Isle of Wight Council

Eastern Yar River Restoration Plan

Final Report

For Issue | 27 January 2015

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Job number 239428-00

Ove Arup & Partners Ltd
Admiral House Rose Wharf
78 East Street
Leeds LS9 8EE
United Kingdom
www.arup.com

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Job title	Eastern Yar River Restoration Plan			**Job number** 239428-00
Document title	Final Report			**File reference**
Document ref				

Revision	**Date**	**Filename**	Report Eastern Yar Restoration Plan.docx		
Draft 1	19 Jan 2015	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Alex Nicholson Tom Hall Irantzu Lexartza	Sally German Prof. David Sear	Will McBain
		Signature			
For Issue	27 Jan 2015	**Filename**	Eastern Yar River Restoration Plan Report.docx		
		Description	Revised report following stakeholder comments		
			Prepared by	Checked by	Approved by
		Name	Alex Nicholson, Irantzu Lexartza	Sally German	Will McBain
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

		Page
	Glossary	0
	Executive Summary	1
1	**Introduction**	**2**
2	**Site information**	**3**
2.1	Site description and background	3
2.2	Ecology	5
2.3	Heritage	7
2.4	WFD information	8
2.5	Historical assessment	13
3	**Stakeholder consultation**	**17**
4	**Methodology**	**18**
5	**Summary of pressures and solutions**	**20**
5.1	Introduction	20
5.2	Catchment-wide pressures	20
5.3	Catchment-wide solutions	23
5.4	Reach-based pressures	24
5.5	Reach-based solutions	28
5.6	Vegetation management	32
5.7	Summary of the key pressures	33
6	**Geomorphological reach summary**	**35**
6.1	E Yar (upper)	36
6.2	Wroxall Stream	48
6.3	E Yar (Lower)	53
6.4	Channel dimensions and form	69
7	**Restoration Plan- summary**	**71**
7.1	Purpose	71
7.2	Proposed restoration plan	71
8	**General constraints**	**75**
9	**Conclusions and Recommendations**	**77**
	Bibliography	80

Tables

Table 1: Classification of the River Eastern Yar (upper) water body (GB10711006220) from the 2009 RBMP and updated 2014 data.

Table 2: Classification of the River Eastern Yar (lower) water body (GB10711005970) with updates up to 2014

Table 3: Mitigation Measures defined for the Eastern Yar water body.

Table 4: Classification of the Wroxall Stream water body (GB10711006210) updated in 2011.

Table 5: List of barriers observed in the Eastern Yar during the walkover.

Table 6: Key pressures and impacts in the Eastern Yar Catchment

Table 7: Summary characteristics of the main geomorphological reaches of the Eastern Yar, from upstream to downstream.

Table 8: Summary of potential solutions and benefits

Figures

Figure 1: Location Map in the Isle of Wight

Figure 2: Bedrock and superficial geology of the Eastern Yar (from Environment Agency, 2014, *Eastern Yar Geomorphic Assessment*)

Figure 3: WFD Water bodies in the Eastern Yar Catchment.

Figure 4: Main watercourse planform changes between 1860/80 and present.

Figure 5: Extent of catchment walkover

Figure 6: a) Example of runoff from agricultural field near Niton; b) GIS analysis of topography of area in photo – showing area as prone to surface runoff.

Figure 7: Excess siltation on river bed (Scotchells Brook)

Figure 8: Low diversity in river channel (Lower Eastern Yar – downstream of Horringford Bridge)

Figure 9: Large area of disconnected floodplain near Morton

Figure 10: Main barriers in the Eastern Yar catchment

Figure 11: Example barriers to fish passage (Left - Alverstone Mill Sluice, Right - Budbridge gauging station).

Figure 12: Geomorphological reaches of the Eastern Yar and general areas in Wroxall Stream and Scotchells Brook Catchment

Figure 13: Left – Arable fields West of Niton exhibiting flow pathways

Figure 14: Arable field near Southford Lane discharging runoff directly into Upper Eastern Yar

Figure 15: Potential locations of catchment wide solutions for further investigation, Upper Eastern Yar

Figure 16: Proposed channel based restoration for the upper Eastern Yar

Figure 17: Views of reach 1

Figure 18: Left – Arable fields discharging runoff in the Whitwell area

Figure 19: General view of Reach 2 and weir in the lower half of the reach

Figure 20 Reach 2 in the upper Eastern Yar.

Figure 21: Reach 4
Figure 22: Reach 5 and road runoff discharging into river.
Figure 23: Reach 6
Figure 24: Reach 7 showing encroaching vegetation
Figure 25: Reach 8
Figure 26: Reach 9 and gauging station.
Figure 27: Reach 10
Figure 28: View into the Wroxall Stream sub-catchment from the top of Wroxall Down
Figure 29: Potential locations of catchment wide solutions for further investigation, Wroxall Stream
Figure 30: Proposed channel-based restoration for the Wroxall Stream
Figure 31: Wroxall Stream, upstream section
Figure 32: Wroxall Stream, middle section and weirs upstream A3020.
Figure 33: Potential locations of catchment wide solutions for further investigation, lower Eastern Yar
Figure 34: Proposed channel-based restoration for the lower Eastern Yar
Figure 35: Reach 11 and Horringford Bridge weir
Figure 36: Reach 12 and line of former channel on floodplain
Figure 37: Reach 13
Figure 38: Reach 14, ponded reach upstream of Alverstone Mill
Figure 39: Reach 15
Figure 40: Screen shot of GIS output showing the runoff pathways detected in the topographic analysis
Figure 41: Reach 16 and abandoned meander in Brading Marshes
Figure 42: Reach 17
Figure 43: Reach 18 (right) and wetland area (left)
Figure 44: Left – Poaching at entrance to field in upper Scotchells Brook sub-catchment; Right – Poaching at livestock crossing point upstream of Apsecastle Wood
Figure 45: View of Scotchells Brook sub-catchment from top of St Martin’s Down (the wooded area in the centre of the photo is Apsecastle Wood leading onto America Wood)
Figure 46: Potential locations of catchment wide solutions for further investigation, Scotchells Brook
Figure 47: Potential channel-based restoration options for Scotchells Brook
Figure 48: Scotchells Brook, upstream section
Figure 49: Scotchells Brook, middle section
Figure 50: Scotchells Brook, upstream of confluence with Eastern Yar
Figure 51: Proposed Eastern Yar catchment restoration plan

Appendices

Appendix A
Waterbody summaries

Appendix B
Workshop Outputs

Appendix C
Walkover Data

Appendix D
Examples of Restoration Techniques

Appendix E
Restoration Plan

Appendix F
Concept Sketches

Appendix G
Generic cost guidance

Glossary

DttC	Down to the Coast
EWLP	East Wight Landscape Partnership
GEP	Good Ecological Potential
GES	Good Ecological Status
HEAP	Historic Environment Action Plan
HMWB	Heavily Modified Water Body
INNS	Invasive non-native species
IWHER	Isle of Wight Historic Environment Record
RBMP	River Basin Management Plan
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
WFD	Water Framework Directive
WLMP	Water Level Management Plan

Executive Summary

The Isle of Wight Council has appointed Arup to develop a catchment scale restoration plan for the Eastern Yar Catchment. The purpose of the project is to provide a catchment-scale plan with a suite of integrated measures aimed at restoring a functioning aquatic ecosystem. This directly responds to the objectives of the Water Framework Directive (WFD) to achieve Good Ecological Status/Potential for the water bodies in the catchment.

The Eastern Yar catchment comprises three separate WFD waterbodies: the River Eastern Yar (upper); the River Eastern Yar (lower), including Arreton Stream and Scotchells Brook; and Wroxall Stream. The two Eastern Yar waterbodies are classified as heavily modified. The Eastern Yar (upper) is classified as being of Good Ecological Potential, whilst the Eastern Yar (lower) and Wroxall Stream are classified as being of Moderate Ecological Status/Potential.

Significant modifications have been made to the Eastern Yar throughout its catchment, and in particular in its central and lower parts. These modifications include channel straightening, channel dredging / bed lowering, modification of the banks and floodplain and extensive land use change. As a result, there are significant artificial pressures affecting natural geomorphological processes and habitat conditions. These pressures were identified in more detail during a walkover survey conducted by specialist geomorphologists, ecologists and catchment scientists as part of this project. Key issues include excess sediment delivery into, and excess siltation of, the channels, a lack of in-channel habitat diversity, channel incision and a lack of channel-floodplain connectivity.

The proposed restoration options outlined in this report include:

- catchment management and natural flood management solutions to reduce the amount of surface runoff and sediment delivery into the watercourses,
- channel planform restoration, to increase sinuosity and/or reconnect historical meanders,
- in-channel works to increase morphological diversity and provide increased habitat availability, and
- floodplain reconnection and removal of in-channel barriers.

The recommended next steps on the project include developing a more detailed implementation strategy/funding plan and establishment of a monitoring programme that will allow the work to be prioritised. Prior to any site works proceeding there will be a need to secure landowner buy-in, conduct historical and paleontological heritage desk studies, ecological surveys, topographical survey and, where necessary, ground investigations. This would be followed by design development, flood risk assessment and identification of any other planning/ consenting requirements. Key physical constraints to implementing the project are likely to include the need for access, to avoid unacceptable flood risk/drainage impacts, the potential presence of utilities, heritage features, protected species and invasive, non-native species.

1 Introduction

The Isle of Wight Council has commissioned Arup to develop a catchment scale river restoration plan for the Eastern Yar Catchment. Work in the area is co-ordinated by the East Wight Landscape Partnership (EWLP) within the Down to the Coast Scheme. This brings together the local authority with national agencies and local interest groups to promote, among others, the conservation, enhancement and restoration of natural habitats and increased community participation to provide learning and training opportunities on landscape and landscape conservation.

Gateway to the East is a key project within the East Wight Landscape Partnership's *Down to the Coast* scheme. Its aims include identifying sustainable measures for:

- restoring the geomorphology of the Eastern Yar and re-connecting the river with its floodplain to help secure an effectively functioning riparian corridor in accordance with the Water Framework Directive (WFD);
- improving the status of SSSIs along its course;
- improving access to the watercourse; and
- a better understanding its archaeological and paleontological resource.

The purpose of this project is to develop a catchment-scale plan outlining restoration measures to address the pressures of the Eastern Yar Catchment in response to the above requirements.

This report provides a summary of the following components of the project undertaken to address the above issues, which are:

- Collation and assessment of available baseline information and local knowledge provided by the IoW Council, EA and stakeholders;
- Field-based assessment of the watercourse (including cross-section information at key locations, a photographic survey and GIS mapping of information collected during the walkover survey (to be provided in an appended CD);
- An assessment of the main catchment pressures identified through the desk and field assessments and any potential solutions;
- A Restoration Plan spatially identifying the opportunities within the study area (including identification of key issues, constraints, opportunities and risks at the site and development of high-level, potential restoration options).
- Recommendations for further work.

2 Site information

2.1 Site description and background

The River Eastern Yar rises in the south of the Isle of Wight, in St. Catherine's Down near Niton, and flows for over 18 kilometres in a north-easterly direction to Bembridge.

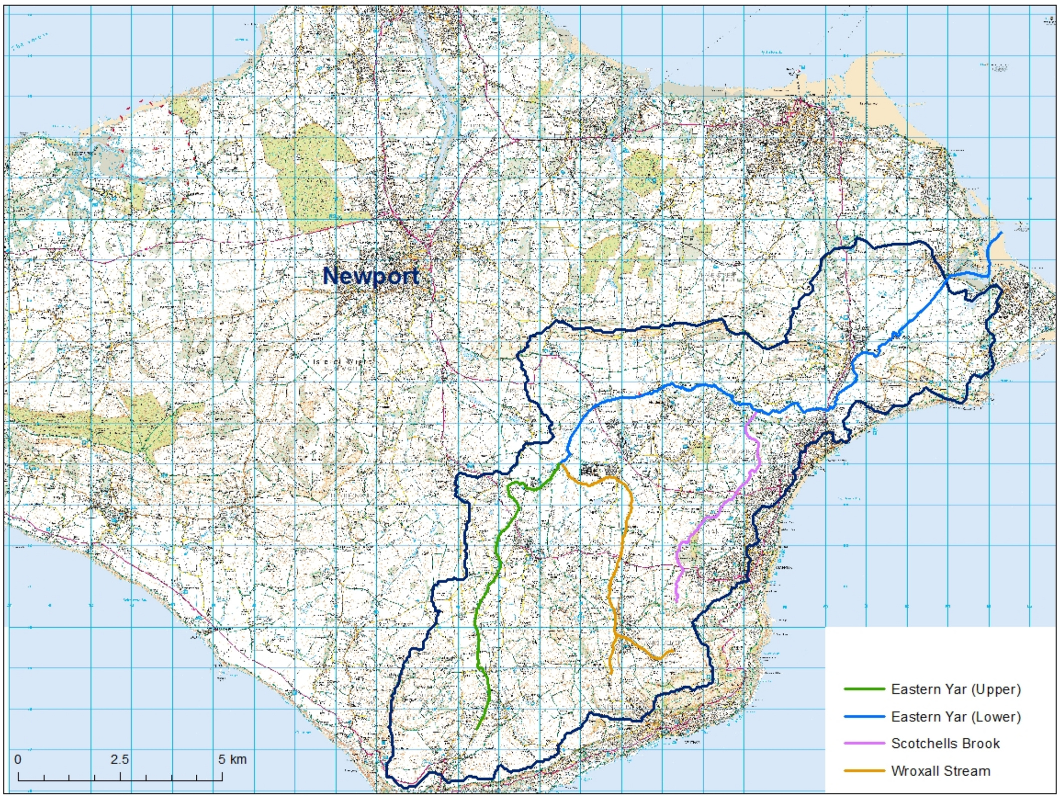


Figure 1: Location Map in the Isle of Wight

The catchment area is approximately 78 km^2, and includes three main water courses (Eastern Yar, Wroxall Stream and Scotchells Brook) as shown in Figure 1, plus a number of other tributaries (such as the Arreton Stream) and a dense network of drains.

A wide range of the geology present in the Isle of Wight (Figure 2) is found within the Eastern Yar catchment (Environment Agency, 2014). The source of the river is located in Upper Greensand and Gault geology (predominately sand and clay). Further downstream it flows through Lower Greensand rocks (sandstone) and then through the gap in the central Upper Cretaceous chalk ridge of the Island at Yarbridge. Superficial deposits are typical of fluvial terraces (including sand and gravels) and alluvium (clay, silt and sand).

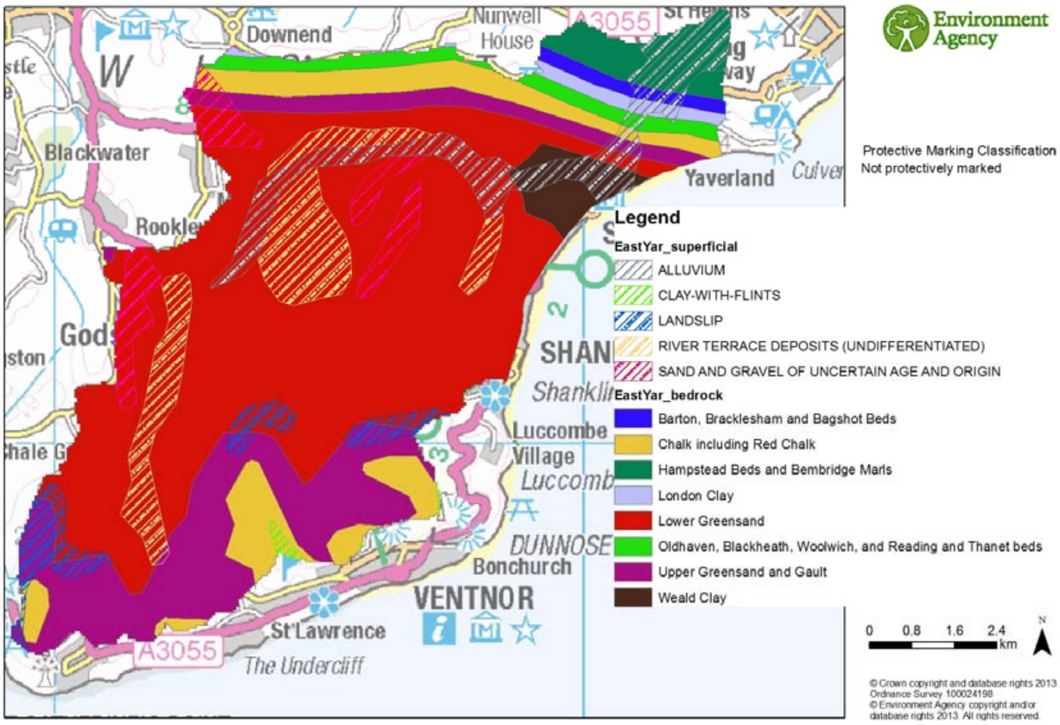


Figure 2: Bedrock and superficial geology of the Eastern Yar (from Environment Agency, 2014, *Eastern Yar Geomorphic Assessment*)

Land use in the catchment is mostly agricultural, with two relatively extensive nature reserve areas in the lower part of the catchment (Alverstone Mead Nature Reserve and Brading Marshes Nature Reserve). Agriculture is a mixture of arable and pasture, and there is also some minor areas of woodland, mostly located in the uplands. The settlements are Sandown and Brading in the Eastern Yar and Wroxall in the Wroxall Stream Catchment and Shanklin in the Scotchells Brook Catchment.

Water levels in the catchment are artificially regulated by the Medina-Yar flow augmentation scheme (e.g. Cox, 2012) and a series of control structures, including a number of weirs and sluices along the course of the river. The Alverstone and Adgestone Marshes Water Level Management Plan (Environment Agency, 2004) and the Brading Marshes Water Level Management Plan (WLMP) (Environment Agency, 2006) were developed in 2004 and 2002 (updated 2006) respectively to address a number of the SSSI units within the Alverstone and Adgestone Marshes and Brading Marshes that are in unfavourable, declining condition. The WLMPs identify the requirements to provide appropriate water levels to support optimal conditions for both conservation and a range of activities such as agriculture and flood risk management. The plans suggest that water levels across the Brading Marshes are considered to be too low to meet the conservation objectives for the site and as such a number of actions have been suggested, including the proposed penning levels at Bembridge Sluice. In addition the plan considers the need for management of the Great and Middle Sluice to enhance upstream habitat condition.

The Environment Agency (2010) has identified a small number of built properties in addition to areas of floodplain at risk of river flooding on the Eastern Yar. It is expected that over the next 100 years this flood risk will increase. These figures do not consider the risk of flooding from the sea, due to the protection provided by the Embankment Road and Sandown Sea Wall which assumes that Sandown Sea Wall will remain in place and effective for the next 100 years. The report also identifies the sluices at Bembridge, Middle and the Great sluices as providing flood protection in addition to supporting appropriate water levels for conservation. Bembridge Sluice provides a 1-200 year standard of protection against tidal flooding, and a 1-50 year against fluvial flooding for properties and urban areas upstream. The worst case scenario for flooding at Bembridge is the coincidence of high fluvial flows and neap tides causing a longer than normal period of tide-lock.

2.2 Ecology

2.2.1 Designated Sites and Habitats

The Eastern Yar catchment includes sites that have been designated at the international, national and local scales due to their significant ecological interest through

The Eastern Yar catchment includes three Sites of Special Scientific Interest (SSSIs) (Cox, 2012), which are:

- Brading Marshes to St. Helens Ledges SSSI - located in the lower part of the catchment, covering the estuary and coastline with a diverse range of coastal freshwater and terrestrial habitats providing significant supporting habitat for a range of flora and fauna;
- Alverstone Marshes SSSI - located in the middle reaches of the catchment, comprising a complex of riparian and floodplain habitats that support two areas of relict fen vegetation whose levels are higher than those of the grazing meadows;
- America Wood SSSI - located in the upper reaches of the catchment alongside Scotchell's Brook, the site comprises former ancient wood-pasture and is the best known example of this habitat on the island.

The catchment also includes a large number of sites that are designated locally for their ecological interest in the Isle of Wight context. Two Local Nature Reserves (LNRs) are present in the catchment, although only Alverstone Mead LNR is associated with or dependent upon the Eastern Yar, with over 50 Sites of Importance for Nature Conservation (SINCs) also present, although only 26 incorporate habitats or species associated with the watercourse.

The Eastern Yar Catchment includes a number of significant, albeit undesignated, habitats, with a number of riparian areas in the catchment identified as reedbed or lowland fen Biodiversity Action Plan habitats. Furthermore, ancient woodland is present in the catchment with a couple of notable areas: America Wood and a complex of five woodlands around Alverstone. Such areas can provide an insight into the make-up of the catchment landscape before historical modifications took place.

2.2.2 Key Species

2.2.2.1 Vegetation

The report by Cox (2012) provides a comprehensive overview of the vegetation within the Eastern Yar catchment. Within this report the catchment was considered to support a diverse range of marginal vegetation, although predominantly in the Lower Eastern Yar between Brading and Alverstone and Scotchells Brook. The macrophyte community present throughout the catchment was, however, considered in the report to be indicative of eutrophic conditions, or at risk of becoming eutrophic and indicative of an enriched environment.

