3.0 - The Design

The following section will describe each component of the design, moving down stream, describing the benefits it will provide.

Detailed specifications follow in 4.0 Technical Specifications.

3.01Cattle Drink Riffle & Faggot Narrowing

It is proposed to concentrate the existing flow over the riffle by narrowing the channel on the LHB using faggot bundles obtained by coppicing / pollarding of riparian tree immediately downstream. A marginal shelf area will be created over of some 15m in length with a new bank line extending 3m into the channel. The top level of the shelf will be set at 10-15cm above mean summer water level. The area behind the faggots will be in-filled with trimmings from the coppicing to create a low energy environment, that will rapidly accumulate sediment, allowing colonisation with marginal water plants such as water forget-me-not *Myosotis scorpiodes*, and reed sweet flag *Glyceria maxima*. Experience on other rivers (River Allen & Avon) has shown that this type of marginal enhancement provides excellent refuge habitat for white-clawed crayfish and feeding opportunities for water voles.

In addition, the old cattle drink on the RHB will be excavated to create a new larger fenced drink. The drink will have a layer of silt excavated to a depth of 50cm which will be infilled with graded rejects. This will stop excess silt entering the channel and promote sustainable land use practices, as featured in the Environment Agency’s ‘Best farming Practices’ guide. This approached has been trailed on the Wensum at Bintry with great success. Not only does the technique cut-off a point source of siltation, but the cattle have access to a constant supply of clean, safe drinking water.

Photo 1: Existing Cattle drink
Photo 2: Example of cattle drink at Bintry on the River Wensum

The cattle drink will also provide a warm shallow fish fry refuge in the summer months. Spoil from the excavation will either be incorporated as backfill within the proposed LHB narrowing or disposed of outside the indicative floodplain. The slope of the drink could be constructed in such a way as to encourage winter flood flows onto the RHB ESA field, This increases storage capacity, and compensates for any reductions in channel capacity due to narrowing.

The existing riffle has been ‘concreted’ by many years off silt deposition, due to reductions in flow velocity caused by abstraction upstream. It is recommended that the riffle be jetted to purge the gravels of silt, and subsequently given a new top dressing of spawning substrate to a depth of 30cm. Experience has shown that the jetting will drop the level of the riffle by approx 10cm, due to silts and sands being purged from the gravel matrix. To compensate further for any loss of channel capacity a two stage channel will be excavated around the cattle drink to a minimum 115% of the 8m channel width (1.2m) and 5 m u/s and d/s.

Note: All specifications for 2-stage channels have been quoted at minimum 115%. Wherever practical they will be wider to gain more shelf habitat and the desired slope angle of 30-45^0.

3.02 - Riffle 1

Downstream of the proposed cattle drink the fishery is severely lacking suitable gravel shallows.

It is recommended to re-instate a riffle 30m long starting at Grid Reference TG176131.

Photo 3: Location of Riffle 1 with spoil heap in background where tape finishes.

Immediately upstream of this site is a large spoil heap of gravel some 30m long which is evidence of past dredging activity. The spoil has been tested to ascertain its suitability for repatriation to form riffle 1. This adds further to the sustainability ethos of the project meaning less fresh aggregate needs to be imported onto the site. The full results of the test digs are in the technical specification section which follows. As a rough guide there appears to be useable gravel at around 43% of the total volume of the spoil heap. The remainder being made up of fine sands, silts and organic matter.

Photos 4&5 : A) Spoil Before Test Screening B) After Test Screening

Due to the high percentage of unsuitable material in the spoil heap, there will be a need for a mobile screening unit to access the site to sort the gravel. This will be a Norberg 348 wheeled mobile three way screening plant.

Using the figures from the test diggings compared with those of the predicted gravel need for Riffle 1 there is deficit of approx 42 tonnes of gravel. This material will need to be imported onto the site. It is recommended that whole stone reject be used. This can used as the central core of the riffle and is cheaper than spawning substrate sized gravels. There appears to be a good spread of gravel sizes in the spoil heap which are within the spawning substrate requirements of barbel, chub and trout and dace. All waste spoil will be transported out of the indicative floodplain.

In order to compensate for any loss of channel capacity, the RHB will be excavated to form a 2-stage channel, being 2.5 m wider than the existing channel (11m) This is wider than the recommended 115% (1.65m) and compensates for the volume of gravel to be placed into the channel. The channel will also be extended 10m u/s and d/s of each riffle (50m). The height of the 2-stage channel will be 10-15cm above mean summer water level. An added benefit of removing the spoil and creating the 2-stage channel is that flood flows can be encouraged to enter the RHB ESA field at a lower discharge that at present. This will increase flood storage and provide an increased degree of attenuation. The riffle will slope to a depth of 1m on the LHB to allow passage of EA weed cutting boats.

The introduction of coarse gravels back into the channel will provide habitat conditions suitable for several BAP species including, bullhead, brook lamprey, white clawed crayfish and water crowfoot.

3.03 - Riffle 2

The second riffle is to be sited at Grid Reference: TG177133, and is 22m in length.

