. | 68.25 | 8 | 45 | 45 |
| W51 | Damaged | Restoration | Fix sediment ingress points. Take action to narrow the dimensions of the channel with material derived from removal of embankments. | 68.25 | 0 | 45 | 45 |
| W50 | Damaged | Assist natural recovery | Desilting of reach. Removal of Hellesdon weir to drop water levels and narrowing of channel using embankment and dredging spoil. Re-establishment of riparian wooded margins. | 45.75 | 8 | 22.5 | 22.5 |

# 8 Conclusions

- The River Wensum geomorphology and gravel bed substrate are a relic of past geomorphological processes that are no longer operating at the same rate. The River Wensum is therefore highly sensitive to changes in morphology and substrate arising from human activity. The gravel bed is stable across all flows in most reaches except those that are artificially steepened (eg downstream of mill weirs). Natural development of pool-riffle sequences and meandering planforms with gravel point bars are therefore highly unlikely. Where they occur in a semi-natural or natural condition, the gravel bed and channel morphology are of high conservation status.
- The River Wensum no longer receives a significant supply of gravel. Removal of gravel from the river will not be replenished and is lost to the river. Fine sediment is mostly derived from catchment sources, with a limited contribution from bank erosion. The sand load is mobile throughout the river under flood conditions. As a result, input points of fine sediment can have long distance impacts.
- The gravel bed stores high levels of fine sediment which may be detrimental to ecological function. This results from a lack of natural gravel "flushing". Remediation through gravel jetting will release up to 950 kg of fine sediments per riffle into the downstream river.
- Fine sediment sources are largely produced from road and field runoff and disturbance of drainage ditches by maintenance. The road and ditch network should be viewed as an extension to the naturally low density drainage network and managed to reduce sediment ingress. Input is typically via the IDB drain network across the wide floodplain. Hence IDB maintenance, in part is, a result of field runoff. The possibility of creating sediment traps at the junction of the valley side and IDB drains is a potential option for sediment management. Sediment traps should not be necessary if land management is improved. In the long term they are not sustainable because they need regular maintenance and should only be recommended as a last resort. It is unlikely to be feasible to build one the size needed to hold back all silt from a severe storm event. It is unlikely that the system of IDB drains and the maintenance of the existing network are contributing to the *reduction* of fines actually reaching the river. The assumption is that these features were originally absent from the landscape. Hence they are a source of new fine sediments regardless (and in some cases especially) because of maintenance. Indeed, reduced maintenance would reduce the efficiency of these drains in delivering fines into the river network.
- Tributary streams are an important source of fines to the main Wensum. Management of sediment runoff into these is a priority.
- The need for management of weed growth in the Wensum is a result of high nutrient loads, over-widened or deepened morphology, fine sediment accumulation and lack of shade suppression. In many locations along the Wensum weed growth represents a process whereby fine sediment can be trapped and over time this can develop into a low level berm which functions like a floodplain within the over-widened channel. It is therefore a process of natural width adjustment. Long term management of the weed growth will only be achieved through encouragement of shading and reduction in ponding.

- Suppression of light by shading represents a method of controlling prolific weed growth in narrow channels such as the upper Wensum and is characteristic of the natural chalk stream riparian corridor.
- Large woody debris is an important missing element of the Wensum geomorphology. Woody debris creates local scour and habitat diversity. Local accumulations also increase channel:floodplain connectivity. At present woody debris is removed from the river and there is an absence of wooded riparian margins from which to recruit debris.
- A methodology has been developed for classifying the whole river in terms of condition relative to natural has been developed based on data provided by the scientific literature and River Habitat Survey. A new Multi-Criteria Analysis (MCA) approach has been developed to create indices of geomorphological function (sediment source, sediment sink), naturalness, and modification. This approach can be used as a decision support tool and method of stakeholder inclusion.
- The MCA analysis has demonstrated that only 18.9% of the total length of the River Wensum had no documented modification though this is likely to be an over-estimate.
- Table 6.2 and the accompanying Maps and GIS provide reach-based guidance on the form of management required to improve the condition of the River Wensum towards a more naturally functioning river in terms of geomorphological processes.