The catchment is known to support two invasive floral species (Cox, 2012) listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), which are Himalayan balsam (*Impatiens glandulifera)* and Australian swamp stonecrop *Crassula helmsii.* The presence of Japanese knotweed (*Fallopia japonica*) has also been reported by stakeholders.

2.2.2.2 Aquatic ecology

The information regarding macroinvertebrates that has been made available (Cox, 2012) reveals a relatively diverse but impacted community. This data suggest that although the BMWP scores vary throughout the catchment, the Average Score Per Taxon is typically between 4 and 5, indicating the community is under moderate to high pressure. The communities' present show some variation in association with river flow conditions, as indicated by the Lotic-invertebrate Index for Flow Evaluation (LIFE) scores, however the communities present are largely correlated with slow to moderate flowing water. The community present in Wroxall stream did, however, show a greater affinity to faster flowing water.

The Eastern Yar catchment supports a number of ecologically significant dragonfly and damselfly species, which can provide useful indicators as to the character and quality of a watercourse with which they are associated. The status of these species appears to be improving in the Eastern Yar catchment (Cox, 2012), with five ecologically significant species identified. Brading Marsh provides a signification resource for the hairy dragonfly *Brachytron praense* and scarce chaser *Libellua fulva*, which have spread upstream to Alverstone Marshes[5]. The banded demoisell *Calopteryx splendens* is locally common in the catchment, whilst the golden ringed dragonfly *Cordulegaster boltonii* is associated with shallow stretches of watercourse in the Wydecombe headwaters and Hale Manor Farm (Dana 2003, 2006).

The Isle of Wight is known to support a variety of fish species, with carp *Cyprinus carpio*, roach *Rutilus rutilus* and dace *Leuciscus leuciscus* the dominant coarse fish species present and rudd *Scardinius erythrophthalmus*, perch *Perca fluviatilis,* bream *Abramis brama* and tench *Tinca tinca* typically found in smaller numbers. The minor streams are largely characterised by the presence of stoneloach *Barbatula barbatula*, bullhead *Cottus gobio* and European eel *Anguilla anguilla*. Additional species occurring in the Island's watercourses include stickleback *Gasterosteus aculeatus*, gudgeon *Gobio gobio* and brook lamprey *Lampetra planeri*.

Within the Eastern Yar, dace and roach comprise the main species present with sea trout *Salmo trutta* also recorded, with an increase in biomass over the 1993 to 2002 survey period (Cox, 2012). The trout population included variation in the size range, indicating successful recruitment within the catchment. Additional fish sampling was undertaken in 2012 at Newchurch and Yarbridge as part of WFD monitoring. The survey at Newchurch identified eel, gudgeon, dace, roach, wild brown trout and bullhead, with specimen numbers ranging from 19 for eel to 7 for trout and bullhead. Small numbers of perch, lamprey, stoneloach and bream were also found. Roach and perch were the main species found at Yarbridge, with small numbers of gudgeon, eel, bream and dace. The low fish densities at Yarbridge are considered of concern (Environment Agency, 2014).

2.2.2.3 Riverside terrestrial ecology

Water vole *Arvicola amphibious* remain widespread in the catchment, however surveys on the Island in 1996 (Grogan and Strachan, 1997), 2003 and 2008 (Rothwell, 2009) have shown populations to fluctuate in some areas and decline in others. In the Eastern Yar catchment fluctuating populations have been identified in Crouchers Cross Stream, Sandford Stream, Hoy's Monument Stream and St. Catherine's Hill Stream, whilst sustained decline over the three surveys were identified in both Wroxall Stream and Scotchells Brook. Other mammals in the catchment include the Eurasian red squirrel *Sciurus vulgaris*, hazel dormice *Muscardinus avellanarius* and bats, with a total of 13 species recorded within the 10km grid square covering the catchment.

2.3 Heritage

The Isle of Wight Valley Floor and Wetland Historic Environment Action Plan (HEAP) recognises the exceptional preservation conditions that can be found at wetlands for archaeological, historic and palaeoenvironmental features. The Isle of Wight Historic Environment Record (IWHER) has recorded in its database known locations within the Eastern Yar catchment, including:

- Brading Haven, Sandown Levels and the Lower Eastern Yar. This area was in the past a tidal inlet that was reclaimed between the 13th and 19th centuries, with further changes in the 20th century. The inlet would have been navigable and at prehistoric periods of low sea level may have been occupied in the margins.
- Alverstone. Pond creation works undertaken in 2005 identified remains of 6th to 12th century causeways.
- Eastern Yar to the South of Brading including land beside tributary streams. Post-medieval drainage systems have been identified from aerial photographs and some interpretation of post-medieval land use has been undertaken.

The presence of the above sites suggests that there is potential for additional features to be present elsewhere in the catchment. Assessment of historical data within this report shows that there has been significant changes within in the catchment. These include modifications to river planform and cross-section shape, land use, floodplain functionality (i.e. channel deepening or the installation of embankments which detach the river from the floodplain and reduces the frequency of out of bank flows) and longitudinal connectivity in the form of weirs and sluices. Evidence of some historical landscape features remain visible in the way of remnant channels, partially functioning or former grazing marsh and historical floodplains that are now disconnected from the river and no longer function as such.

However, the HEAP stresses that the archaeological potential of small wetlands such as those in the Eastern Yar catchment is not well understood and is poorly recorded in Historic Environmental Record due to their poor visibility and the difficulty in identifying existing features. In addition, the study, excavation and conservation of such archaeological or historical features can be difficult and expensive.

There are potential opportunities, within the context of river restoration and integrated catchment management, to raise the profile of wetland heritage. Heritage concerns should be integral to the restoration proposals, which should allow for the study of the significance of any remains present to prevent damage and implementation of appropriate mitigation. The HEAP proposes a range of actions for the conservation and management of the historic environment, including consultation for restoration projects and improving the knowledge of the archaeological and historic heritage of the Eastern Yar catchment. Such knowledge should be taken into consideration when planning restoration works as it becomes available.

There is good potential for river restoration proposals to be entirely compatible with restoring historic landscapes or land uses, particularly where they involve channel re-meandering or reconnection of floodplains to support grazing marsh. In addition, waterlogged conditions would be beneficial for the survival of archaeological and palaeobotanical material in wetlands that would otherwise be damaged by the effects of dessication and/or oxidation.

2.4 WFD information

The Eastern Yar catchment comprises three water bodies under the Water Framework Directive (WFD) as shown in Figure 3. These are the River Eastern Yar (upper) (GB107101005970), the River Eastern Yar (lower) (GB107101006220), including Arreton Stream and Scotchells Brook and the Wroxall Stream (GB107101006210). All three water bodies are classified as low, small and siliceous watercourses, with the two River Eastern Yar water bodies also classified as heavily modified.

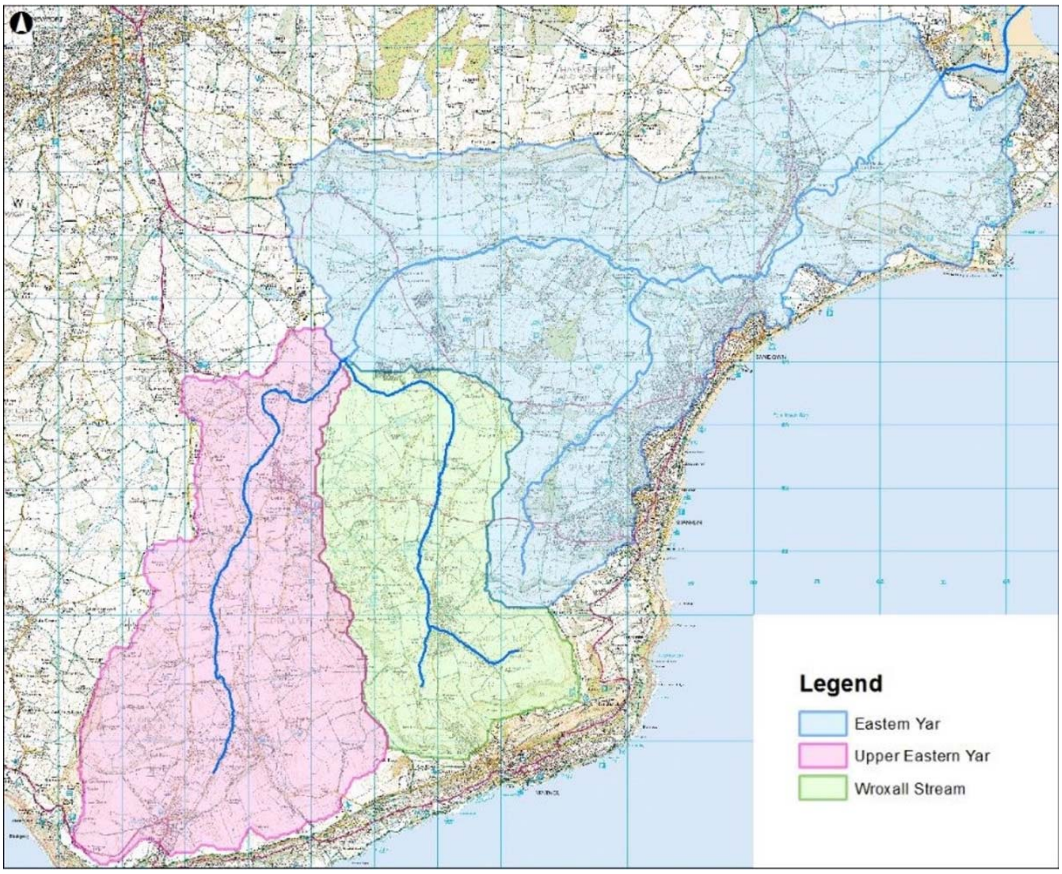


Figure 3: WFD Water bodies in the Eastern Yar Catchment.

The tidal section of the river downstream of Brading Marshes is classified as a separate water body (GB107101006010) also named River Eastern Yar. This HMWB with Moderate Ecological Potential, is outside the scope of this report. The following sections summarise the status of each of these water bodies with further information found in Appendix A.

2.4.1 Water body status and objectives

2.4.1.1 Easter Yar (Upper)

The upper Eastern Yar extends from the source to the confluence with Wroxall Stream and was classified in the 2009 River Basin Management Plan (RBMP) (Environment Agency, 2009) as having Good Ecological Potential (GEP) as detailed in Table 1 and being a Heavily Modified Water Body (HMWB) due to water regulation (strategic transfer) and water storage (non-specific) uses. The overall water body classification was revised to Moderate in 2014 based on the New Building Blocks classifications[1]. The Poor status for phosphate is due to contributions from Roud Sewage Treatment Works (STW), but there are also indications of additional nutrient pressures upstream of the treatment works[1]. The status of macrophytes and phytobenthos is classified as Moderate. This water body is also designated under the Drinking Water Directive and the Nitrates Directive. There is no data available with reference to hydromorphology WFD

[1] EA, personal communication.

classifications. Appropriate actions to address causes of WFD failure will be proposed and undertaken[2].

Table 1: Classification of the River Eastern Yar (upper) water body (GB10711006220) from the 2009 RBMP and updated 2014 data.

Quality Element	Status
Overall Ecological Potential	Moderate
Objective	Good Potential by 2015
Biological Quality Elements	
Phytobenthos/Macrophytes combined	Moderate
Physico-chemical quality	Good
Ammonia	High
Dissolved oxygen	Good
pH	High
Phosphate	Poor
Temperature	High
Hydromorphological Elements	No data

2.4.1.2 Eastern Yar (Lower)

The largest section of the Eastern Yar, from the confluence with Wroxall Stream to the tidal limit, is classified as being in Moderate Ecological Potential and it is designated as a Heavily Modified Water Body (HMWB) due to drinking water, flood protection, water regulation (strategic transfer), water storage (non-specific) uses and urbanisation. The Mitigation Measure status which drives the overall classification of the water body as a HMWB is moderate.

Macroinvertebrates are the only biological quality element that has been used to determine the status of the water body, due to the uncertainty in the fish data (see below). The macro-invertebrate communities present within the R. Eastern Yar vary between sites, with High Status at Burnt House (originally misclassified as Moderate) and Horringford and Poor status at the Arreton Stream due to septic tank discharges (Environment Agency, 2014b). The WFD classification for macroinvertebrates is Poor, as the overall status is driven by lowest score observed in the water body.

[2] Environment Agency, personal communication

Table 2: Classification of the River Eastern Yar (lower) water body (GB10711005970) with updates up to 2014

Quality Element	Status
Overall Ecological Potential	Moderate
Objective	Good Ecological Potential by 2027
Biological Quality Elements	
Fish	Interim classification discounted, will be monitored in RBMP2
Invertebrates	Poor
Supporting elements	
Ammonia	High
Dissolved oxygen	Good
pH	High
Phosphate	Good
Temperature	High
Hydromorphological Elements	
Hydrology	Does not support good
Mitigation Measures Assessment	Moderate

Fish monitoring will be included in RBMP2 to help aid classification of status. Although fish surveys were conducted in 2012 at Newchurch and Yarbridge to provide a basis for classification, the interim classification (High for both sites) derived from this initial sampling was considered erroneous for the Yarbridge site on the basis of local knowledge and evidence and as there is wider evidence that the fish population is at less than GES (see Waterbody Summary in Appendix A) the 2012 surveys have been discounted[14]. It is thought that an additional sampling site at Horringford may be included in the future to provide greater confidence in the results.

As a HMWB a number of mitigation measures have been defined for this water body (summarised in Table 3). Five of these are identified as 'In Place' (*Appropriate water level management strategies and four measures related to different aspects of Vegetation Management)* and the remaining eight have been linked to specific actions to be undertaken in order to achieve GEP (see more details in Appendix A). In addition, a number of other Actions have been defined for the catchment as a whole in the RBMP and a stakeholder group has been created with the aim to overview existing evidence and advice on actions to be implemented.

Table 3: Mitigation Measures defined for the Eastern Yar water body.

Mitigation measure	In Place?
Remove obsolete structure	Not in Place
Increase in-channel morphological diversity	Not in Place
Re-opening existing culverts	Not in Place
Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works	Not in Place
Operational and structural changes to locks, sluices, weirs, beach control, etc	Not in Place
Selective vegetation control regime	Vegetation management undertaken by a contractor, appropriate techniques and management already in place
Appropriate vegetation control technique	Vegetation management undertaken by a contractor, appropriate techniques and management already in place
Appropriate timing (vegetation control)	Vegetation management undertaken by a contractor, appropriate techniques and management already in place
Appropriate techniques (invasive species)	Not in Place
Retain marginal aquatic and riparian habitats (channel alteration)	Vegetation management undertaken by a contractor, appropriate techniques and management already in place
Sediment management strategies (develop and revise)	Not in Place
Appropriate water level management strategies, including timing and volume of water moved	In Place
Educate landowners on sensitive management practices (urbanisation	Not in Place

2.4.1.3 Wroxall Stream

The Wroxall Stream is a southern tributary of the Eastern Yar. It is not classified as Heavily Modified and it is at Moderate as detailed in Table 4. Although the other supporting elements are high the moderate classification for Phosphate influences the overall status of the water body, it is thought that this moderate classification may be the result of discharges from local Sewage Treatment Works and diffuse pollution from arable land (Environment Agency, 2014c).

Macroinvertebrates are the only biological quality element that has been assessed in the Wroxall Stream. The macroinvertebrate community present within Wroxall Stream only slightly varies from the composition and abundance that would be expected in this type of watercourse, and is therefore has been classified as being in good status for this element.

Table 4: Classification of the Wroxall Stream water body (GB10711006210) updated in 2011.

Quality Element	Status
Overall Ecological Status	Moderate
Objective	Good Ecological Status by 2027
Biological Quality Elements	
Invertebrates	Good
Supporting elements	
Ammonia	High
Dissolved oxygen	High
pH	High
Phosphate	Moderate
Temperature	High
Hydromorphological Elements	
Hydrology	Does not support good

2.5 Historical assessment

An assessment of historical change was conducted using historical maps, ranging from 1861 to the present, together with relevant documents (Cox, 2014, Environment Agency, 2014). Significant aspects that were considered include those related to land-use change (see Section 2.5.1) and changes of the river corridor and planform (Section 2.5.2 and shown in Figure 4). Information provided by stakeholders was particularly useful at this stage. Relevant GIS shapefiles are provided separately to accompany this report.

Significant modification to the channel has taken place throughout the catchment, and in particular in the central and lower part of the catchment, including channel straightening, channel dredging and bed lowering, bank modification and embankment/floodplain modification (including some floodplain development) as well as wider land use changes.

In addition to these changes in the main channel these is now a dense network of agricultural drains, most of which discharge into the main river or its tributaries which was absent in 19th century and early 20th century maps.

The Lower Eastern Yar was naturally tidal in the past as far as Alverstone and was reclaimed in two stages: first from Alverstone and then from an old sea wall to the west of the Brading Marshes. Reclamation was completed by 1880.

2.5.1 Land use change

Detailed changes have been reported in the Eastern Yar Rivers Report (Brownscombe, 2012) and this section along with interpretation from our historical map assessment informs the findings in this section.

Only a small number of ancient woodlands remain from what would have been an extensive woodland landscape 4,000 years ago. Enclosure of common grazing land took place from post-medieval times to the 20th century, with significant agricultural change taking place in the 19th and 20th centuries. In that period field patterns re-organised or fields amalgamated, and previously unenclosed grassland was used for cultivation.

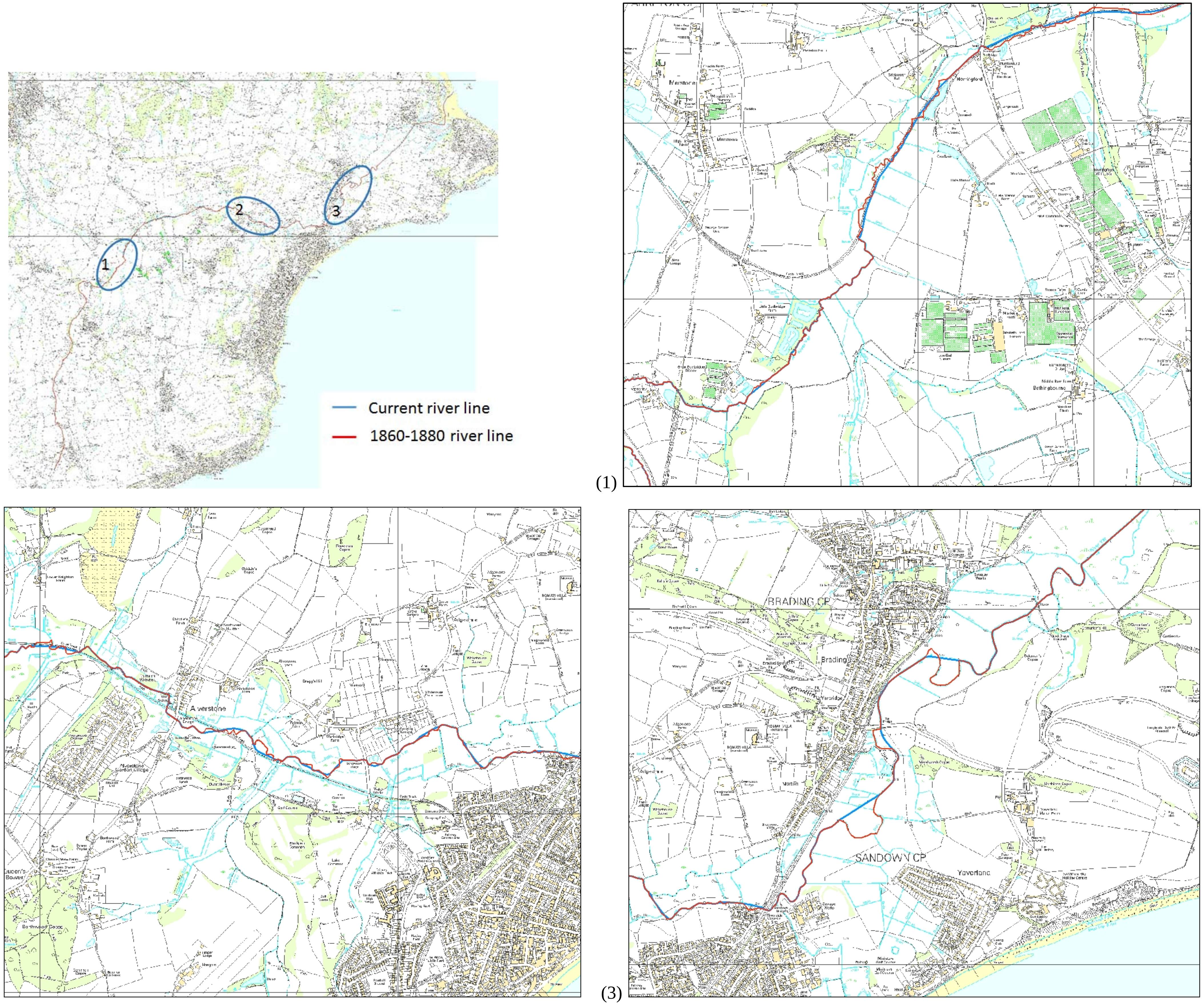
Some areas that were previously wetland/grazing marsh have been drained, although they remain prone to seasonal saturation. Disconnection between the channel and the original, dynamic floodplain over a significant length of the water course has led to changes in the nature of the floodplain, with replacement of typical open floodplain vegetation with scrub.