Photo 6: Location of Riffle 2 looking upstream

As with Riffle 1 there is a spoil heap from previous dredging operations. Test diggings have show an average of 52 % usable gravel. When compared to the original riffle calculations there is a shortfall of 91tonnes. This figure seems a little surprising at first, however the spoil heap is not as wide or as high as the Riffle 1 dredgings. If ground conditions are wet too it may

be necessary to transport the spoil for riffle 2 to the screener, and back again, rather than risk bogging down of expensive plant.

It is recommended that whole stone reject be imported to form the central core of the riffle, for the reasons outlined for Riffle 1.

Compensation for any loss of capacity will be provided by the excavation of a 2-Stage channel along the length of the riffle to a width of 2m. This is wider than the recommended 115% (1.15m) of existing channel width (10m) and compensates for the volume of gravel to be placed into the channel. The channel will also be extended 10m u/s and d/s of each riffle (42m). The riffle will slope to a depth of 1m on the LHB to allow passage of EA weed cutting boats.

3.04 - Off-River Refuges

Recent studies on the Wensum* have found that there is severe lack off channel nursery and adult habitat such as meander loops, dykes and cattle drinks. There are two dykes located in the meadow that have until recently remained un-managed.

It is proposed to re-profile to the dykes located at TG178131 & TG179131. Further to this it is strongly recommended that larger refuges are incorporated into the dykes. These features will act as important nursery areas in the summer and flood water refuges in the Winter months. Similar projects on the Waveney and Wensum have proved to be very successful being used by juvenile and adult fish alike. Connection to the main river will be using a culvert pipe, set below the bottom of the dyke. This will be back-filled to allow angler and vehicular access. The dykes and back waters will also need stock proof fencing erected. It is recommended to plant with isolated clumps of native trees and bushes for cover from predators and shade. Total length of each refuge will be 37m with the backwater being 25m long x 10m wide. Depth will be approximately 1m.
(See technical specification and Diagram 4)

Backwaters provide benefits to many other species, particularly water voles. As water voles become increasingly rare along main rivers and streams, their occurrence and survival along backwaters and ditches has a very high conservation value. Management is a key factor in realizing the potential of a dyke system for water voles and other wildlife.

The new profile of the refuges has been designed to be particularly attractive to voles. With a steep bank for burrowing on one side and a stepped berm profile at water level for latrine and foraging habitat on the other (see diagram 4 – Technical Specification). The Anglian Rivers and Otters Project have surveyed the site and voles are only present in limited numbers, due to lack of suitable river bank habitat. This component of the project would provide this much needed habitat and is fully supported by the Project Officer – Steve Henson. The fencing of the refuges will further provide a 2m buffer strip between the grazing marsh and the dyke.

Photo 7) Existing Shallow Dyke
Photo 8) A backwater and refuge on the River Wensum at Billingford

The refuges will have to be periodically maintained to stop vegetation succession. When this is required, best practice should be as follows:

- De-silting without interfering with the banks
- Working from one bank only, and progress upstream, working in short stretches.
- Leaving gaps of 19-20cm as untouched refuge areas for water voles.
- At least one third of the dyke should remain untouched.

As voles are currently not present in the dykes there is no predicted impact of the re-profiling works and refuges, as habitat is being actively created.
* River Restoration Feasibility Study – Environment Agency (1999)

3.05 - Riffle 3

The third and final riffle will rely purely on the importation of aggregate as there is no available spoil.

The riffle will be 30m long requiring 297 tonnes of a mix of reject for the core and 5-40mm for the spawning substrate.

As with the preceding two riffles a 2-stage channel will be excavated to a width of 3.5m. This is wider than the recommended 115% (1.65m) of original channel width and compensates for the volume of gravel to be placed in the channel. The channel will also be extended 10m u/s and d/s of each riffle. The riffle will slope to a depth of 1m on the LHB to allow passage of EA weed cutting boats.

The creation of this 2-stage channel will encourage wetland emergent plants which are suitable habitat for water voles during foraging.

Photo 9: View downstream to site of Riffle 3

3.06 River bank Fencing

A total of 436m of 3 strand HT stock proof fencing is to be installed. This will be set back approx 3m from the edge of the bank.

The fencing will allow the re-establishment of riparian and emergent vegetation. This will provide shade and cover for fish, and a potentially important new habitat resource for water voles and desmoulins whorl snail, both BAP species. River bank fencing is an extremely cost effective habitat restoration technique. Recent schemes on the Rivers Bure, and Wensum have been very successful. Five stiles will be erected at regular intervals along the fence line to enable ease of angler access.

Photo 10: Recent Fencing Scheme on the River Bure showing plant re-colonisation.

3.07 – Access from Costessey Mill.

At present the access from the main car park is very wet and muddy. It is suggested that a short length of board walk be lain down to allow safe access, especially in the winter months. NACA currently have a stock of 2nd hand board walk in storage at Bawburgh Pits. This could be installed at
minimal cost at a future syndicate working party.

Photo 11: Current access on to fishery

3.08 Future Maintenance

The Costessey Point Project (NACA & Peter Kettringham) will be responsible for the future maintenance of the site after completion of the scheme. This should not be a major burden as the project has been designed to be sustainable. Future maintenance envisaged at this time would comprise:

- Repair of fences / styles
- Periodic re-profiling of Off-river refuges (subject to best practice)
- Tree / shrub management.

NOTE: Dimensions for all the above features follow in the next section – Technical Specifications

Author: Simon Johnson. for The Costessey Point Project