The prioritising of the restoration options should be guided by catchment scale requirements. These include:

- Establish a programme for treating the sediment ingress problems identified by this report prior to any physical habitat restoration/rehabilitation or enhancements except where these form part of the sediment source control.
- Set in place a condition monitoring plan for all semi-natural/natural and recovering reaches.
- Prioritise the restoration/rehabilitation/enhancement on the basis of linking existing natural/semi-natural reaches first.
- Seek to improve those reaches closest to semi-natural conditions.
- Work from upstream to downstream within the catchment in order to maximise flood protection benefits and to establish high quality biological drift downstream.

A key recommendation of this report is to support the Wensum Catchment Officer already appointed to investigate ways in which these sources and ingress points can be better managed to reduce fine sediment delivery into the River Wensum.

# 9 Further research

Three main areas of further research have been identified that would improve the quality of decision making on the River Wensum:

1. The scientific analysis of the semi-natural habitat and geomorphology of the River Wensum is based on relatively limited information. A key research requirement is to improve the accuracy of the conceptual model of the River Wensum, specifically

identifying the nature of the pre-modification habitats, channel morphology and substrates in more detail through a programme of palaeo-environmental research.

2. The output from this report has been hampered by a lack of data on sediment transport rates. Calibration of the turbidity records collected by Anglian Water at Costessey abstraction point would make possible an estimation of the variability of sediment load from the upper catchment over a longer timescale (possibly back to the1950's).

3. The very high levels of fine sediment stored within potential spawning gravels throughout the River Wensum raise questions about the quality of these habitats. A study to determine the oxygen supply potential within the gravels should be undertaken together with measurements of sedimentation rates. This would provide guidance on the habitat quality for spawning salmonids (sea trout and brown trout) as well as the efficacy of potential remediation works.

4. The MCA approach and its value for decision support and stakeholder engagement in river restoration have not been fully tested. The River Wensum MCA system could be used as a trial of the methodology.

5. The regional regression equations for estimating bankfull channel dimensions for natural conditions should be augmented by inclusion of measurements from former channels preserved in the Wensum floodplain.

6. It is recommended that a broad scale modelling exercise is undertaken to determine the impact of the proposed mill removals and channel cross-section reductions using the existing ISIS hydrological model. The study should focus on flood risk benefits.

7. A detailed sediment modelling exercise could be run using the existing hydraulic model to determine the impact of the proposed restoration options on sediment fluxes through the Wensum.

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# Appendix 1 River Wensum catchment sediment source and pathway assessment protocol

**Storm survey *(catchment sediment sources, pathways and characteristics*)**

An important element of this project will be the identification and quantitative assessment of fine sediment sources within the catchment and channel. From the experience of the field survey undertaken by GeoData on 28/29 September 2004 it is clear that many of these sources can be located and sampled during storm events. **It is proposed that a storm event monitoring survey be undertaken by EA/ IDB operatives following the protocol outlined below.** The approach is based on driving around the catchment of the Nar and Wensum during significant rainfall events between October and December 2004 and noting:

1) Where fine sediments are entering the river network (Record on 1:25000 map or GPS survey point).
2) Taking a digital photo of the entry point into the river network and source of the sediment.
3) **At point of entry into stream system** estimate the width and depth of flow, and estimate the velocity of the flow by timing the passage of a suitable float (leaf, stick) over a known distance (1 – 5 metres). This will be used to estimate an index of discharge.
4) **At point of entry into stream system** take a 250 – 500ml sample of water using a pre-washed polythene sample bottle (to be supplied by GeoData consortium) and recording on it the location, six figure National Grid Reference, time of sample, catchment, watercourse, source of sediment.
5) Mapping on a 1:25,000 scale map the route and source of the fines. This can be done by following the runoff route and sketching on the 1:25,000 map.
6) Sending the samples immediately for analysis, or keeping refrigerated until possible to send. Samples should be analysed for sediment concentration, particle size and if possible P, N and C content.

It is advised that during this period the officers / individuals involved should carry a set of pre-labelled bottles and the necessary equipment required in their vehicles so that sudden events can be sampled.

Examples of sources identified include:

- Road side verges and road runoff
- Pig farm units
- Runoff from arable and pasture fields
- Runoff from aggregate works
- Runoff from farm tracks.