The reclamation of tidal land at Brading Marshes brought significant changes to the land use of that area, with the establishment of grazing marshes and the creation of important ecological habitat units.

Most settlements in the catchment have existed for a long time, but some of them have significantly extended during the 20th century, for example Godshill, Niton, Sandown, Brading and Shanklin. Uses of the area for recreational purposes also increased during that period. Several Sites of Special Scientific Interest (SSSIs) and nature reserves have been designated in the area since the mid-20th century.

2.5.2 River and floodplain changes

There have been significant changes in channel planform in the Eastern Yar. This can be determined by comparing current and historical OS maps. There are numerous relict features in the landscape. Some of these features, such as abandoned meanders, are clearly shown in the current maps.



(1)

(2)

(3)

Figure 4: Main watercourse planform changes between 1860/80 and present.

The earliest available OS maps are from 1864. Comparing with an earlier 1793 map ('Mudge' survey), Cox (2014) has identified a change from a poorly drained floodplain upstream of Alverstone to the development of a more complex drainage system. Downstream of Alverstone, multiple sinuous channels found in the floodplain on the earlier map appear to have been straightened by 1864, although the main channel did not show significant modification.

Further straightening throughout the whole catchment took place subsequently, although most of it is concentrated in the central and lower parts, with the main meanders being completely disconnected from a new and straight channel (Figure 5 shows where there is significant deviations between the contemporary and historical planforms). Different episodes of channel straightening have been driven by railway construction in the late 19th century and urban and agricultural development and. At the same time, the drainage system was becoming more complex, with a large number of straight ditches aiming to remove water from agricultural fields and floodplains.

The disconnection of the river channel from the floodplain due to incision/channel deepening has been enhanced as dredging material is often places on the bank tops, creating 'bunds' or made into more formal embankments that reduce the frequency of out-of-bank events. However, if there is an out-of-bank episode these bunds can often become an obstacle for any water trying to return to the river, leaving fields and other areas under water or highly saturated for significant periods of time. This lack of an active floodplain and the loss of a regular wetting process has led to areas of open floodplain marsh being replaced by areas colonised by scrub.

Long-term dredging of the main channel during the mid to late 20th century has also caused significant changes to the shape (morphology) of the channel, transforming it from a system with a highly sinuous planform which was connected to its floodplain into a deeply incised trapezoidal channel with low morphological diversity and consequently reduced availability of quality ecological habitats with poor connectivity between the river and its floodplain.

3 Stakeholder consultation

Community engagement is one of the key aims of the DttC (Down to the Coast) scheme. Stakeholder participation is fundamental to the success of any integrated and holistic catchment restoration approach. Thus, as part of the process to develop the Eastern Yar River Restoration Plan, stakeholder workshops were planned and undertaken as follows:

- On 11 November 2014, an initial stakeholder workshop was undertaken in Cowes to discuss the main catchment issues opportunities and constraints. In this workshop, the importance of engaging individual landowners early on in the process was highlighted (see Appendix B for further details of workshop outputs);
- On 10 December 2014, a landowner and stakeholder workshop was undertaken in Cowes to discuss the main catchment pressures and potential generic solutions (see Appendix B for further details of workshop outputs);
- On 22 January 2015, a final stakeholder workshop was undertaken to discuss the preliminary findings of the Eastern Yar River Restoration Plan. Stakeholder comments were used to provide a final version of this report.

4 Methodology

A desk study of historical and contemporary maps, existing asset information and GIS data was used to attain an initial understanding of the system as outlined in the previous section. This information has been used to inform data requirements for field surveys and has aided further assessment of the catchment condition and pressures.

A geomorphological walkover survey of the river was undertaken between 11th and 13th November from Southford to Brading Marshes, including also sections of Wroxall Stream and Scotchells Brook. The geomorphological assessment, based on the Fluvial Audit methodology (e.g. Sear *et al*. 1995) characterised the watercourse into separate physical geomorphological reaches based on key indicators of geomorphological change, including; significant changes in bed and bank material, channel planform and geometry, channel gradient, dominant processes, adjacent land use and riparian character, and the presence of artificial structures[3]. Some measurements of channel widths and bank heights were collected to provide an indication of typical channel cross-sections and floodplain topography and natural erosion and depositional features were also recorded to inform our understanding of how active and dynamic the system is as they provide an indication of the variability in channel form and process.

In addition to the geomorphological survey, a catchment walkover was undertaken at the same time that covered the sub catchments of the Eastern Yar (see Figure 4). This survey focussed on developing an understanding of the relationship between sediment and water at the catchment scale and assessing feasible opportunities and priority locations for Natural Flood Management (NFM) within the sub catchments. Prior to the catchment walkover, a GIS analysis of the topographic data (LiDAR) had identified areas with the potential for surface runoff to take place – this was undertaken to provide a focus for the walkover survey. To undertake this task a package called ‘Hydro-Tools’ within the ArcGIS toolkit was used. This analysed the LiDAR data to determine flow direction and areas of possible water accumulation within the catchments. This output was combined with background mapping and satellite imagery to determine feasible locations which may be potential runoff sources, and as such were prioritised in the catchment walkover for ground-truthing. Sites where Natural Flood Management (NFM) features such as large wood and in-ditch settlement ponds could be utilised were pre-identified using the GIS analysis and then ground-truthed. Large floodplain areas, including areas between Horringford Bridge and Bembridge where visited to assess opportunities for floodplain reconnection and maximising floodplain storage. All of the results from these catchment walkover surveys were captured in GIS.

[3] See Appendix C for more details. Shapefiles are provided separately.

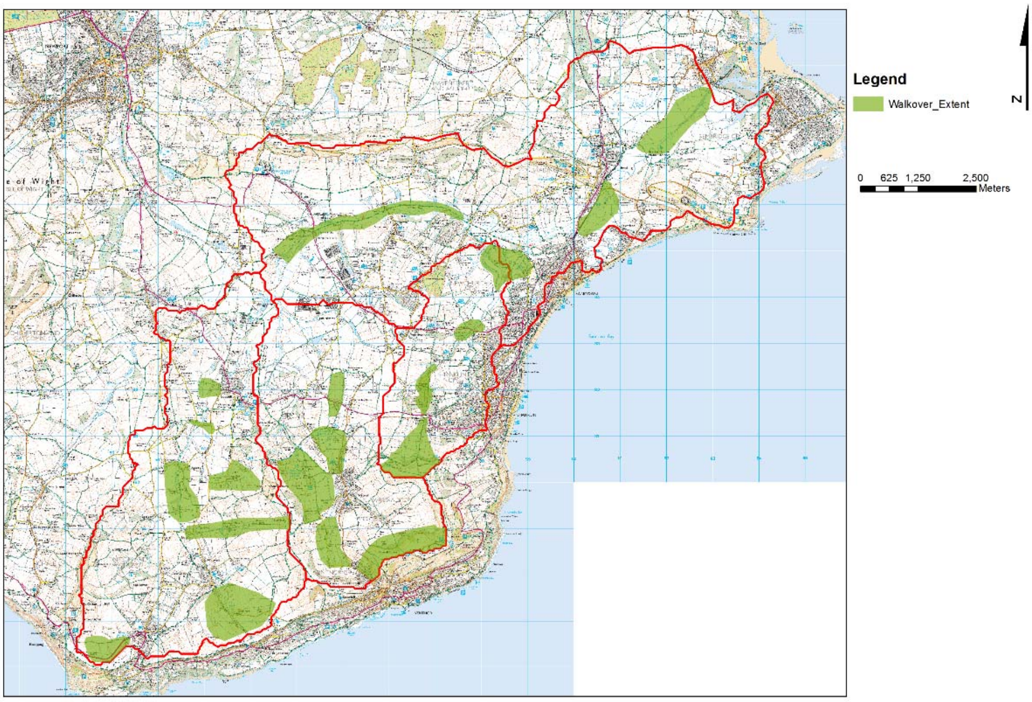


Figure 5: Extent of catchment walkover

Weather was wet and overcast on the first day, and clearer on the two following days. The amount of information gathered was limited by the high flows, although compensated by local knowledge. The high water levels and high suspended sediment content hindered the clear observation of substrate material and size and dominant flow types for part of the survey. Although access to the channel could not be gained due to health and safety reasons in places, information was collected regarding channel geometry and typical cross-sectional dimensions (Table 5) to provide an indication of the variability in channel form within the surveyed reaches. Substrate material composition and silt depths were also estimated where possible with the aid of a ranging pole. Significant sediment remobilisation within the channel was observed on the day of the visit.

5 Summary of pressures and solutions

5.1 Introduction

During the river channel and catchment walkover surveys, and through the stakeholder workshops a number of pressures influencing the current condition of the watercourses have been identified. These are:

- Catchment-wide water and sediment delivery; watercourse siltation;
- Incised, uniform river channels or channel morphology;
- Poor interaction between river and floodplain;
- Barriers to longitudinal connectivity and fish passage;
- Water quality;
- Vegetation – encroaching vegetation and presence of invasive non-native species (INNS)
- Presence of invasive non-native species

The WFD classification will be impacted on by these pressures and contribute to the current less than good of the quality elements and ultimately the cause of the failure to achieve Good Ecological Status/Potential. The following sections summarise the pressures in the context of the Eastern Yar catchment and discuss the solutions that may be used to address them.

5.2 Catchment-wide pressures

5.2.1 Catchment-wide water and sediment delivery

The Eastern Yar catchment is predominantly agricultural, especially in the uplands. It was noted that, during the catchment walkover, surface runoff was observed in many of the agricultural areas of the catchment as illustrated in Figure 6, which shows a relatively newly-sown arable field.

Surface water pathways such as those shown in Figure 6 and discussed in section 6 are present across several areas of the catchment. The geomorphological survey also identified incised, straightened and uniform river channels that are disconnected from their floodplains. These factors increase the volume, as well as the rate at which runoff is delivered to watercourses. Once in the watercourses, floodwater can pass more rapidly downstream than would be the case in an unmodified system. Both of these processes can result in increased risk of flooding in downstream locations.

a)

b)

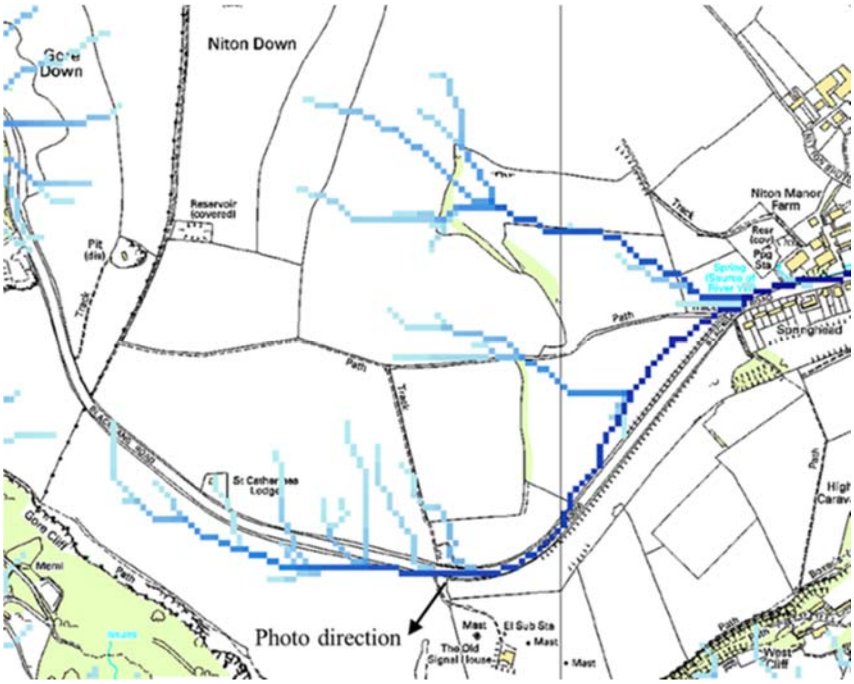


Figure 6: a) Example of runoff from agricultural field near Niton; b) GIS analysis of topography of area in photo – showing area as prone to surface runoff.

In addition, delivery of water over the surface of the land has the added risk of carrying soil and associated nutrients and pollutants off the land and into watercourses. The WFD water body summaries and Environment Agency 2013 Geomorphic Assessment (Environment Agency, 2013 and 2014b and c) have identified runoff as a source of sediment into the river and a potential cause of phosphate failure together with inputs from STWs. The Eastern Yar shows high level of siltation even when not at high flows, as reported also by EA geomorphic assessments in 2013 and 2014, with increasing levels downstream. Deposition in the lower parts is also high, with the potential to have a significant impact on channel capacity. Although there are also sediment contributions from bank erosion and bed scour, dredging has been used in the past to remove excess silt from the channel, which may exacerbate bank erosion (e.g. Simon, 1994), thus leading to more sediment delivery via this mechanism.

The presence of fine sediment in the water column can affect the aquatic environment in a number of ways. An increase in turbidity reduces light penetration and silt deposition modifies the substrate of the river bed (e.g. Kemp *et al*., 2011, Jones *et al*., 2012a and 2012b) (Figure 7). These effects in turn can have deleterious effects upon the flora and fauna present within the watercourse, reducing habitat suitability, disturbing communities/populations or causing direct harm to individual species. It has also has implications for water quality as discussed in Section 5.7.

Figure 7: Excess siltation on river bed (Scotchells Brook)

The latest SSSI condition assessment for the Alverstone Marshes identifies unfavourable status as a result of the dumping of river dredgings (an indirect impact).

5.2.2 Water quality

Water quality within the Eastern Yar is considered in the WFD Water Body Summary as having a potential impact on the watercourse, with diffuse pollution from agriculture characteristic of the rural setting. The presence of four Sewage Treatment Works is also likely to have a combined detrimental impact on the water body. WFD water body summaries show that actions have been designed to address this problem. These actions need to be implemented to ensure the success of any proposed restoration options.

Deterioration in water quality impacts on the floral and faunal communities present through a reduction in pollution sensitive species. This allows pollution tolerant species to become more dominant which may result in a reduction in species diversity and stressed populations within macrophyte, macroinvertebrate and fish communities.

The Eastern Yar Scope of Restoration Strategy (Cox, 2014) identifies that changes in the water chemistry of the wetlands of the Eastern Yar have been evident, as the nutrient and sediment enriched waters from the river have changed from the previously base poor acid mire habitats in eutrophic marshes. As a result the extent and distribution of a number of sensitive floral species have significantly altered, for example the previously frequent round-leaved sundew *Drosera rotundifolia* is now virtually extinct whilst the previously common bog pondweed *Potamogeton polygonifolius* is now restricted to only a few locations.

5.3 Catchment-wide solutions

5.3.1 Corner of field ponds / runoff interception

A runoff interception pond is purely for the interception and short-term storage of overland flow during periods of intense rainfall where there can be, effectively, 100% runoff. This runoff can carry with it sediments and pollutants from fields (including fertilisers and farm effluent). Retention ponds have been used in catchments in Belgium to hold runoff for a certain amount of time, which limits the peak discharge to a level that is manageable by the drainage system (Verstraeten & Poesen, 1999). Studies into muddy floods in the European Loess belt have been investigating the impact of grassed waterways and earthen dams as a means of controlling runoff and filtering flow (Evrard *et al*., 2008). The plot-scale experiments observed a significant reduction in peak discharge (mean of 69%) between the start of the series of interventions and the catchment outlet, shortly after the final retention pond. Evrard *et al*. (2008) present a hydrograph of the inflow at the flume, preceding the mitigation, being augmented by the presence of the earthen dams that act in sequence. Runoff coefficients had also dropped (mean of 40%) in the direct vicinity of the grassed waterways, which was linked to increased infiltration. The system in Belgium successfully reduced both downstream discharge and sediment discharge at the outlet of the 3km^2 catchment using cost effective mitigation. Evrard *et al*. (2008) concluded that a catchment without intervention would suffer up to seven-times the rate of erosion than one with these measures.

5.3.2 Ditch management

Farm ditches rapidly deliver water fallen on the fields to downstream watercourses. These ditches can be managed to attenuate flows and filter sediment. The aim of ditch management is to keep sediment at source and improve downstream water quality (Barber & Quinn, 2012).

5.3.3 Large Woody Dams

Large Wood can have huge effects on flow resistance using soft engineering techniques, which have very little impact on the ecology of the area. During states of high discharge, LWD forces the water level, in proximity to them, to rise and spill onto the flood plain, where further wood is installed to increase friction (Beven, 1979; Gippel, 1995). This process slows the propagation of the flood peak by creating a far more tortuous route downstream. Appropriate locations have to be chosen, however, to ensure that the desired effect is achieved.

5.3.4 Maximise floodplain storage / Offline storage ponds

Offline storage ponds function by diverting flow from the main channel during peak-flow events. An inlet structure situated on the riverbank, which is approximately 1m wide, controls the filling of the pond. Ponds located adjacent to rivers, remove peak flow through filling when the water level in the stream reaches a certain height (taking 3-4 hours to fill). The features, therefore, have the potential to, both, reduce flood peak and increase the lag-time of the flood hydrograph at that point in the river (Wilkinson, et al., 2010; Wilkinson, et al., 2014).

Existing floodplain that is able to interact with the watercourse can have increased capacity by careful placement of soil bunds and simple landscaping if natural flood storage areas are less than required to deliver flood risk benefits. Increasing the capacity gives greater attenuation effects of an existing flood reduction measure.

5.3.5 Farm Management

In addition, continuing and extending existing Sensitive Farming measures will contribute to improving the condition of the Eastern Yar catchment with reference to water and sediment delivery to the main river.

5.4 Reach-based pressures

5.4.1 Channel modifications

The Eastern Yar presents, for a significant part of its course and tributaries, uniform and incised channels with low morphological and flow diversity due to historical modifications (e.g. Figure 8). The channel has been straightened, contributing to reduce in-channel variability. Embankments created historically with dredged material have contributed to the disconnection of the channel from what would have been an active floodplain, preventing natural processes to take place and reducing high flow attenuation opportunities (e.g. SEPA, 2006).

The result of these historical modification has been a loss of natural structure in the watercourse and reduction in the diversity of habitats present. Niche habitats for particular flora and fauna are likely to have been lost. As a result, communities will typically comprise lower species diversity made.

Figure 8: Low diversity in river channel (Lower Eastern Yar – downstream of Horringford Bridge)

5.4.2 Poor connectivity between river and floodplain

Incised, straightened and widened channels often result in poor hydraulic connectivity with their adjacent floodplains. This has been exacerbated by embankments created by the disposal of dredged material that not only contribute to the disconnection of floodplain/wetland areas, event those that are lower topographically than high flow levels (e.g. some areas of Alverstone Marshes and WT land), but also present a barrier for water to go back to the channel when out of bank events do occur.

Increased conveyance in these channels, which increases flood risk to downstream areas, also means that the local floodplain floods less often. This has implications for soil moisture levels, but also limits sediment and nutrient delivery to the floodplain locally. Floodplain interaction is important for wetland habitat and the grazing marshes like Brading Marsh and the area downstream of Morton as shown in Figure 9. Benefits of controlled improved connectivity would thus include improved natural processes and habitats and potential reduction of flooding pressures in other areas, both rural and urban. Any proposals would need appropriate consultation with landowners and stakeholders and assessment of socio-economic, flood risk and ecological implications.

Figure 9: Large area of disconnected floodplain near Morton

5.4.3 Barriers to longitudinal connectivity and fish passage

All fish species move through a river catchment, or migrate between the river and sea, for the purposes of foraging, reproduction, overwintering or to move between habitats that provide suitable opportunities at different times of the year.

Diadromous fish species, including sea trout, European eel and lamprey species, are more vulnerable to the effects of artificial barriers such as weirs or sluices. The presence of such barriers will potentially isolate the species from a significant part of available habitat, either preventing downstream migration to foraging habitat and/or to breeding areas (European eel), or upstream migration to spawning habitat (sea trout and lamprey species) and/or nursery and feeding habitat (European eel).

Non-diadromous fish species still undertake movements within a catchment, for feeding and spawning. The presence of significant artificial barriers may therefore isolate populations within the catchment, reducing genetic diversity within sub-populations and potentially restricting the population abundances of different species as a result of reduced accessibility to habitats.

Several barriers have been identified on the geomorphological survey (see Figure 10, Figure 11 and Table 5). Although some of these barriers may be obsolete, others like Budbridge gauging sluice, or the Great Sluice and Bembridge Sluice, are still in use, and any intervention or modification will need to take this into consideration

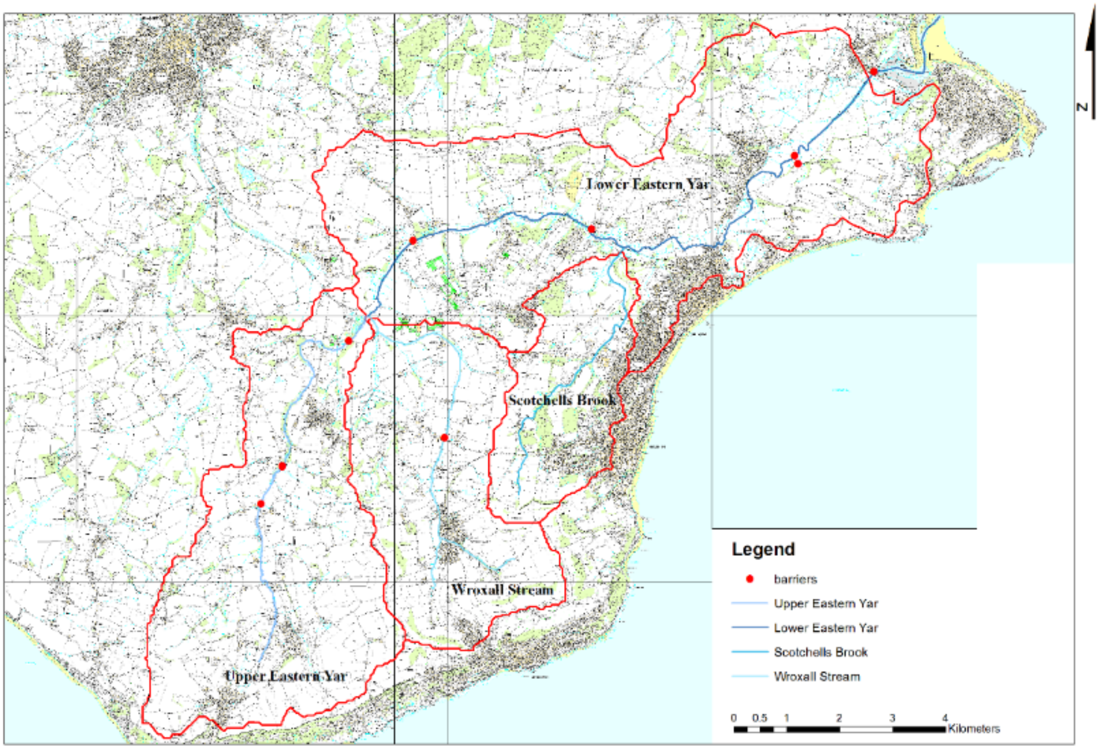


Figure 10: Main barriers in the Eastern Yar catchment

Figure 11: Example barriers to fish passage (Left - Alverstone Mill Sluice, Right - Budbridge gauging station).

Table 5: List of barriers observed in the Eastern Yar during the walkover.

Barrier	Grid Reference
Roud, E of Berrycroft Farm	SZ51479 80472
E of Lower Elliots	SZ51957 81081
Budbridge Gauging Station	SZ53144 83529
Horringford Bridge Weir	SZ54352 85424
Wroxall A3020 weirs	SZ54916 81730
Alverstone Mill Sluice	SZ57716 85633
Great Sluice	SZ61648 86879
Middle Sluice	SZ61560 87035
Bembridge Sluice	SZ63045 88594

The fish populations recorded in the catchment demonstrate that it is likely that barriers are having an impact on fish populations within the catchment. For example, the presence of sea trout and lamprey (most likely brook lamprey, which is not a migratory species) in the upstream section at Newchurch demonstrates the presence of suitable habitat for these species, but sea trout were not recorded downstream in the catchment.

However, European eels are present in both upstream and downstream sections and in greater number at the upstream section at Newchurch. This suggests that European eel are able to migrate through the catchment. However, the ability of eels to live for prolonged periods in freshwater should be taken into account when interpreting these data.

5.5 Reach-based solutions

Identified solutions for the Eastern Yar need to assess the potential to use, on one hand, process based solutions, which work natural processes to with natural processes to deliver changes and benefits, on the other hand, form based restoration, which needs to recreate or engineer desired morphology that can support desired processes. Although process based restoration is less costly, a combination of low energy, little coarse sediment recruitment and limited erosion in the Eastern Yar creates conditions that will require at least some form based approaches. (See Beechie *et al.*, 2010).

5.5.1 Re-meandering

This technique is used to either reconnect the previously modified channel back into historical channels that have been cut-off and abandoned in the floodplain or to recreate a new meandering channel which is typical for the system within the floodplain, possibly following a former course (if appropriate). Restoring the channel to its original course (or similar) would recreate the natural morphology, providing significant benefits for the river including:

- Enhanced hydromorphological conditions (with appropriate channel dimensions and sinuosity);
- Improved aquatic habitat and wider biodiversity value:

- Improved connectivity with the floodplain;
- Improved angling conditions; and
- Opportunities for incorporating additional benefits (e.g. amenity features, flood storage and wetland habitat features, improved floodplain connectivity).

This kind of restoration needs to be undertaken after the management of sediment sources to avoid siltation of the restored channels (Sear, 1994). It is important to note that with any works of this nature spatial and land ownership constraints, socio-economic and flood risk implications would need to be considered, although in areas of low productivity or already established wetland the restoration is likely to provide both flood risk and conservation benefits.

5.5.2 In-channel works

In-channel works can be used to create features within the channel, which can help restore natural flow dynamics, morphological diversity and improve habitat for key aquatic, marginal and riparian species. Some of the less modified reaches in the Eastern Yar catchment do show a variety of flow types and diverse morphology, but these key habitats are limited.

Following identification of where this work might be appropriate further work (i.e. detailed design) would be needed to determine the exact locations and nature of these features and their composition to ensure that the desired dynamic processes are achieved. Although there is some gravel in the Eastern Yar, it is not a gravel rich system, and therefore if required, existing material should be maximised as much as possible rather than importing it, which would increase costs significantly.

The straightened, incised sections of the Eastern Yar lack at present sinuosity or morphological variability, which in turn leads to poor flow diversity and a system that cannot deal with either the sediment inputs or the silt already trapped within the system. It is difficult to achieve conditions similar to those of natural rivers in such channels, but features such as **aquatic berms**, **flow deflectors**, **large wood deflectors**, and ‘**D**’s can be appropriate in combination with bank re-profiling. The function of these features reduces the size of the typically oversized low flow channels resulting from modifications, to make it more appropriate for the dominant low flow condition and increasing in-channel diversity, while trapping excess fine sediments. Potential benefits of these features are:

- Increased channel diversity and in-channel sinuosity.
- Increased flow-type diversity and local flow velocities and turbulence.
- Improved aquatic and marginal habitat diversity for fish and other species.
- Improved local sediment transfer conditions.

These features can be introduced in a variety of forms at a variety of locations depending on site specific issues, but would often if possible perform better with a combination of solutions. In areas straightened areas where remeandering is not possible, in-channel works could be used as an alternative in combination with bank reprofiling and/or, increased channel sinuosity.

5.5.3 Bank re-profiling

This involves the modification of the trapezoidal channel with homogenous cross-sectional shape which is found throughout the study area, likely to have been as a result of straightening and historical dredging, to address over-deepening issues and increase morphological variability.

A range of different cross-section techniques can be adopted to achieve the desired outcome. This could be designed in a way that maintains, if necessary, channel capacity, while allowing improved connectivity with the lower areas of the floodplain (see Appendix D). This would achieve a narrower low flow channel while maintaining the overall capacity in flood flow conditions. For the straightened reaches, the new cross-section could be combined with in-channel features to address the lack of sinuosity. Where there is floodplain availability and appropriate feasibility assessments show it is possible and cost-beneficial to fully reconnect the floodplain, bed raising or channel narrowing could be used in combination to increase the occurrence of local active connection to provide more natural conditions.

In addition, near to vertical banks which are present almost throughout the catchment complicates the control of INNS plants significantly. Although works for this measure would need to ensure that good management and control practices are followed to avoid spread of seeds, it could eventually be a useful contribution to INNS control and be implemented in coordination with other vegetation management efforts.

Further work would be needed to determine the exact locations and nature of bank reprofiling and detailed design should determine the required channel dimensions and gradients with relation to the predicted flow rates to ensure that no detrimental scour/erosion will take place.

This action could provide several significant benefits to the system including:

- Increased flow diversity (flow depths/velocities, sediment dynamics, etc.);
- Improved connectivity with the floodplain.
- Reduction of excessive bank erosion (by reducing the steepness of the banks and favouring the establishment of riparian/marginal vegetation);
- Promotion of formal sediment deposition areas stabilised by marginal vegetation;
- Improvement of aquatic, marginal and riparian habitats;
- Improved angling conditions and reduction of in-channel vegetation encroachment; and
- Improved control of INNS such as Himalayan balsam, Japanese knotweed, etc.

5.5.4 Removal of embankments

See section 5.3.1.

5.5.5 Wetland improvements/creation of floodplain storage areas

Several options are available to improve floodplain conditions, connectivity and riparian habitats, such as wet woodlands, scrapes, flood storage features, etc. Opportunities in the Lower Eastern Yar are numerous. For example, RSPB-owned land in the Brading Marshes offers suitable locations for prioritising floodplain reconnection and wetland improvements.

Improving wetland connectivity can provide significant advantages for key species such as those present in SSSI areas in the Eastern Yar. In addition, runoff generated by precipitation events carries with it materials, be it nutrients, pollutants or even sediments, which cover the land leading to river networks. Wetlands and riparian zones can control the effect this runoff has on river ecology. By filtering the runoff water and sediment flows, wetlands can improve the river water quality and reduce erosion rates as well as help slow down runoff flow, thus mitigating flood risk (Mander et al., 1997; Maitre et al., 2003).

Potential negative impacts of out of bank events could be addressed by a more systematic approach using wetland features that can also provide a flood storage function and selecting specific location with improved floodplain connectivity.

This actions could provide:

- A re-naturalised hydrologic regime.
- Improved wider biodiversity.
- Increased flood storage and reduction of flood risk downstream.
- Additional aesthetic and amenity benefits.

5.5.6 Solutions to improve barriers to fish passage

It is assumed that the EA has already identified and is working towards addressing major barriers to fish passage within the catchment and as such solutions for these issues are not developed within this report. But in summary typical solutions might include

- Technical fish passes
- Naturalised fish passes – rock ramp or step-pool
- Fish by pass channels
- Modification of the impoundment by lowering the crest or adding easements to the face or upstream/downstream
- Removal of barrier

These barriers also have an impact on the longitudinal movement of flow and sediment. It is expected that significant amounts of silt will have been deposited behind in channel structures over the years, and any action to improve fish passage will have to take this into consideration.

5.6 Vegetation management

The East Wight Watercourses Review and Project Identification (Cox, 2012) identifies that the encroachment of scrub, including bramble, along the riparian habitats of the watercourse is causing a deterioration in habitat quality for water vole. The lack of an active connection between the channel and the floodplain may be exacerbating this impact in places. A survey of the species on the island (Rothwell, 2009) identified a need for management throughout the Eastern Yar to improve habitat for water voles with particular focus required on Scotchells Brook, Wroxall Stream and Sandford Stream. The disconnection due to modification

The resultant heavy encroaching of the watercourse as a result of dense riparian growth can also cause a reduction in the extent and distribution of macrophyte species (e.g. Dawson, 1988), with resultant impacts on the habitat through a loss of marginal habitat for macroinvertebrates and fish and a reduction in primary production, with knock-on effects through the food chain. Lack of riparian vegetation is also a problem in some areas, reducing shading and refuge and limiting input of wood that provides habitats and in-channel diversity.

5.6.1 Invasive Species

The presence of Himalayan Balsam throughout the catchment has potentially significant implications with regards to the input of sediment and bank erosion. The species often suppresses the growth of native plants to create dense stands, which die back in the autumn. Once the species has died back, the banks are left bare of vegetation, and as a result susceptible to erosion. Japanese knotweed is also present in the catchment (reported by stakeholders).

The recorded presence of Australian swamp stonecrop, also known as New Zealand pigmy weed, has potential to become a significant pressure on the Eastern Yar if they were to spread into the main catchment. Where Australian swamp stonecrop establishes, it quickly out-competes native vegetation and maintains a dominance by rapid growth and uptake of almost all available nutrients.

5.6.2 Vegetation Management solutions

According to the Waterbody Summary for the Eastern Yar and the 2014 EA geomorphic survey, there are already vegetation management measures in place (Environment Agency, 2014a, 2014b), except in the case of INNS. There is an opportunity to assess existing approaches and to co-ordinate non-native species control with initiatives such as Plant Positive and restoration options that can aid the control (e.g. floodplain reconnection, bank reprofiling, etc.). Any action would need to ensure best practice is followed as required by law to present dispersal, but where possible should also contribute to removal and eradication.

5.7 Summary of the key pressures

A summary of the identified key pressures in the Eastern Yar Catchment is presented in Table 6. Many of the pressures are widespread within the catchment.

Table 6: Key pressures and impacts in the Eastern Yar Catchment

Pressure	Impacts	Solutions
Catchment-wide water delivery	High connectivity of surface water and drain networks leading to rapid delivery of peak flow during storm events.	Introducing measures to slow or attenuate runoff and river flow throughout the catchment could reduce the risk of flooding further downstream and control the amount of sediment entering the river. Measures include river restoration, farm management and NFM.
Catchment-wide soil erosion, sediment and pollutant transport	Water quality impacts related to agricultural runoff and urban/industrial runoff sources; Sources from bank erosion and channel scour; Impacts on channel morphology (burial of bed forms) and related impacts on flow and geomorphological processes; Loss of habitat quality	
Channel morphology (artificial modifications: uniformity, channel diversion and local straightening)	Lack of morphological diversity; Trapezoidal channel form, over-deepening; Limited diversity in flow types and aquatic habitat conditions; Poor connectivity with floodplain; Reduced gradient (diversion), promotion of channel incision during high flows (straightening); High conveyance of flood flows	Solutions for addressing modifications to channel morphology and improvements to connectivity with the floodplain include: Re-meandering, the creation of wetlands, bank re-profiling, and the creation of new in-channel features and large wood.
Barriers to fish passage	Impacts on biological and sediment connectivity (e.g. fish passage and sediment transport downstream); Impacts on local hydromorphology (water levels, ponding and siltation upstream, scour downstream); Impacts on flood risk (restriction to high flows, blockage risk); Impacts on local physic-chemical parameters and/or direct loss of aquatic habitat; Reduced potential for natural channel adjustment processes (lateral and longitudinal)	Solutions to this pressure include: removal of barriers and associated bed re-profiling and in-channel works, structures or mechanisms to allow fish passage (and sediment transfer)
Excessive riparian and in-channel vegetation	Excessive shading (impacts on physic-chemical parameters and biological indicators); Impacts on channel morphology; Impact on flow and geomorphological processes (e.g. coarse wood dams and in-channel trees promoting sediment deposition and back-ponding and	Solutions for excessive vegetation include: Vegetation management

	upstream, localised bed and bank scour downstream)	
Sparse riparian vegetation	Lack of tree cover, exposed channel (impacts on physic-chemical conditions and biological indicators); Access for livestock leading to poaching, bank degradation and sediment inputs; No buffer against surface runoff	Solutions for excessive vegetation include: Vegetation management

The following section looks at the Yar in detail, identify at a Geomorphological Reach scale the key pressures, the suitability of any solutions and where these may be applicable.

6 Geomorphological reach summary

During the geomorphological walkover survey the Eastern Yar was divided into 18 geomorphological reaches, with Wroxall Stream and Scotchells Brook each divided into a further three areas (Figure 12). Further details and maps are provided in Appendix C and a CD rom will accompany this report containing all of the GIS files.

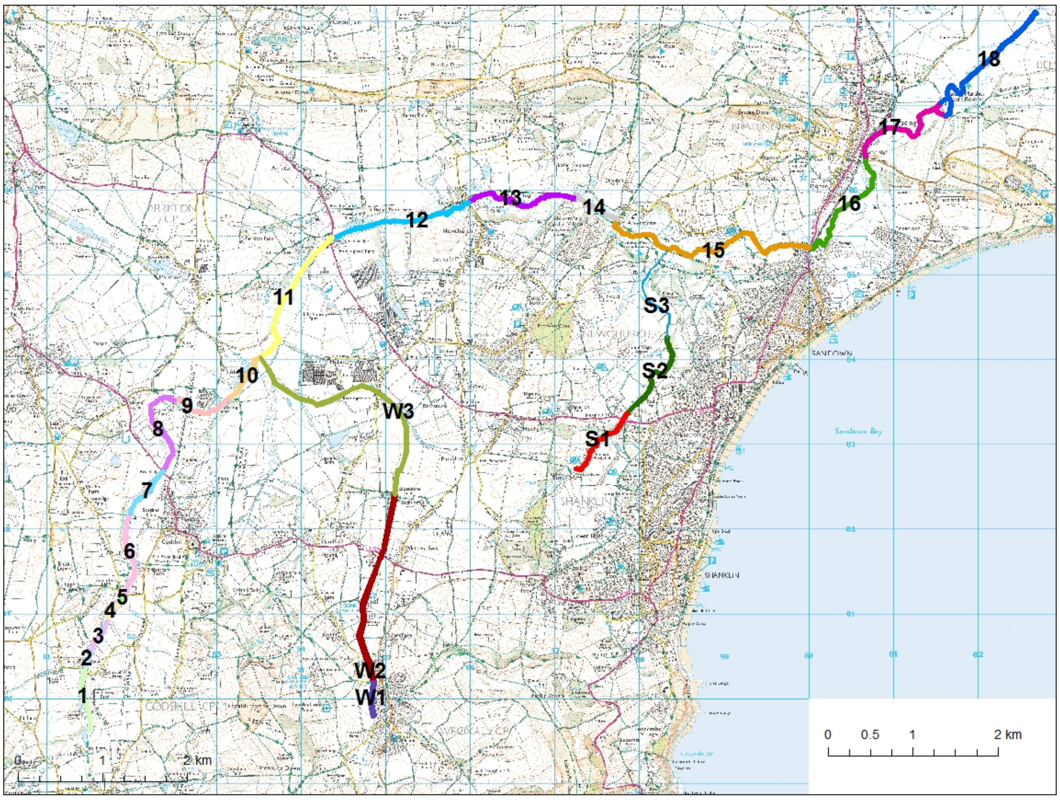


Figure 12: Geomorphological reaches of the Eastern Yar and general areas in Wroxall Stream and Scotchells Brook Catchment

The following section provides a summary of the characteristics of each of the Reaches surveyed during the geomorphological and catchment walkovers that fall into each of the three WFD water bodies to provide a wider location context. At the end of the summary for each reach solutions are identified that might be adopted to address the key pressures identified.

6.1 E Yar (upper)

Observations on the agricultural land surrounding this section of the catchment showed surface runoff and sediment erosion on the landscape could be adding stress to this section of the Eastern Yar (e.g. Figure 13 and Figure 14).

Further investigation in this areas would be necessary to assess the potential benefits and specific areas of opportunities for reducing flood risk and excess sediment levels in the Eastern Yar through the implementation of runoff and sediment management measures in this area.

Figure 13: Left – Arable fields West of Niton exhibiting flow pathways

Figure 14: Arable field near Southford Lane discharging runoff directly into Upper Eastern Yar

The main catchment based proposals are related to runoff management techniques that will reduce sediment erosion and soil loss in agricultural land, while limiting sediment delivery into the watercourses. These actions could also provide additional benefits for flood protection.

Potential general areas that could be further investigated as locations for the implementation of runoff management and ditch management techniques are shown in Figure 15. These areas were identified at the desk study and catchment walkover, although more specific feasibility assessments would be required. These actions could provide increased benefits if combined with the use of large woody dams (LWD) at strategic locations in upstream areas of the catchment.

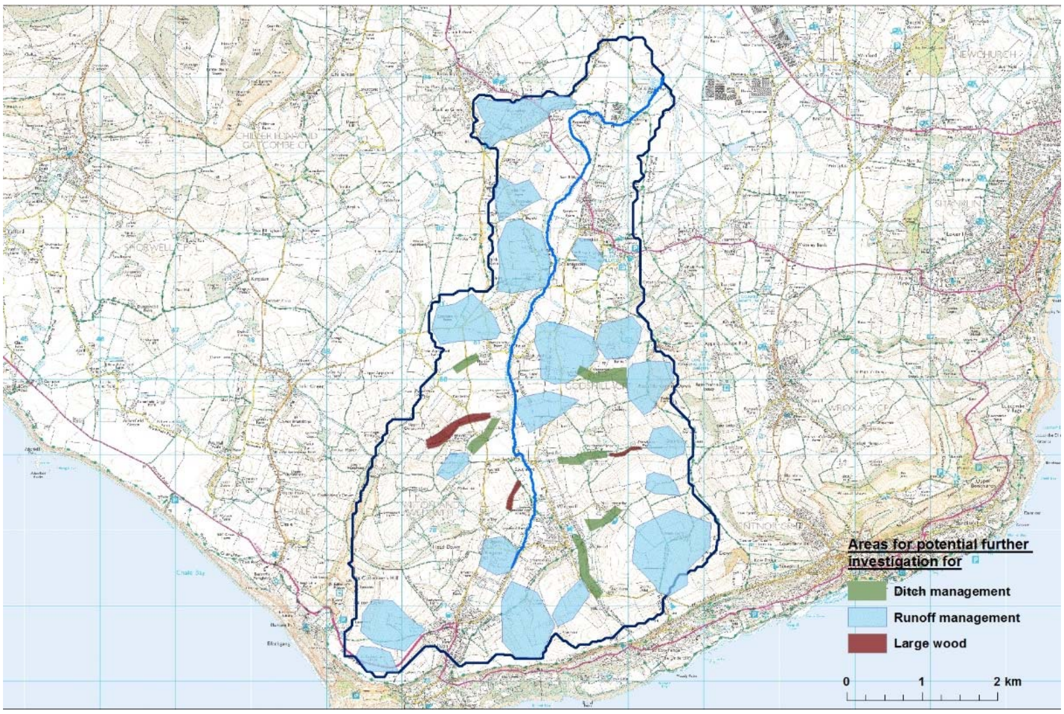


Figure 15: Potential locations of catchment wide solutions for further investigation, Upper Eastern Yar

Figure 16 provides a summary of the restoration options at a sub-catchment level and the following sections provide details of the pressures and solutions at a reach scale.