In many instances the entry points and pathways of fine sediments from the catchment are discrete points although the sources are often diffuse. During a storm event, drive along the roads adjacent or crossing the river and floodplain, noting points where road, track, tributary or drain runoff is heavily laden with silt close to the floodplain boundary or river. Similarly, check field exits for evidence of sediment being transmitted onto the road and drain network and follow down to where it enters the stream.

Examples of a sediment input and source recorded during a heavy rain storm on 28 September 2004 in the Nar catchment are presented below. The concentration of the pig farm and farm track derived input was 9740 mg/l compared with 28 mg/l for the river. The second example is derived from the erosion of verges by traffic associated with an aggregate works. (Photos from Nar catchment)

The first picture is a fine sediment input from road verge erosion into the River Nar via the IDB Country Drain. The second picture illustrates a sediment runoff pathway down a farm track. The third photo illustrates a fine sediment input from a pig unit and road routeway near West Acre showing the highly concentrated plume during the rain event. The majority of fine material had been moved downstream and was present over 1 km of watercourse.

# Appendix 2 Criteria, scores and weightings used for MCA analysis

### Chalk stream and river MCA

| GIS field | Score field | Description | Source | Sink | Naturalness | Modif | Class[1] | Values from | To | Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Reach | | Unique reach code | | | | | | | | |
| SedBar | *scSedBar* | Barriers to sediment movement upstream | | | | | 0 | None | | 1 |
| | | | | | Y | | 1 | Minor | | |
| | | | | | | | 3 | Major | | |
| FineSedt | *scFineSed* | % fine sediment (silt and clay) | Y | Y | Y | | 1 | 0 | 4.9 | 4.5 |
| | | | | | | | 3 | 30 | 49.9 | |
| | | | | | | | 5 | 50 | 74.9 | |
| | | | | | | | 10 | 75 | 100 | |
| | | | | | | | 2 | 5 | 29.9 | |
| MinHeight | *scHeight* | Minimum bank height | | | Y | | 0 | 0 | 1 | 3 |
| | | | | | | | 1 | 1.1 | 1.3 | |
| | | | | | | | 3 | 1.4 | 100 | |
| WDRatio | *scWDRatio* | Width-depth ratio | | | Y | | 0 | 5 | 15.9 | 4 |
| | | | | | | | 1 | 16 | 24.9 | |
| | | | | | | | 3 | 0 | 4.9 | |
| | | | | | | | 3 | 25 | 1000 | |
| PlanMod | *scPlan* | Plan modification | | | Y | | 0 | Unmodified | | 3.75 |
| | | | | | | | 3 | Modified | | |
| FlowType | *scFlow* | Type of flow - glide, ponded, run | | | Y | | 0 | Run | | 2 |
| | | | | | | | 0 | Riffle | | |
| | | | | | | | 1 | Glide | | |
| | | | | | | | 5 | Ponded | | |
| PrpBrmAr | *scBerm* | Proportion of reach area that is covered by berms | | Y | Y | | 0 | 0 | 24.9 | 2 |
| | | | | | | | 3 | 25 | 10000 | |
| Modif | *scModif* | Modification level | | | | Y | 0 | 1 | | 4 |

[1] Class is the score allocated to the individual data field values (a within field value), weights are the relative influence of each field to the decision. (between field values).

| GIS field | Score field | Description | Source | Sink | Naturalness | Modif | Class[1] | Values from | To | Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2 | 2 | | |
| | | | | | | | 3 | 3 | | |
| | | | | | | | 4 | 4 | | |
| | | | | | | | 5 | 5 | | |
| PondPer | *scPond* | % ponded | | | | **Y** | 0 | 0 | 24.9 | 3 |
| | | | | | | | 5 | 25 | 100 | |
| Ingress | *scIngress* | No. of ingress points | **Y** | | | | 0 | 0 | | 3 |
| | | | | | | | 3 | 1 | | |
| | | | | | | | 3 | 2 | | |
| | | | | | | | 3 | 3 | | |
| BedVgPer | *scBedVeg* | Bed veg % | | | | **Y** | 0 | 0 | 79.9 | 2 |
| | | | | | | | 3 | 80 | 100 | |
| PpErsnLn | *scErosion* | Proportion of erosion by bank length | **Y** | | | | 0 | 0 | 4.9 | 5 |
| | | | | | | | 1 | 5 | 9.9 | |
| | | | | | | | 2 | 10 | 49.9 | |
| | | | | | | | 3 | 50 | 100 | |