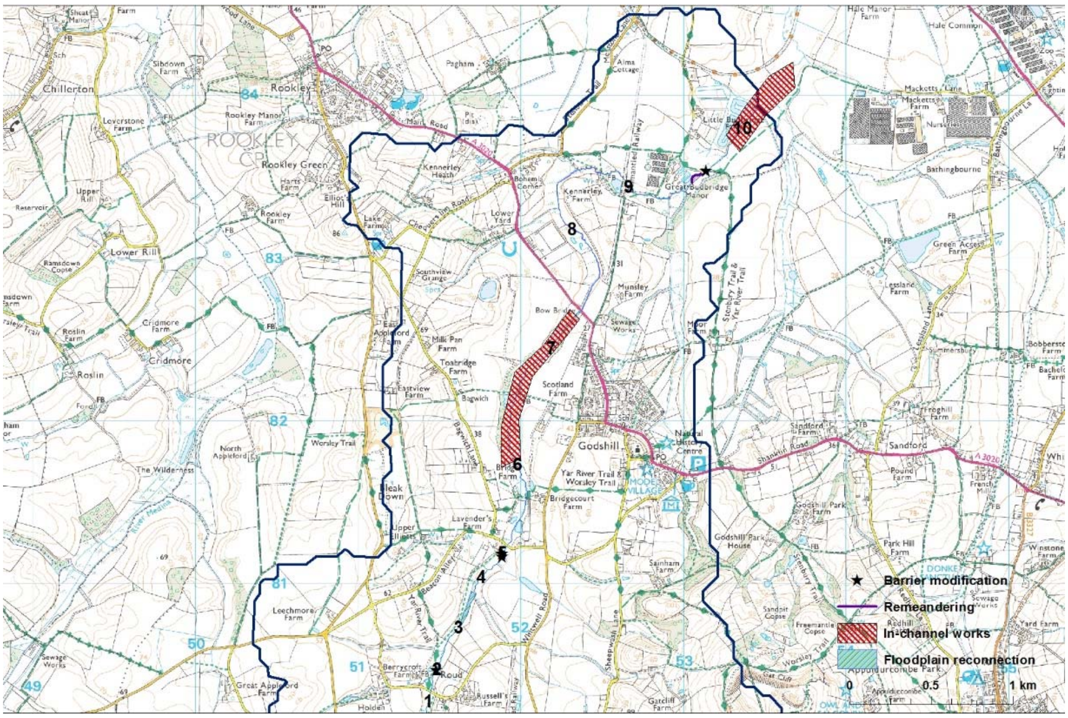


Figure 16: Proposed channel based restoration for the upper Eastern Yar

6.1.1 **Source to Roud – Reach 1** upstream of Roud STW to Roud roadbridge

The Yar at its source is a very small stream (up to 1 m wide and 10 cm deep) with irregular access due to development and vegetation) and is culverted under roads and through some residential areas with some reinforced walls near housing, however, the stream runs mostly through rural land.

The flow is relatively diverse, and signs of both active erosion and deposition processes taking place. Riparian cover is composed mostly of herbaceous vegetation and shrubs, with sparse wooded cover.

Some minor channel straightening has taken place next to Roud STW (less than 30 m long).

Figure 17: Views of reach 1

6.1.2 Roud to Wroxall Stream confluence – reaches 2 to 10

Between Roud and Burbridge, the channel is more sinuous than it would appear in the contemporary OS maps, which may be a sign that the channel is starting to recover from historical modifications. Although the river shows some flow and morphological diversity, the channel is fairly trapezoidal in some places. This channel shape and evidence of incision is more evident and widespread in the downstream end of the water body, with signs of bed lowering and undercutting.

The catchment walkover showed that agricultural land surrounding the river is contributing significant amounts of runoff and associated sediments into the drain and river network (see Figure 18). The 2013 EA report also identifies sediment input into the river from surrounding fields in this area. Some sediment input is also coming from bank erosion and channel bed incision. These fine sediments can contribute to the deterioration of morphological quality and aquatic habitat condition of the system.

Figure 18: Left – Arable fields discharging runoff in the Whitwell area

Reach 2 – Roud roadbridge to first left bank tributary

The channel becomes wider in this section, with relatively diverse flows including runs and some small poorly formed riffles. Several small ditches and one larger tributary drain into this reach. As mentioned above the channel planform in this area is more sinuous that the OS maps show. Although there are some short sections where the channel is trapezoidal, with near vertical banks there are also more asymmetrical parts where different erosional and depositional processes are taking place. There is evidence of some incision and also some fluvial erosion on the right bank in a few places.

Figure 19: General view of Reach 2 and weir in the lower half of the reach

The riparian vegetation is composed mostly of dense shrub and woody vegetation on the right bank, while it is less dense and mostly composed of grasses and scrub on the left bank. Ponds (located on the left floodplain) that may be performing a runoff attenuation function were observed in this reach.

There is a small weir at the upstream end of the reach, linked to the road culvert in Roud and a larger weir further downstream.

Reach 3 – left bank tributary to right bank tributary confluence between Beacon Alley and Whitwell Road

This reach is a sinuous section of the river, with slower flows than those observed in the upstream reaches, suggesting a shallower gradient/longprofile. The channel in this section is fairly trapezoidal in places, with some signs of incision that may be related to historical dredging of the bed. Morphological diversity is also lower than in Reach 2, with predominately runs. There is some large wood in the channel (Figure 12), increasing morphological processes and diversity locally.

There is a 1 m wide drain running parallel to channel in this area. There is evidence of recent out-of-bank episodes in the upstream section of the reach, such as flattened vegetation and saturated land. Steep banks and incision in the lower section lead to disconnection between the channel and its floodplain, which increases as it flows downstream. However, the left floodplain also appears to become easily waterlogged. Marginal habitat become less developed in this reach.

Riparian vegetation cover is mixed on both banks, with approximately 35% of it being wooded.

Figure 20 Reach 2 in the upper Eastern Yar.

Reconnecting the channel to the left floodplain by reprofiling the bankat the downstream end of the reach, where it is not used for agriculture purposes, could improve floodplain wetland habitat and contribute to downstream flood risk reduction, while adding some diversity by creating a more asymmetrical cross-section. Details of the potential locations of these actions are shown in Figure 16 and in Appendix E.

Reach 4 - right bank tributary confluence between Beacon Alley and Whitwell Road to East of Lower Elliots

The channel is sinuous and fairly diverse in Reach 4, with erosional and depositional features present. Banks are steep, and composed of cohesive silty and sandy material. The channel is incised and disconnected from its floodplain. There is a dense riparian vegetation cover, composed up to 50% of trees on the left bank, but more open and with sparse tree cover on the right bank.


Figure 21: Reach 4

There is potential for improving the connection to the left bank floodplain on the upstream section of the reach, where there is an area currently covered in rough vegetation, improving both channel morphology and marginal and riparian habitat quality. Details of the potential locations of these actions are shown in Figure 16 and in Appendix E.

Reach 5 – East of Lower Elliots to Beacon Alley road bridge

In this reach, the banks are higher (approximately 2 m) and flows are faster. The channel is incised and there is evidence of bank erosion on the left bank. The channel is trapezoidal with steep banks in places.

The riparian cover is mixed. With dense woody vegetation and scrub on the left bank, and slightly less dense on the right bank.

Road runoff was observed draining directly onto the river at the bridge on the downstream end of the section. This could have an impact on water and sediment delivery downstream, but also potentially on water quality due to the input of runoff and road associated pollutants.

Figure 22: Reach 5 and road runoff discharging into river.

There is a small weir East of Lower Elliotts, which could be related to the channel straightening that has taken place immediately upstream. There is an area of woodland and rough grassland at that location and there could be an opportunity to re-meander the channel or at least increase its sinuosity here. However, any option would have to take into account the existing farm (and buildings) (which has been present in this area before any channel modifications took place) and flood risk implications. If re-meandering is not feasible, the sinuosity of the channel could be increased along the existing planform. Figure 16 (and Appendix E) shows the possible location of this re-meandering option.

Reach 6 – Beacon Alley road bridge to footbridge west of Scotland Farm

The channel becomes wider (3 m) in this reach, with high and steep banks. Although the planform is fairly sinuous, in-channel morphological diversity is low.

Access to the channel is poor, with dense woody vegetation on both banks, providing a buffer between the channel and arable fields.

Figure 23: Reach 6

In-channel works, including the creation of alternating berms and introduction of flow deflectors to narrow down the low flow channel could aid improvements in geomorphological processes and morphological diversity. Bank re-profiling would provide additional diversity and ensure that channel capacity is maintained.

The river has been straightened in this reach, approximately 50 m near Bridgecourt House, but reconnection would be difficult, as the original location of the channel is now part of the built-up area.

Reach 7 - footbridge west of Scotland Farm to Bow Bridge

The channel narrows down slightly to approximately 2.5 m on average in this reach. There is some in-channel diversity and some evidence of active processes, although the reach is mostly uniform with little diversity in morphological form. The left bank is sloping in sections, while the right bank is steeper. There is a layer up to 0.05 m deep of silt on the river bed near the toe of the bank.

There is dense riparian vegetation composed mostly of scrub and trees, which are encroaching the channel in places. This heavily vegetated area provides a natural buffer between the river and arable land on both sides, and can also provide shade and shelter to aquatic species. Habitats may be negatively affected, however, where the vegetation is encroaching the channel due to impact on marginal habitats.

Figure 24: Reach 7 showing encroaching vegetation

This existing vegetated bank area could be reprofiled together with in-channel flow deflectors to increase morphological diversity without losing channel capacity but improving fluvial processes. These works should be taken in conjunction with those proposed for reach 6. The works should be designed in order to maintain a good buffer and vegetation cover whilst managing the encroaching vegetation.

Reach 8 – Bow Bridge to footbridge at Kennerley Farm

Bow Bridge STW is located at the start of this reach and the left bank is much higher (approximately 4 m) than the right bank (2-2.5 m). There is some morphological and flow diversity in the channel.

The banks are heavily vegetated with shrubs and trees, which are encroaching the channel in places and as such vegetation management may be need in this section. No significant opportunities for in-channel improvements were identified.

Figure 25: Reach 8

Reach 9 - footbridge at Kennerley Farm to Great Budbridge Manor bridge

Banks are much lower in this reach on average (approximately 1.5 m), and sloping in places, although the left bank is more vertical in general and there is evidence of fluvial erosion and channel failure.

There are fewer trees on the banks, with riparian vegetation dominated by shrubs and tall grasses. Large wood was observed in the channel, appearing to having been placed deliberately (potentially to slow down flow) at a section not located near productive land

Figure 26: Reach 9 and gauging station.

Budbridge gauging station is located at the downstream end of the reach. This is a functioning hydrometric monitoring station[4] that is currently a barrier to fish passage. Any improvements to fish passage would need to consider that this is a functioning hydrometric monitoring station[5]. There are also some ponds, created in the 20th century on the left floodplain in the vicinity of the gauging station, potentially related to disused greenhouse infrastructure at Budbridge Manor.

A 120 m long section in the downstream end of the reach, upstream of the gauging station has been straightened. Landowners should be consulted and flood risk, socio-economic implications and potential impacts on gauge should be assessed in order to assess the cost-benefit of any potential remeandering in this area.

Reach 10 - Great Budbridge Manor bridge to confluence with Wroxall Stream

The channel in this reach is trapezoidal, 2.5 to 3 m wide on average with a slightly higher right bank (2 m) than left bank (1.5 m). There is evidence of both fluvial and sub-aerial erosion on the banks.

There is a fairly high embankment on the left bank, possibly constructed with arising's from historical dredging of the river bed. There is a similar but lower embankment on the right bank.

[4] Environment Agency, personal communication.
[5] Environment Agency, personal communication.

Figure 27: Reach 10

A sharp meander was disconnected in this section in the past creating a straightened section which was shortened to a third of the original length (from 100 m to 35 m). Some fishing ponds have been created on the left floodplain in the 20th century. The site of the original channel is now productive arable land with a small wooded buffer area adjacent to the channel. These factors may cause complications if reconnection was desirable, especially if the land is of high productivity. As an alternative, there may be potential for in-channel works to narrow low flow channel and reprofile the banks to improve channel morphological and improve habitats locally.

6.2 Wroxall Stream

The Wroxall Stream is in the best condition in comparison to the other waterbodies in the catchment, and specifically in terms of morphology and flow diversity and typically the river bed substrate composition is dominated by gravels. There appears to be a lack of natural large wood in the channel, although there are riparian trees present.

The sub-catchment has exhibited far fewer pressures in terms of sediment erosion and transport – particularly in the upper part of the catchment. There are limited obvious examples of runoff pathways and much of the land is utilised for light grazing, which in the confines of the steep valley is extremely beneficial (in terms of reducing runoff risk). Figure 28 shows a view of the catchment from the top of Wroxall Down, showing that there are fewer arable fields in the upper part of the sub-catchment.

Figure 28: View into the Wroxall Stream sub-catchment from the top of Wroxall Down

Wroxall Stream has upstream areas that could be included in a runoff management scheme with significant benefits for both the sub-catchment and the Eastern Yar as a whole (Figure 29) This would also help manage diffuse pollution from agriculture which has been identified as one of the potential reasons for failure of the water body (Environment Agency, 2014). Further investigation is required to assess the use of specific locations, including use of appropriate tools to assess potential benefits and costs. Actions in this area need to consider inputs from the STW.

Figure 29: Potential locations of catchment wide solutions for further investigation, Wroxall Stream

There may still be potential to improve the management of some of these areas – especially towards the bottom of the catchment, where more arable farming is evident. The morphological condition of the channel, particularly the substrate, supports the fact that there are fewer catchment pressures in the Wroxall Stream sub-catchment in terms of excess fine sediment input, although some pressure in terms of water quality has been identified in the WFD water body summary (Environment Agency, 2014c).

Proposed in-channel works for the Wroxall Stream downstream of the A3020 (Figure 30) road bridge would involve the redistribution of existing material within the channel to create features such as bars to increase in channel diversity. Minor large wood features could also be potentially introduced to increase diversity and encourage differential processes to take place.

There are some access constraints, but would be a relatively low level intervention that would contribute to improving system dynamics.

Bank re-profiling options could also be explored, together with some floodplain storage/reconnection options on tributaries

Figure 30: Proposed channel-based restoration for the Wroxall Stream

The sub-catchment was divided into three general areas based on access and general condition. The following sections

Reach W1 – upstream section

The channel has a fairly natural bed in the upstream section. The main channel modifications are found adjacent to developed areas, with artificial banks used mostly for flood protection purposes, and significant culverting through Wroxall itself as a result of its urbanisation in the 20th century. Floodplain connectivity is generally low as a result of the aforementioned bank protection, although there is some connection where the stream drains agricultural land.

Figure 31: Wroxall Stream, upstream section

Reach W2

The bed is armoured, with substrate composition dominated by fine and coarse gravels within this reach. In some sections the bed is very uniform across the channel, with very little cross-sectional and longitudinal variability, which could imply lower habitat diversity in these areas.

There is bank protection related to built-up areas, limiting the opportunity to increase floodplain connectivity. There are two small weirs upstream of A3020 road bridge. The purpose of the structures is unknown.

In-channel works using existing material present within the channel could provide benefits to this area by increasing diversity where it is poor.

Figure 32: Wroxall Stream, middle section and weirs upstream A3020.

Reach W3

The substrate composition is dominated by fine gravel, with some finer sediments. There are some armoured sections with very little cross-sectional and longitudinal variability. There is bank protection related to built-up areas and associated infrastructure.

In-channel works based on the redistribution of existing material could provide benefits to this area by increasing diversity. Bank reprofiling options could also be explored, together with some floodplain storage/reconnection options on tributaries.

6.3 E Yar (Lower)

For most of this sub-catchment the channel is incised and the bed has been lowered along a significant part of its course, probably as a result of historical dredging. The channel is typically trapezoidal, with near vertical banks that are undercut near the toe in places, suggesting that the river is trying to adjust its morphology to a more natural form (i.e. attempting to recover from historical modifications). The significant channel straightening that has taken place in the Eastern Yar in this area is very noticeable in this area, as some of these abandoned channel sections remain as wetland areas or are prone to waterlogging.

Himalayan balsam is present in this sub-catchment, and the dominant near vertical banks add an additional complication to the efficient control of this invasive non-native plant.

Sediment erosion was observed mainly in agricultural fields located north of the river in this section. This is combined with the sediment yield from the Upper Eastern Yar sub-catchment. Several instances of high sediment runoff being routed through the road network were also recorded. Slowing, storing and filtering this runoff at source or opportunistic locations along its natural route could have multiple benefits at source and further downstream. Capturing sediment valuable to agriculture, or wetting areas for habitat improvement can reduce flood flows and improve downstream water quality.

Catchment management options including runoff and ditch management, use of LWD and overland ponds. A number of potential locations for further investigation are shown in Figure 33, from which a selection could be implemented depending on feasibility and land-ownership constraints. Ideally, areas that would address the largest extent of flow paths should be targeted as a priority. These actions could reduce sediment erosion and soil loss in agricultural land, while limiting sediment delivery into the watercourses. These proposals would also provide additional benefits for flood protection. The use of tools such as FARMSCOPER or similar might be recommended to assess further steps towards implementing these measures.

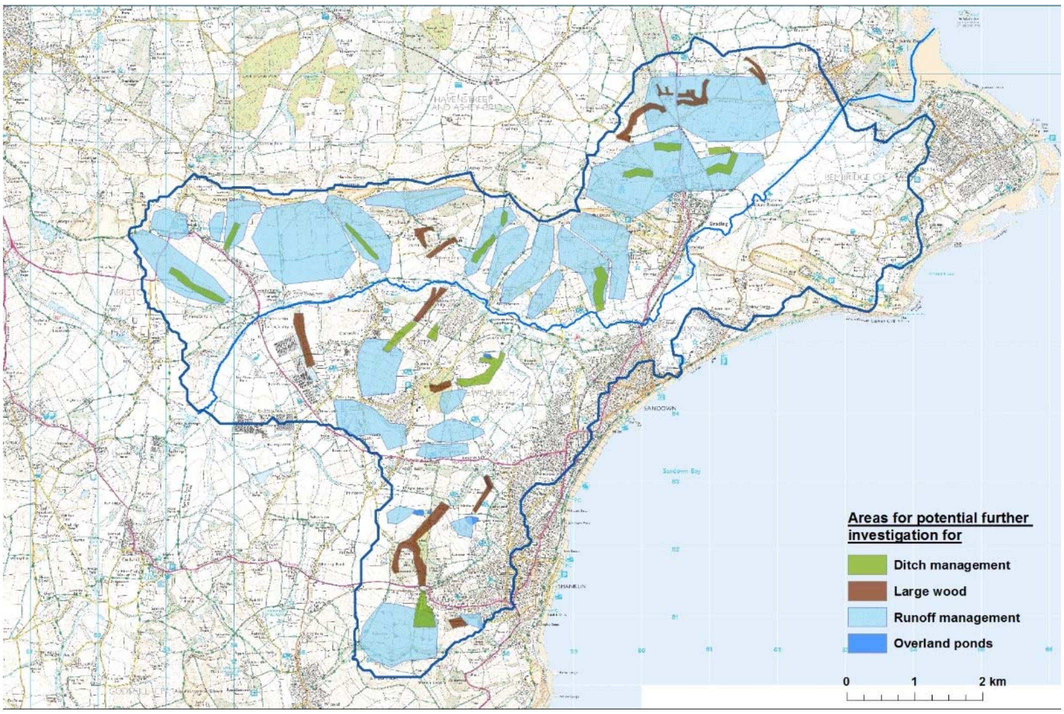


Figure 33: Potential locations of catchment wide solutions for further investigation, lower Eastern Yar

Figure 34 provides a summary of the restoration options at a sub-catchment level and the following sections provide details of the pressures and solutions at a reach scale.

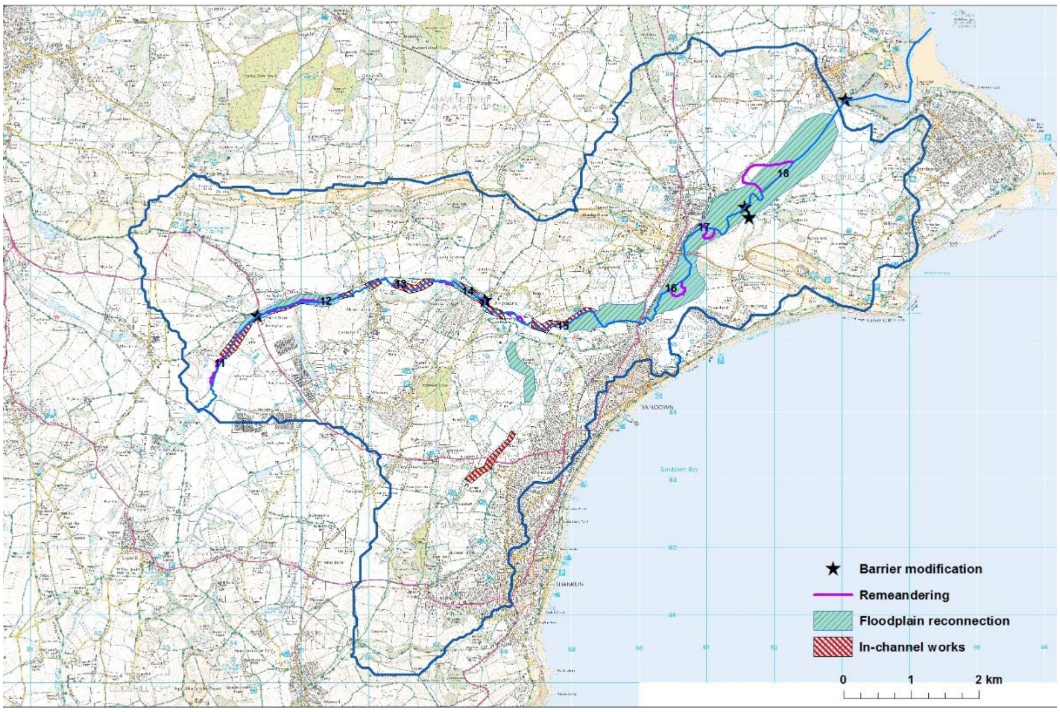


Figure 34: Proposed channel-based restoration for the lower Eastern Yar

6.3.1 Wroxall Stream confluence to Alverstone – reaches 11 to 15

Reach 11 - confluence with Wroxall Stream to Horringford Bridge

Significant straightening has taken place in this reach, with abandoned meanders still apparent on the left floodplain. There is evidence of incision and raised embankments possibly linked to historical dredging, and the bed of the channel is lower than the pond created on the right floodplain at Horringford in the 20th century.

The channel is trapezoidal and in-channel diversity is low. Coverage of bank vegetation is thinner than in upstream reaches, with sparse tree cover (approximately 15%). There is artificial bank protection in places along the reach, some linked to housing and its associated infrastructure.

Figure 35: Reach 11 and Horringford Bridge weir

There is potential for re-connecting to abandoned channels in the upper half of the reach. There is arable land and grassland in those location, so any reconnection options would have to be discussed with landowners and undertake appropriate socio-economic and flood risk impact assessments. In the downstream section, the pond near Horringford is located where the former course used to be, limiting significantly any re-meandering opportunities. As an alternative to increase diversity in this area, there could be potential for in-channel works including bank re-profiling on the left bank (rough grazing use) and floodplain reconnection. Landowner consultation and assessment of potential implications for road bridge would be required.

There is a weir at the downstream end of the reach, upstream of Horringford Bridge, with a flat concrete apron. If the weir is redundant, it could be removed to improve longitudinal connectivity for fish and fluvial processes, although the structure may be linked to bridge foundations. If the weir cannot be removed, a technical fish pass is likely to be the best alternative, and a bypass channel would be complicated due to the presence of the road and bridge. There is a smaller culvert and weir further upstream.

The potential locations for these solutions are shown in Figure 34 and in Appendix E.

Reach 12 – Horringford Bridge to Langbridge

The trapezoidal channel in this reach is embanked and heavily incised due to historical straightening and dredging. These modifications have led to a loss in morphological diversity and floodplain connectivity, as reported as well by the EA geomorphic walkover (Environment Agency, 2014). The banks are composed of cohesive fine material, with evidence of erosion and undercutting near the toe, suggesting that the river is trying to adjust its morphology to a more natural form. There is some erosion on the outside of bends where the river is more sinuous, and also some depositional features such as mid-channel bars.

Figure 36: Reach 12 and line of former channel on floodplain

The bed substrate is mostly composed of fine material, but there is also some gravel present. Riparian vegetation is encroaching the channel in places. Large macrophyte beds are also present. Although disconnected from the channel, the floodplain waterlogged near Langbridge.

Significant straightening has taken place in this reach. There is low potential for re-meandering in the uppermost section, but further downstream first on the right floodplain and then on the left floodplain, which are now both grassland there is space on the right floodplain and the imprint of old channel is still visible on the left bank (Figure 36), where the field was highly saturated at the time of the walkover. This area could be used for re-meandering or flood storage. The existing cycle path would need to be crossed for this purpose, which would require a cost-benefit analysis and an assessment of the impact on the amenity value (which could also potentially be enhanced).

If full re-meandering is considered not appropriate, the area on the left bank could be used an engineered reconnection for flood storage. The existing cycle path would need to be crossed either of these purposes, which would require a cost-benefit analysis and an assessment of the impact on the amenity value (which could also potentially be enhanced).

In-channel works to increase morphological diversity could be an alternative where re-meandering is not possible, including modification of the channel planform to increase sinuosity along existing river line, narrowing low flow channel with the use of woody deflectors and re-profiling at least one bank in most places. There is also potential for enhancing existing bars using in-channel material, using vegetated bars and berms to trap silt in place.

The most appropriate solution for this reach is likely to be a combination of re-meandering, planform modification and in-channel option, according to feasibility. The potential locations for these solutions are noted in Figure 34 in Appendix E.

Reach 13 – Langbridge to cycle track bridge upstream of Alverstone Mill

Within this reach the banks are steep, and the channel form is trapezoidal and incised with embankments from dredging with low in-channel diversity and uniform flow. The central section is very sinuous, although the uniform channel shape prevents a diverse system from developing. The right bank is dominated by herbaceous vegetation and shrubs, with some sparse trees also on the left bank. There are some areas with little riparian vegetation cover where bank erosion can be observed. There is a high silt load, and the bed could not be seen either at the time of the EA walkover in September 2014 (Environment Agency, 2014). There is some gravel in the substrate, but it is mostly dominated by fine sediments.

Figure 37: Reach 13

An area that appears on the map as a drain on the left side is in reality a much wider wetland area. Improving floodplain connectivity in this area would increase wetland habitats, although it is disconnected from the river on the other side of a cycle track.

Upper and lower parts of the reach were straightened from a very sinuous channel, however, there is limited opportunity to re-meander due to the presence of built infrastructure and arable fields.

There may be an opportunity to increase diversity by undertaking in-channel works and potentially introducing or redistributing gravels at key locations.

The feasibility of re-meandering in the downstream part of the reach could be investigated, however, the historical river line crosses the cycle track several times which may limit opportunities. The central sinuous section would benefit from the removal of the embankments, re-grading of the banks and the introduction of flow deflectors to increase diversity. If embankments are removed, it is recommended that the potential reuse of the material is investigated, as it could be used to create aquatic berms, or if any gravel is present it could be sorted out and reintroduced to the channel.

The potential locations of these solutions are shown in Figure 34 and Appendix E.

Reach 14 - cycle track bridge upstream of Alverstone Mill to Alverstone Mill

This reach is impacted by the ponding effect of the sluice at Alverstone Mill. Although riparian vegetation is fairly dense in the upstream section of the reach, it becomes relative sparse nearer the sluice. The channel shape is mostly trapezoidal with very little morphological diversity, although there is a more asymmetrical section in the upstream part of the reach. There is a path that runs parallel to the channel, with evidence of bank erosion from walkers/dogs, and embankments on part of the section.

Figure 38: Reach 14, ponded reach upstream of Alverstone Mill

Modifications of this impounded section relate to presence of Alverstone Mill (earlier than 1860 maps). In addition to the ponding, the sluice is a barrier to fish passage. It would be difficult to improve the diversity of existing channel effectively if the barrier was not removed, although a naturalised bypass channel could be created, designed to be adapted to existing flow characteristics and providing additional channel capacity and creating upstream access for fish. To create this bypass channel would require the sacrifice some land (doesn't appear to be productive) and part of path that runs next to the river, although the nearby cycle path can provide an alternative route. Flood risk and socio-economic analysis would be required. Figure 34 (and Appendix E) shows the potential location of these features.

Reach 15 – Alverstone Mill to Sandown Bridge

The channel in this reach runs through Alverstone Mead Nature Reserve in the upstream section and through the Wildlife Trust owned land further downstream. The remaining surrounding areas are mostly fields, with herbaceous riparian vegetation and very few trees. It is a fairly sinuous section, although in-channel morphological diversity is low in the upper section due to the uniform, trapezoidal shape of the channel. The channel becomes more diverse in the downstream part of the reach. The confluence between Scotchells Brook and the Eastern Yar is located in this reach. Some bank protection is present around infrastructure such as bridges and Burnt House pumping stations.

Embankments likely to be created from dredging material form bunds on banks that limit connectivity between the channel and its floodplain. Even at the time of the site visit (which followed periods of high rainfall/flows) the river water level was higher that the topographic level of the floodplain and was still retained within the channel.

Substrate silt thickness was measured at some spot sampling points located near the bank toes up to 0.20 m, and at some points presence of some gravel was also noted.

Figure 39: Reach 15

There are two straightened sections in this reach, one immediately upstream of the Scotchells Brook confluence, and the other one upstream of Sandown Bridge. There may be potential for remeandering in the furthest upstream section, subject to appropriate studies and consultation. In the downstream end of the reach, the area where of the historical channel was located has since been urbanised (Balgowan Estate). If the land on the opposite left bank is available, a new diverse channel could be created in this area. There is also potential to increase in-channel morphological diversity with flow deflectors and regrade the modified banks, along with improved lateral connectivity. Removal of the embankment could help improve wetland and grazing marsh habitat quality by aiding a natural reconnection to the floodplain. The potential use of the embankment material on site should be investigated. The potential locations of these features can be seen in Figure 34 and Appendix E.

6.3.2 Alverstone to Brading Marshes – Reaches 16-18

Evidence of channel straightening is also visible in this section, which is corroborated by historical OS showing meandering sections where the river is now straight. Some of the abandoned channel sections are still present and are also shown in current OS maps.

The channel is mostly trapezoidal in shape, with little in-channel diversity in terms of morphological features and flow types, and the system is therefore providing low habitat diversity. There is vegetation encroaching into the channel in places.

According to sources in the stakeholder workshop, most of the runoff with potential to deliver significant amounts of water and sediment into the water body can be observed in the northern part of the sub-catchment. This area has also been identified in the GIS analysis as having great potential for surface water runoff due to the steep valley sides of this part of the catchment (see Figure 40). . The majority of the catchment walkover in this sub-catchment was based in the Brading Marshes to assess the potential for reconnecting the river with the surrounding floodplain.

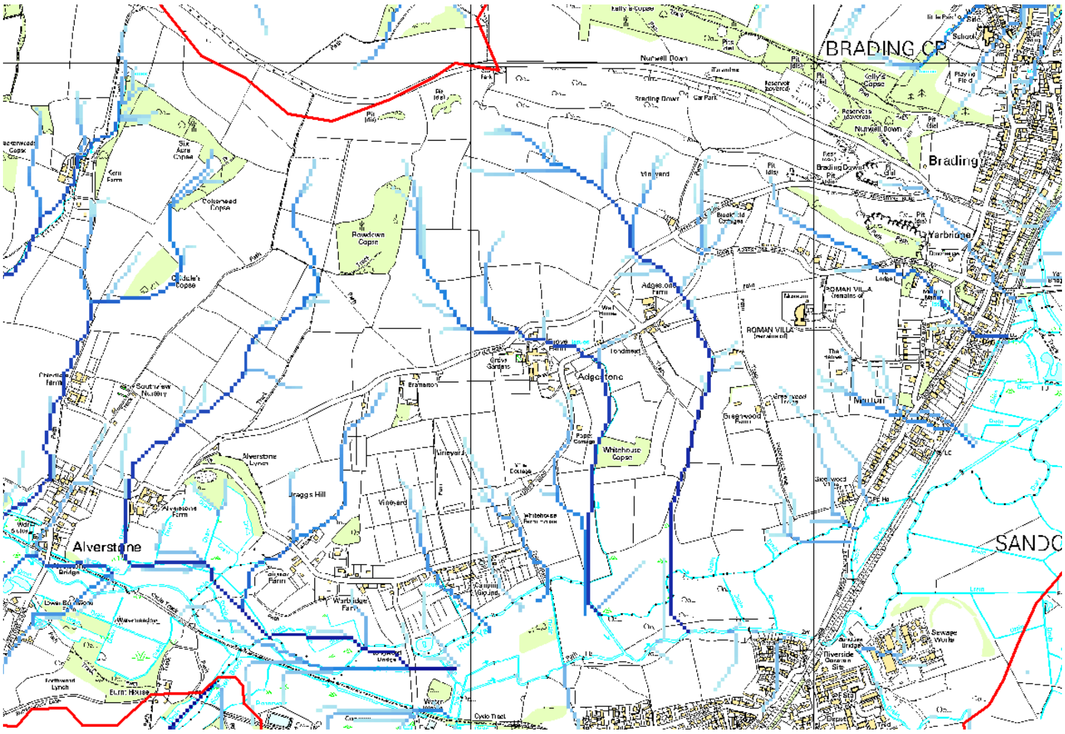


Figure 40: Screen shot of GIS output showing the runoff pathways detected in the topographic analysis

Reach 16 – Sandown Bridge to Yarbridge

The channel in this reach is typically 3 m wide, with banks 1.5 m high and covered in denser vegetation. The floodplain is predominantly grassland, with fields on the right bank and scrub on the left. There is some evidence of minor stock poaching the banks in this reach.

The channel is incised and has experienced bed lowering through dredging. The dredged material is likely to have been deposited along the bank tops forming a bund, disconnecting the river and the floodplain resulting in the floodplain being more prone to waterlogging as water will struggle to drain naturally back to the channel. In addition, it has been reported by stakeholders that some material resulting from dredging the channel has also been deposited on some hollow areas of the floodplain, impacting fenland or grazing marsh habitats.

The channel is mostly trapezoidal in shape, with little in-channel diversity in terms of morphological features and flow types with poor marginal habitats. Siltation in this section appears to be more pronounced with respect to the sections upstream. Substrate silt thickness was measured at some spot sampling points at up to 0.30 m near the bank toe.

In some areas, the loss of the active floodplain is leading to the establishment of scrub which can encroach into the channel and wetland areas result in loss of valuable habitats.


Figure 41: Reach 16 and abandoned meander in Brading Marshes

Some of the land on this reach is owned by the RSPB. There is an abandoned meander on the right bank which maintains still its original morphology and could be reconnected to the river with significant benefits in terms of improved fluvial dynamics and habitat conditions. In addition, there is opportunity to improve lateral connectivity where possible along the reach, providing additional support to grazing marsh habitats. Feasibility may be limited closer to the railway embankment. Figure 34 shows the location of where these solutions could be implemented.

Reach 17 – Yarbridge to Great Sluice

This reach runs along the railway at the upstream end. The channel is trapezoidal, with little in-channel diversity. There are significant wet areas on the floodplain, mainly in the lower section of the reach. Vegetation cover is sparse on the right bank in the upstream section, with denser wooded vegetation between the railway and the channel on the left. Bank vegetation is mostly herbaceous further downstream, with a significant presence of marginal reeds.

The sluices at the downstream end of the reach are the main water level control structures, required to maintain appropriate levels for conservation and flood protection purposes. These structures pose significant barriers to longitudinal connectivity and fish migration. Any modifications to improve fish passage would need to be integrated with the structure use it.

Figure 42: Reach 17

There is a section where a meandering section has been straightened and there is good potential for reconnecting this historical meander to the main channel. In addition, steep banks could be modified to improve lateral connectivity with the floodplain. The locations of these opportunities are shown in Figure 34 and Appendix E.

Reach 18 – Great Sluice to upstream of Bembridge Sluice

The channel in this reach in Brading Marshes Nature Reserve is mostly trapezoidal, with little in-channel diversity. The channel is incised and dredged material has been deposited to create an embankment along the banks, creating a disconnection between the channel and the floodplain. Some bank failure was observed. There are significant wet areas in the reach. Riparian vegetation is predominantly herbaceous, with some marginal reeds.

Figure 43: Reach 18 (right) and wetland area (left)

There is an historical meandering section that has been straightened and shortened to half of its original length, There is good potential for reconnecting this historical meander and removing the embankments and reprofile the banks to improve lateral connectivity and morphological diversity. Figure 34 (and Appendix E) show the location of this feature and the possible solutions in this reach.

6.3.3 Scotchells Brook

Except for the reaches closest to the source, Scotchells Brook shares many of the characteristics of the Lower Yar, with incised, overwide and overdeep channels with little morphological and flow diversity. Siltation is significant in the channel, both on the bed and as suspended material. The flow of the brook is slackened noticeably at the confluence with the Yar.

The assessment of the contributing catchment showed areas of runoff generation and potential for sediment transfer into the water body (see Figure 44). The upper reaches of the main channel and its tributaries, however, also showed opportunities to slow down the flow and sediments before they reach the more impacted reaches of the river – particularly given the steep topography leading to Apsecastle Wood (see Figure 45). Several opportunities for slowing and attenuating flow were found within the upland agricultural areas and within the woodland in the centre of the Scotchells Brook sub-catchment.

Figure 44: Left – Poaching at entrance to field in upper Scotchells Brook sub-catchment; Right – Poaching at livestock crossing point upstream of Apsecastle Wood

Figure 45: View of Scotchells Brook sub-catchment from top of St Martin's Down (the wooded area in the centre of the photo is Apsecastle Wood leading onto America Wood)

Catchment management options for Scotchells Brook include runoff and ditch management, use of large woody dams and overland ponds (Figure 46). Further investigation is required to assess specific locations that could have the most benefit in this area. Scotchells Brook shows the same high silt content pressures of the Eastern Yar, and these actions would help reduce sediment erosion and soil loss in agricultural land, and limit sediment delivery into the watercourses. These proposals could also provide additional benefits for flood protection. Socio-economic and flood risk assessments would be required.

The use of LWD at Apsecastle Wood and America Wood would be a tool for water retention following the land management of sediment sources, with would have benefits for both physical habitats and water quality.

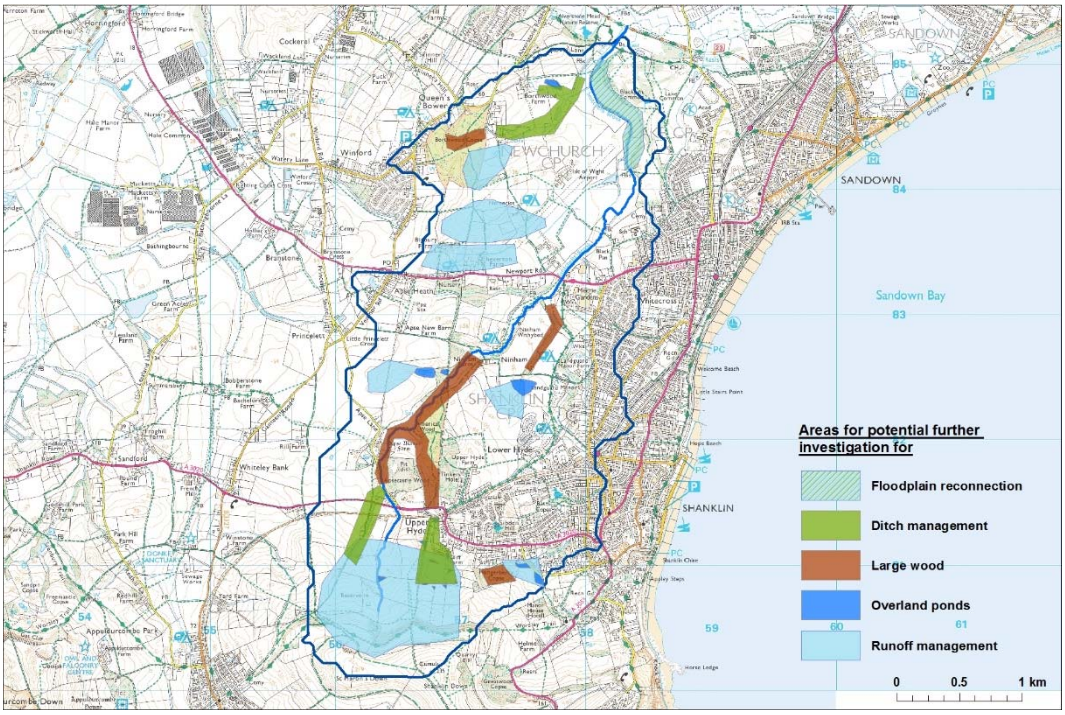


Figure 46: Potential locations of catchment wide solutions for further investigation, Scotchells Brook

The channel further downstream is heavily incised, straightened and with little morphological diversity, and in-channel works to reprofile the banks, improve floodplain connectivity and create a diverse low flow channel would contribute to improve the ecological status of this section and propagate its benefits downstream. If feasible, remeandering and solutions that increase sinuosity are appropriate, otherwise in-channel works, or a combination should be considered.

The flow of the brook is slowed down at the confluence with the Eastern Yar, and the channel spills onto its floodplain upstream of the footbridge at high flows. It is proposed that floodplain reconnection works are taken to the area further upstream to make level fluctuations more gradual. This would benefit existing habitats by restoring natural processes, and also provide additional benefits for flood protection downstream.

Figure 47 provides a summary of the restoration options at a sub-catchment level and the following sections provide details of the pressures and solutions at a reach scale.

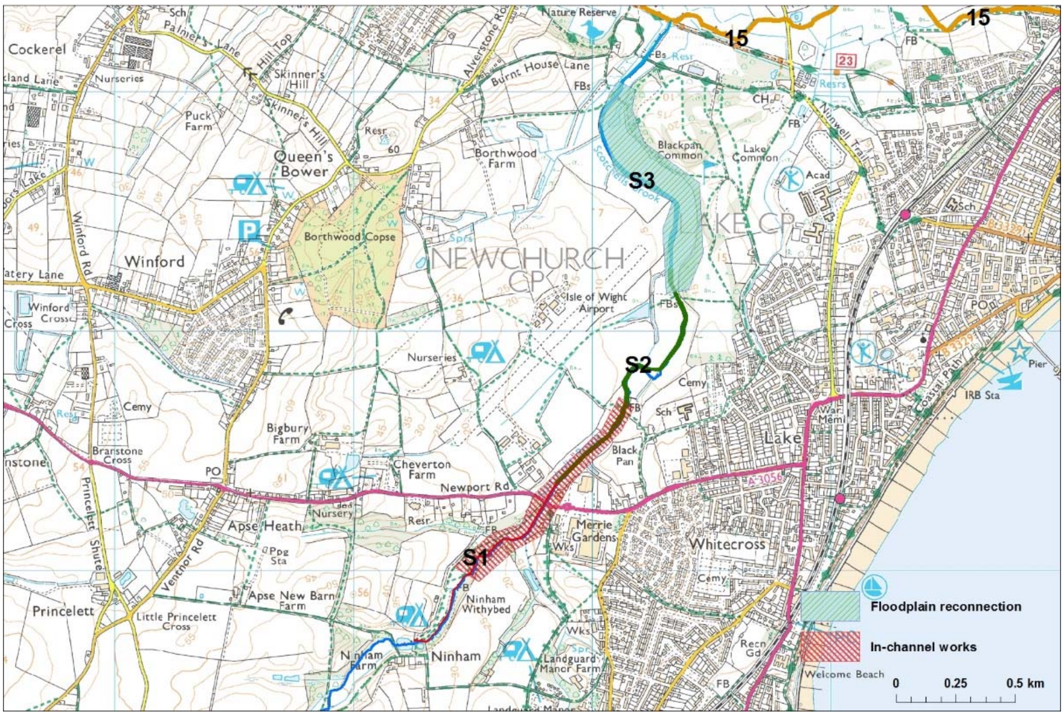


Figure 47: Potential channel-based restoration options for Scotchells Brook

Reach S1

The upstream section of Scotchells Brook is relatively high energy, with significant wooded areas providing large wood to the channel. The planform is fairly natural and there is in-channel variability which is more limited towards the downstream end of the reach, where the channel becomes more trapezoidal.

There is potential for some minor in channel intervention in this reach to increase morphological and flow diversity, with introduction of flow deflectors and/or redistribution of existing material.

Figure 48: Scotchells Brook, upstream section

Reach S2

The channel becomes clearly incised in this reach with little morphological and flow diversity and poor connectivity to the floodplain. Due to the uniformity of the channel, there is little process variability in the system. Siltation is significant in the channel, both on the bed and as suspended material.

In-channel works, including bank reprofiling where possible, could contribute to improve system diversity and provide better quality habitats. Appropriate feasibility would need to be undertaken to identify specific locations for such improvements. Any actions would have to be integrated with invasive plant species management actions.

Figure 49: Scotchells Brook, middle section

Reach S3

The channel is uniform with low morphological diversity and poor connectivity to the floodplain, as dredged material has been deposited to create an embankment along the banks. The brook follows more or less same line as 1860, with slightly less irregular sinuosity. The flow of the brook is slackened noticeably due to a locking effect from the confluence with the Yar and siltation levels are high.

Reconnecting the channel to its floodplain would contribute to improved riparian wetland habitat. Improvements to in channel diversity and cross-sectional form to create a more asymmetrical in shape, which would promote more dynamics processes to take place within this reach.

Figure 50: Scotchells Brook, upstream of confluence with Eastern Yar

6.4 Channel dimensions and form

A summary table of the main characteristics of each geomorphological reach is provided below (Table 5).

Table 7: Summary characteristics of the main geomorphological reaches of the Eastern Yar, from upstream to downstream.

Reach	Typical channel width	Typical right bank height	Typical left bank height	Channel shape
1	0.5-1 m	variable	variable	Mixed
2	2 m	1.5 m	1.5 m	Channel fairly trapezoidal.
3	2-2.5 m	1.5-2 m	1.5 m	Trapezoidal in places
4	2-2.5	1.5 m	1.5 m	Trapezoidal in places
5	2.5 m	2 m	2 m	Trapezoidal channel.
6	3 m	2 m	2 m	Trapezoidal, vertical banks
7	2.5-3 m	2.5 m	2.5 m	Sloping left bank, steep right bank
8	2.5-3 m	2-2.5 m	4 m	Trapezoidal channel.

9	2.5 m	1.5 m	1.5 m	Mixed
10	2.5-3 m	2 m	1.5 m	Trapezoidal channel.
11	2.5-3 m	2 m	1.5-2 m	Trapezoidal channel.
12	2.5-3 m	2 m	2 m	Trapezoidal channel.
13	2.5 m	1.4 m	1.4 m	Trapezoidal channel.
14	3 m	1 m	1.5 m	Trapezoidal channel.
15	2.5 m	1-1.5 m	1-1.5 m	Trapezoidal channel.
16	3 m	1.5 m	1.5 m	Trapezoidal channel.
17	3-3.5 m	1.5 m	1.5 m	Trapezoidal channel.
18	3-3.5 m	1.5 m	1.5 m	Trapezoidal channel.

7 Restoration Plan- summary

7.1 Purpose

The purpose of the proposed catchment restoration plan is to address the existing ecological/geomorphological quality issues through the implementation of a range of both catchment and reach based solutions and to address the pressures and their associated impacts, (as identified in Section 5).

As the issues are inter-related they cannot be effectively addressed in isolation. Furthermore, hydromorphological condition, biological processes, and water quality are closely interconnected, and thus improving the hydromorphological condition of the water body can also contribute to mitigation of water quality and ecology issues. It was agreed by IoW Council, its partners and stakeholders that the restoration strategy should have an integrated approach. The restoration strategy takes also a catchment-wide perspective, considering options that will have a wider benefit on the system.

It is assumed that the EA has already identified and is working towards addressing major barriers to fish passage within the catchment and as such solutions for these issues are not developed within this report.

7.2 Proposed restoration plan

The proposed restoration plan (Figure 51 and Appendix E for a higher resolution figure) is composed of a number of general catchment management options and channel corridor restoration proposals. These are:

- Barrier removal;
- Re-meandering- reconnecting historical channels or increasing sinuosity of straightened channels;
- In-channel works;
- Ditch management;
- Large woody dams;
- Runoff management;
- Floodplain reconnection;
- Overland ponds.

In addition, vegetation management is required along the watercourses in the catchment. Such management already takes place in the lower Eastern Yar, according to the WFD Water Body Summary, except in the case of management of invasive species. Assessment of existing plans, and integration with efforts of vegetation management in other areas of the catchment may be required to ensure the effectiveness of any actions. Vegetation management efforts would need to address encroaching vegetation in some areas, lack of riparian vegetation and presence of invasive non-native species.

In general terms, to ensure that any channel-based options achieve the best possible benefit, it would be prudent to address, in parallel, the issue of excess fine sediment delivery to the system. In the same vein, water quality issues relating to STWs will also need to be addressed.

It is understood that the Environment Agency is undertaking an assessment of the main barriers in the watercourses and will implement appropriate solutions.

A summary of typical average costs for different types of restoration is provided in Appendix G.

Table 8: Summary of potential solutions and benefits

Solutions	Main Benefits
NFM: Corner of field ponds / intercepting runoff	Intercepting runoff from the land will slow the rise of flood peaks downstream and capture sediment at source.
NFM: Ditch management	Attenuation of ditch flows, reduced sediment transport and improvements to water quality.
NFM: Large Woody Dams	Increases roughness of river channel encouraging interaction with the floodplain (in sacrificial areas). Habitat creation for fish. Acts as a debris catcher for naturally occurring woody debris.
NFM: Maximising floodplain storage / offline storage ponds	Creates additional capacity on floodplains and can be designed to target certain flows.
River Restoration: Re-meander	Purpose designed channels can be used to enhance hydromorphological conditions (flow diversity and sediment dynamics), increase oxygen levels and improve aquatic habitat and wider biodiversity value Restore previously modified/degraded channel sections, or to bypass existing structures such as culverted sections, improving connectivity and fish passage and providing more natural habitats; Opportunities for incorporating additional benefits (e.g. amenity features, flood storage features, wetland features, etc.)
River Restoration: In-channel works	Increase flow-type diversity by increasing local flow velocities and turbulence, providing thus improved dissolved oxygen levels; Create features to support an improved distribution of fine and coarse sediments to improve flow and habitats; Create features to trap and immobilise existing fine sediments to reduce the amount of fine sediment and sediment associated pollutants released into the system and improve benthic habitats; Improve benthic, aquatic and marginal habitat quality
River Restoration: Bank re-profiling	Increase morphological variability, providing improved aquatic, marginal and riparian habitats for biological indicators; Increase hydromorphological diversity (flow depths, velocities, sediment dynamics), improving thus more diverse flow dynamics and increasing dissolved oxygen levels in the system; Reduce bank erosion and associated sediment input to the channel to reduce the amount of sediments and sediment associated pollutants being delivered into the channel; Promote formal sediment deposition zones, stabilised by marginal vegetation growth, to reduce the release of fine sediments and sediment associated pollutants into the system, thus improving habitat conditions and water quality;
River Restoration: Vegetation management and selective clearance	Reduce encroaching Reduce bank degradation, scour, ponding of flows, etc., to provide improved flows and increased dissolved oxygen levels and provide better marginal habitats, thus improving habitat conditions and water quality; Control of invasive species to improve conditions for improved ecological assemblages; Improve riparian coverage in areas with low vegetation cover Additional benefit of improved amenity value
Vegetation management Marginal / riparian planting	Reduce excessive channel exposure to reduce the amount of sediments being delivered into the channel and protect aquatic habitats; Provide refugia and feeding habitat for aquatic species by providing a more heterogeneous system, thus improving the ecological assemblages and status of the river; Stabilise banks and reduce fluvial erosion and poaching to reduce the amount of sediments and sediment associated pollutants being delivered into the channel and protect aquatic habitats; Buffer direct surface runoff to reduce the amount of sediments and sediment and runoff associated pollutants being delivered into the channel
River Restoration: Wetland improvements/creation	Provides habitat for wading birds. Evidence for improving water quality and reducing downstream flood risk.

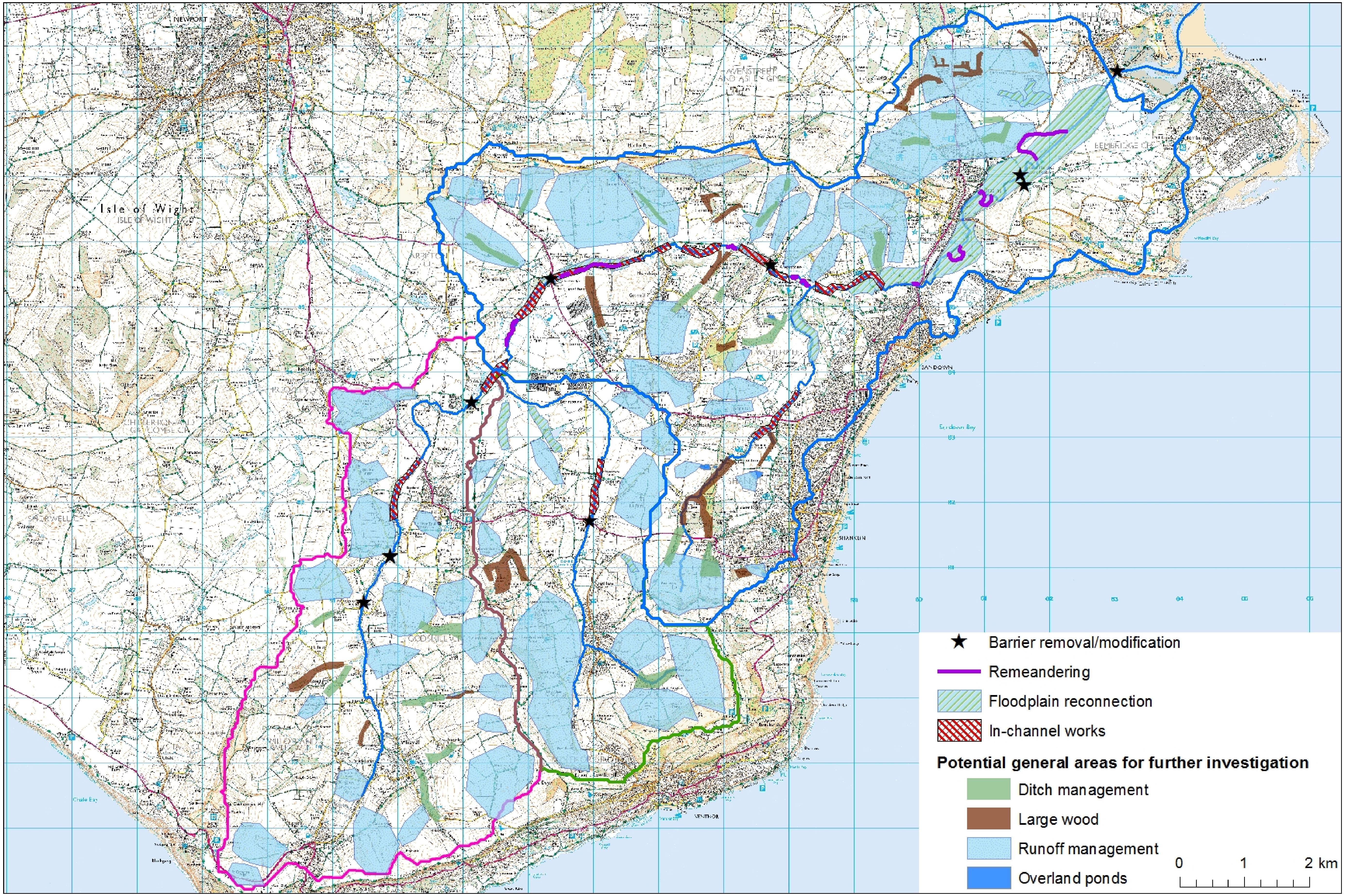


Figure 51: Proposed Eastern Yar catchment restoration plan

8 General constraints

A number of site constraints have been identified for the whole catchment by the desk study and at the initial and stakeholder workshop. The main issues raised are summarised below, and will need to be considered and reviewed during the subsequent stages of works in the catchment.

- Flood risk impact assessment will be necessary, including modelling where appropriate, to demonstrate flooding mechanisms to provide evidence to support the proposals. This assessment should consider questions such as flood risk, flooding process and the impact of different restoration options on flood wave propagation downstream.
- Medina / Yar augmentation- artificial discharge control.
- As with all projects, funding will be required to pay for both implementing and maintaining any measures implemented over their lifetime. Often whole life maintenance costs can be very significant. Low maintenance solutions that are reinforced by natural processes are therefore preferable;
- Access for vehicles may be complicated in some area due to dense vegetation, housing, narrow/steep valley sides, etc.
- At some locations where re-meandering is proposed construction of new bridges may be necessary. Some floodplain reconnection proposals may impact existing paths.
- Private land ownership will require careful negotiation. Appropriate cost-benefit analysis will be required. Having multiple landowners involved could potentially work in the projects advantage, if the landowners concerned can be provided with evidence that the benefits of the proposals will outweigh the costs in the long term;
- Potential impacts on amenity value will need to be assessed, although some of the restoration has the potential to provide amenity improvements.
- If excavated material is not reused on site waste disposal costs will need to be considered
- Structures / obstructions to fish passage may need to be retained to maintain water levels in different sections of the river
- Structures / obstructions to fish passage may have heritage value. Surveys may be required.
- Archaeological and palaeoenvironmental sites can be difficult to locate and identify, and may only be apparent once works have started in an area
- There may be potential heritage/archaeological constraints if assets of heritage value are found when implementing solutions such as floodplain reconnection and in-channel works. A strategy for potential finds may be required. Preservation in situ could be the best option, as anaerobic conditions can be extremely important and mitigation expensive.
- Some interventions may require planning permission;
- There may be clashes with utilities at the locations of some of the proposals;
- Contaminated land may pose a constraint to some proposals;

- Significant periods of fish migration and spawning sensitive times need to be considered for any in-channel works
- Impact on ecology and protected species such as water voles will need to be considered;
- Presence of invasive species (including Himalayan balsam, New Zealand stonecrop, Japanese knotweed and parrots feather); Any works requiring soil movement need to take into account the potential large amount of seeds that may be present in the soil and adopt appropriate management measures. However, restoration options may also aid invasive species control and eradication efforts. Appropriate planning and coordination would be required to ensure that the most benefit is achieved.
- Consideration will need to be given to the implications of works upon internationally and nationally designated sites, including the habitats present and the avian fauna they support.

9 Conclusions and Recommendations

The main conclusions of this report are that:

- Significant modification has taken place throughout the catchment in the past including channel straightening, channel dredging and bed lowering, bank and floodplain modification and land use change.
- As a result, there are significant pressures affecting geomorphological processes and habitat conditions and the river is failing in many places under the WFD.
- These pressures were assessed in more detail during a geomorphological walkover survey. This survey identified excess sediment delivery into the watercourses and excess siltation in the channels leading to morphological, habitat and water quality impacts. There is also a lack of in-channel morphological diversity. Channel incision has resulted in reduced channel floodplain connectivity.
- Following identification of the pressure sources and the generic solutions that can be used to address them, the catchment-scale restoration plan proposes a suite of interventions focused on specific geographical areas and presented for each of the main sub-catchments in the catchment.
- The proposed restoration options include catchment management and natural flood management solutions, to reduce the amount of water and sediment delivery into the watercourses, channel planform restoration, to reconnect historical meanders, in-channel works to increase morphological diversity and provide increased habitat availability, floodplain reconnection and removal of in-channel barriers.
- A number of constraints have been identified that need to be taken into consideration and may affect the implementation of the plan, including access and land ownership, ecology, flood risk considerations, potential for the presence of features of heritage value, presence of utilities, invasive species, etc.
- Potential further work requirements to continue working towards the implementation of the restoration plan have also been identified. These include the need for monitoring plans and ecological surveys, identification of additional survey requirement, analysis of flood risk considerations, assessment of socio-economic impacts, planning requirements and development of a strategy for managing historical and paleontological heritage.

Based on the findings of the report and comments from stakeholders, we would recommend that key areas, where easy wins could be achieved helping to deliver WFD and wider ecological objectives, are considered in the next stage of work.

- In-channel works on the Eastern Yar (upper) in the vicinity of Scotland Farm (reaches 6 and 7) would contribute to improve morphology and aquatic and marginal habitats for key species.
- Similar benefits with reference to morphology and habitat quality would be achieved further downstream on the Yar near the confluence with Wroxall Stream (reaches 10 and 11) where in-channel works and bank reprofiling were recommended. This intervention is also likely to help deliver specific WFD

mitigation measures for the water body. If the full length of channel in this area was improved it is likely that over time it may trigger a process of natural recovery which would start to propagate downstream.

- The in-channel works proposed in the Wroxall Stream, which include relocation of gravels within the channel to improve morphology and sediment dynamics, is an easy and cheap solution that will provide large benefits.
- The areas of in-channel works and floodplain reconnection (via embankment removal) proposed for Scotchells Brook would address many of the issues that have caused the overall poor character in this tributary resulting in improved habitats and dynamic processes.
- In the lower part of the catchment where land owners such as the RSPB are keen to implement restoration, the benefit of reconnecting the watercourse to the historical course should also be considered in the next stage of works. This would be a relatively easy reconnection, where original channels still exist, requiring little excavation and no need to dispose of material off site. Due to the location of these interventions, at the downstream end of the catchment, it is important to note that unless upstream issues relating to fine sediment delivery to the river are resolved, the full benefits of this restoration may not be realised. However, immediate benefits will be achieved in the immediate area with reference to improved local morphology and wider improvements for wetland species of conservation interest and the conditions of the SSSI.

In general terms, to ensure that any channel-based options achieve the best possible benefit, it would be prudent to address, in parallel, the issue of excess fine sediment delivery to the system. In the same vein, water quality issues relating to STWs will also need to be addressed.

The recommended next steps on the project include developing a more detailed implementation strategy/funding plan and establishment of a monitoring programme that will allow the work to be prioritised.

Monitoring plans should be devised to adequately assess the baseline biological status of the waterbody within the study area and to ensure a standard of repeatability to monitor success in the future. A minimum of two years of baseline ecological data, using standard techniques, is usually required prior to any interventions. Availability and quality of existing monitoring data (e.g. WFD ecological monitoring) should be assessed. Appropriate indicators could be a combination of WFD indicators and key catchment species. It is recommended that monitoring of physical data, such as suspended sediment, is also included, due to the high levels of silt in the system.

Prior to any site works proceeding there may be a need to undertake:
Continued stakeholder engagement – discussion of proposed restoration options,
interventions; key constraints and opportunities to be able to maximise the benefits of

- Continued stakeholder engagement – discussion and prioritisation of proposed restoration options, and key constraints and opportunities to be able to maximise the benefits of interventions;
- Identification of option feasibility and design development;
- Development and implementation of a monitoring plan to set the baseline and allow for the evaluation of the success of any restoration;

- Pre-construction ecological surveys (some surveys have already taken place in the catchment or are planned for the near future), identification of protected species and invasive, non-native species. ;
- Identification of the need for access with landowner negotiations, if necessary;
- Identification and collection of detailed topographical (channel cross-sectional and floodplain) survey to inform detailed design;
- Ground investigations and utilities investigations;
- Hydraulic investigations, land drainage impact and flood risk assessment;
- Assessment of socio-economic impacts;
- Planning Application requirements (including ecological and river works consent licenses);
- Conduct historical and paleontological heritage desk studies and development of a strategy for managing assets or features of heritage value.

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Appendix A

Waterbody Summaries

Contents

A1 Eastern Yar (GB107101005970) 1

A2 Wroxall Stream (GB107101006210) 2

A1 Eastern Yar (GB107101005970)

Live Document – subject to change

Water Body Summary Sheet

Water Body Summary Information (Data based on SERBMP Dec 2009)

WATERBODY ID	WB NAME	CATCHMENT	WB TYPE	HMWB
GB107101005970	Eastern Yar	Isle of Wight	River	Yes

WB COORDINATOR	AEP LEAD	CATCHMENTCOORDINATOR	DESK STUDY AUTHOR
Linda Treasure	Eamonn St Lawrence	Peter Taylor	Sean McGrogan

Designations							
Bathing Water	Drinking Water	Shellfish Water	Freshwater Fish	Nitrates Directive	Urban Waste Water	Wild Birds Directive	Habitats and Species
Yes	Yes	No	Yes	Yes	No	Yes	Yes

Overall Ecological Status/Potential	Confidence WB is less than good	Elements Driving Classification	Other Failing Elements (element status)	Elements Passing
Moderate	Very Certain	Mitigation Measures	Invertebrates (poor- very certain) Quantity and Dynamics of Flow	Ammonia (Phys-chem & Annex 8), Dissolved Oxygen, pH, Phosphate, Temperature, Copper, Zinc, Cypermethirn

Relevant Monitoring Points					
Diatoms	Macrophytes	Fish	Invertebrates	Physico-Chemical	Chemistry
Not Monitored	Not Monitored	Not Monitored	42307, Arreton Stream, Haseley Manor (poor) 42920, Burnt House (moderate) 41927, Horringford (good)	Y0004401- River Eastern Yar at Brading Y0004402- River Eastern Yar at Burnt House Y0004415- Scotchells at confluence Y0004418- Arreton stream st Heasley Manor	Y0004401- River Eastern Yar at Brading Y0004402- River Eastern Yar at Burnt House Y0004418- Arreton stream st Heasley Manor

Photographs of catchment

Horringford- Eastern Yar
Picture taken in Spring 2004.

Burnt House- Eastern Yar
Picture taken in Spring 2004.

Situation
BACKGROUND = The Eastern Yar flows for 24.27km; the waterbody is composed of two tributaries and the main Eastern Yar river. The North tributary begins North of Godshill and is joined approximately 3 km downstream by a tributary beginning at Arreton. The South tributary begins West of Shanklin and joins the North tributary East of Alverstone. The lower part of the waterbody flows through Brading marshes and together are designated as a Site of Special Scientific Interest, Ramsar site, a Special Protection Area and a Nitrate Vulnerable Zone. The area is also entirely artificial, dug out in the 1880s following the reclamation of the lower Brading Marshes. **STATUS =** The waterbody is currently at Moderate status and is not expected to improve by 2015 as it would be disproportionately expensive. The Eastern Yar is designated as a heavily modified waterbody due to reasons for flood defence, drinking water, water regulation, water storage and urbanisation. The quantity and dynamics of flow has also been assessed as not achieving good status, therefore WFD requires us to bring all failing biological elements up to good status. This requirement is based on flow issues contributing to ecological failures rather than them being purely a result of physical modifications. **PRESSURES** = Due to the rural setting of the river it is thought diffuse pollution is having an impact on the stream, along with physical modifications made to the channel. There are four STW located in the waterbody, the combination of these may be causing a detrimental impact to the river. The Arreton stream is a small tributary to the Eastern Yar, included in the waterbody. The stream is relatively short, approximately 1.6km, with numerous discharges along its stretch, including discharges from Hazely Combe and Arreton STW. **FAILING ELEMENT OVERVIEW =** The following is a summary of the current situation for each failing element. This was last updated on **14th December 2011**. **Invertebrates:** The main Eastern Yar would achieve Good (site 42920, Burnt House was incorrectly classified as 'Moderate' when it actually achieved 'High'). The invertebrate ecology of the entire waterbody is 'brought down' significantly by the site 42307, Haseley Manor, which is located on the tiny Arreton Stream. Arreton stream has historically been problematic due to septic tank discharges, Arreton STW, Hazely Combe STW, numerous licensed discharges along the stretch and agricultural diffuse pollution. Much work has already been done to improve the water quality such as leaflet dropping about septic tank care to all the villagers in Arreton. It is hoped **Action NA3** will further improve the effluent quality from Arreton and Hazely Combe STW. Also the Arreton Stream, being so small, is prone to low flows and is very iron rich due to the surrounding geology. Both of these natural issues will limit the invertebrate community in the small stream. **Fish: (updated 06.02.14 D. Longley)** • This Waterbody will be monitored for fish in RBMP2 and the surveys on which classification will be based were conducted in 2012 at Newchurch and Yarbridge. • The 2013 FCS2 interim classification for fish is High for both samples and for the waterbody. This is erroneous as the catch at Yarbridge was clearly poor and there is abundant evidence that the fish population is at less than GES and is under considerable pressure from sedimentation, morphology, hydrology and obstructions to fish passage. • The cause of the miscalculation has been discussed with the national FCS2 lead, who confirms that it is due to the very low expected prevalences for Yarbridge – this is a recognised problem which typically arises from the calibration model having no similar catchments locally. There is no way of adjusting FCS2 to rectify this at present (national recalibration would be necessary). • The solution proposed by the national FCS2 leads is simply for the High classification to be discounted on the basis of local knowledge and evidence. A further measure will be to include a third sample site, Horringford, to represent the intermediate habitat quality. **Mitigation Measures**: All feasible mitigation measures need to be put in place to achieve good potential. All mitigation measures will be assessed to ensure all appropriate mitigation measures are implements. Where possible this will be implemented as part of the second round of the better rivers programme. There are twelve mitigation measures assessments for this waterbody, only one is currently in place. **Quantity and Dynamics of Flow**: The hydrology in the Eastern Yar has been assessed as not supporting good status. A water resources investigation is planned which will identify relevant actions to improve the hydrology in the stream (**Action NA2).** This stretch of the Eastern Yar runs over almost every single geology we find in Southern Region, from the oldest to the youngest. There will be a great variation in the amount of groundwater in the river along the stretch, and hence the effect on quality will also be very variable.

Situation
WATER RESOURCES = WR WFD Stage 1 is a desktop study to confirm the flow compliance result is correct and ascertain whether the ecological monitoring sites are suitable for assessing abstraction impacts. The ecological status of suitable monitoring sites are noted. Those where flow non-compliance is confirmed and the ecological assessment indicates there is a potential hydroecological problem, progress to WR WFD Stage 2. WR WFD Stage 2 assesses the reasons for the failure and the water resource abstraction pressure upon the failing ecology. **Water Resource WFD Stage 1=** The flow compliance result in this waterbody has now been confirmed as indicating failing to support 'Good' status. The ecology has also been assessed as failing. ***WR WFD investigations Stage2 (Identify cause of failure)*** Complete - no need to move onto stage 3 **ACTIONS TO REACH GOOD ECOLOGICAL STATUS/POTENTIAL –** The Stage 3 Investigation process uses the evidence on the causes of failure within the waterbody to generate actions which, once implemented, will move the waterbody to Good Ecological Status/Potential. These Stage 3 actions will build upon the improvements which the RBMP Actions are currently delivering. See the table below for RBMP Actions, and Stage 3 Actions. This table of actions is not a finite list of actions that maybe required, and as our evidence and understanding of the waterbody continues to improve; actions may be changed, removed or replaced. The poor water quality of the Arreton Stream is solely responsible for dragging down the classification of the entire waterbody. Inverts failing for a number of reasons including, agricultural diffuse pollution, impact of a number of septic discharges and Arreton and Hazely Combe STWs. Physical alterations to the stream have also had an impact. Actions including Catchment Sensitive Farming visits, investigations of STWs and septic tank discharges have been identified. To address Mitigation Measures along the length of this large waterbody a number of actions have been identified including: bank rehabilitation / re-profiling; enable fish passage (e.g. fish pass); control and eradication of selected high risk species; removal of sediment; undertake geomorphological assessment; and share best practice on partnership working. Eastern Yar River Restoration group has been formed (E Wight Water Environment Group), with members from EA, RSPB, AONB, NE, HWT and IoW. The aim of this group will be to take a strategic overview to look at existing evidence and advice on projects to be implemented. Develop a prioritised plan, probably based on ease of implementation, cost and who would be best to lead. For Water Resources, although there is Southern Water abstraction at Burnt House, there is no evidence that this is having an impact on the ecology of the Stream. Project ideas are being developed for the East Wight Partnership bid, to restore and enhance the management of sections of the watercourses for wildlife and public enjoyment and understanding.

Action ID	Action Description	Progress	Team / Organisation
RBMP Actions (Assigned in the South East RBMP)			
SEO112	Improvements to water company assets at 7 locations in the Isle of Wight Catchment, to deliver benefits against the pressures identified or investigate the need for further investment	Brading STW, Completion Date 31/03/2015. Eastern Yar GB107101005970 Roud WWTW, Completion Date 31/03/2015, Eastern Yar GB107101006220	Southern water
SE0119	Flood/Coastal Erosion Risk Management Measure - Appropriate channel maintenance strategies and techniques e.g. remove woody debris only upstream of, or within, areas of urban flood risk	Should be considered with mitigation measures (40 &39)	FCRM

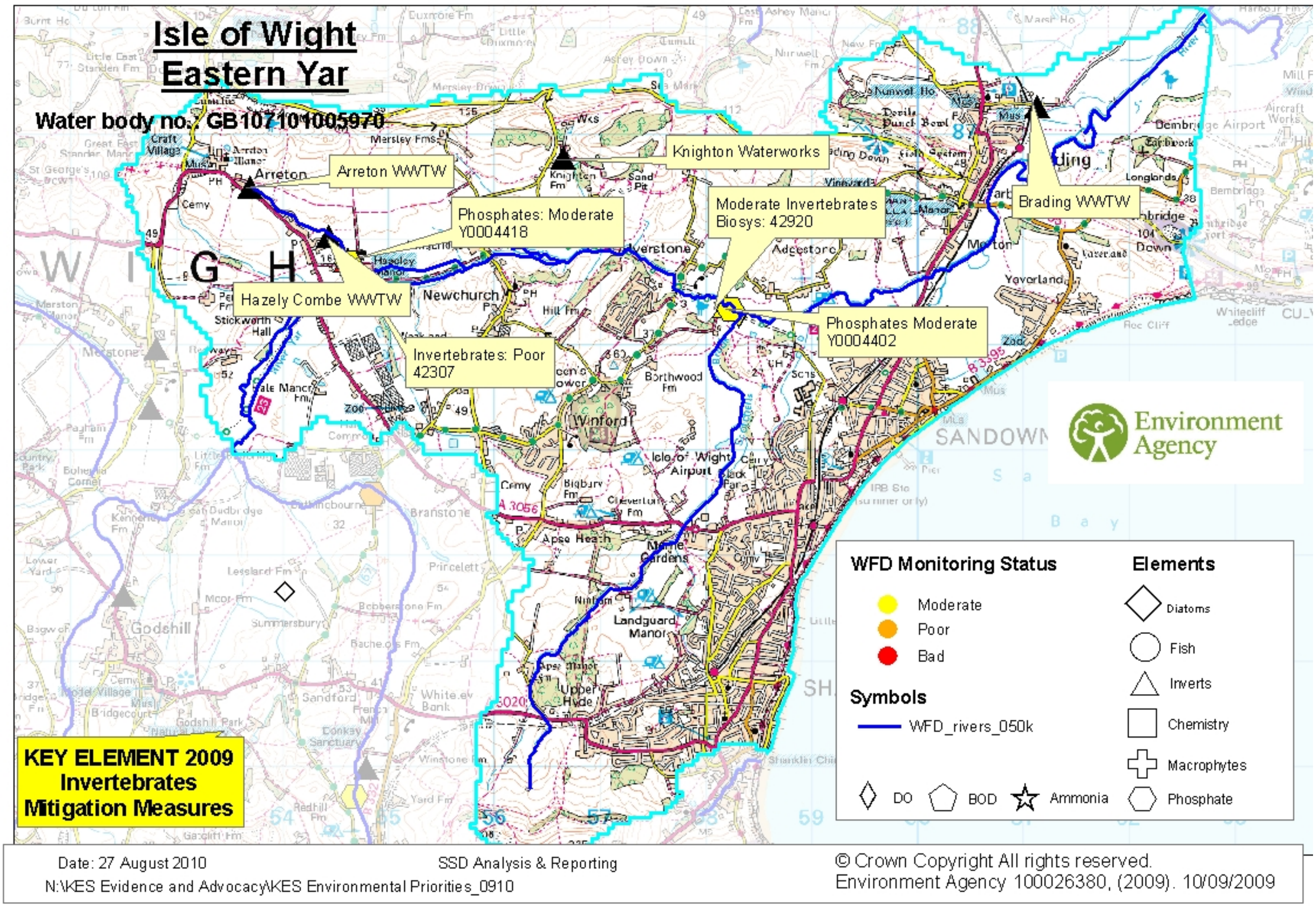
Action ID	Action Description	Progress	Team / Organisation
	minimise disturbance to channel bed and margins		
SE0124	Flood/Coastal Erosion Risk Management Measure - Appropriate water level management strategies, including timing and volume of water moved	Should be considered with mitigation measures (41)	In Place
SE0199	Carry out investigative riverine and land based field work into the origins, causes and solutions to sedimentation. Outcome: Improve our understanding of problems, in order to take effective action to address them.	Completed, sedimentation not having negative on inverts.	Hampshire & IoW Wildlife Trust, EA
SE0233	Identify priorities for second round of 'Regional Better Rivers Programme'. Outcome: Second planning cycle schemes improve habitat and ecology in waters agreed from a pool of 53 candidates totalling 545 km, building on monitoring and lessons from the first round.	Dormant	SEP (Ecol) EA
SE0306	Work with Natural England to target Catchment Sensitive Farming type activities and agri-environment schemes to ensure adoption best farming practices. Outcome: Reduce diffuse pollution sources from agriculture within water bodies identified as being impacted or at risk.	Ongoing	Hampshire & IoW Wildlife Trust, EA
Sub Actions			
SE0199-1	Work with EM Team to design monitoring programme to identify origin of sedimentation.	Implemented	ART, EA
WB Add on RBMP			
SE0200	Carry out investigative riverine and land based field work into the origins, causes of and solutions to pollution where we need to improve certainty. Outcome: Improve our understanding of problems, in order to take effective action to address them.	Complete	EM, EA
SE0198	Carry out additional riverine sampling into the origins, causes of and solutions to pollution where we need to improve certainty. Outcome: Improve our understanding of problems, in order to take effective action to address them.	Complete	ART, EA
WB Add on RBMP Action(Sub Actions)			
SE0200-1	Carry out additional phys-chem surveys to establish the causes and location of the water quality problem	Complete	S&C EA
SE0200-2	Analyse data from the phys-chem survey.	Complete	ART EA
SE0200-3	Take action to resolve any issues identified in spatial water quality investigation	Complete	EM, EA
SE0198-1	Calculate indicative classification for phys-chem	Complete	ART, EA
SE0198-2	Collect spring and autumn invertebrate sample from 42307, Arreton Stream, Haseley Manor	Complete	S&C EA
SE0198-3	Reclassify above site	Complete	ART, EA
SE0198-4	Collection of Spring and Autumn invertebrate samples from new site '158493' and in summer collect physical environment data	Complete	S&C, EA
SE0198-5	Calculate indicative classification for above site	Complete	ART, EA
New Actions			
NA1	Correct the waterbody mapping area to include waterbodies GB107101005970 and GB107101006010 together.	Done through Waterbody Review	ART EA
NA2	Carry out a water resources investigation for the waterbody.	No ecological impact. New site now in place, so further assessment underway	ART EA
NA3	Consider what actions to take to improve Arreton and Hazely Combe STW effluent quality, with an aim to enhance the sanitary conditions of the watercourse downstream.	Action now under SSD-IW-024 SSD-IW-028	Land & Water
Redundant RBMP Actions (Of those listed above)			
SEO120	Flood/Coastal Erosion Risk Management Measure - Appropriate techniques (invasive species)	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SEO122	Flood/Coastal Erosion Risk Management Measure - Appropriate	Having spoken to	FCRM

Action ID	Action Description	Progress	Team / Organisation
	timing (vegetation control)	relevant colleagues in FCRM the action is not currently appropriate.	
SEO123	Flood/Coastal Erosion Risk Management Measure - Appropriate vegetation control technique	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SEO131	Flood/Coastal Erosion Risk Management Measure - Operational and structural changes to locks, sluices, weirs, beach control, etc	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SEO132	Flood/Coastal Erosion Risk Management Measure - Preserve (e.g. fencing) and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SEO133	Flood/Coastal Erosion Risk Management Measure - Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SE0134	Flood/Coastal Erosion Risk Management Measure - Preserve and, where possible, restore historic aquatic habitats	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SEO140	Flood/Coastal Erosion Risk Management Measure - Selective vegetation control regime	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
SEO138	Flood/Coastal Erosion Risk Management Measure - Retain marginal aquatic and riparian habitats (channel alteration)	Having spoken to relevant colleagues in FCRM the action is not currently appropriate.	FCRM
Stage 3 Actions (the Pathway to good Ecological Status)			
SSD-IW-024	Invertebrates - actions to take to improve Arreton STW effluent quality		Land & water and Region
SSD-IW-026	Focus EM and CSF work around Arreton Stream.		Land & Water
SSD-IW-027	Investigate the septic tank discharges into the Arreton Stream		Land & Water
SSD-IW-028	Consider what actions to take to improve Arreton and Hazely Combe STW effluent quality, with an aim to enhance the sanitary conditions of the watercourse downstream. Gathering Evidence for AMP.		Land & Water Region
SSD-IW-029	Encourage riparian land owners to leave a buffer strip adjacent to the river in an attempt to halt sediments getting washed into the watercourse. Focus on Arreton Stream. Invertebrates - actions to take to improve diffuse pollution		Land & Water
SSD-IW-030	New development, 5.3 hectare site south of Hazeley Combe, Arreton. Identify / ensure sewage is discharged to, an appropriate site.		Land & Water & SP
SSD-IW-092	Horringford invert site does get impacted by high flow as the channel here is very straight. The flow in the more natural adjacent channel is very low. If flow was restored to this meandering channel then this would provide a better invert sampling point.		ART
SSD-IW-100	Pollution prevention visit to College Close industrial area in Sandown to identify any activities that could be having a negative impact of the Eastern Yar and providing guidance to ensure this is stopped.		Land & Water

Mitigation Measures (MM) – Not In Place				
MM ID	**MM Description**	**Action ID**	**Actions to Implement MM**	**Progress**
2	Remove obsolete structure	SSD-IW-025	Recommendations in 'East Wight Watercourses; 'Review and Project Identification', which includes: Remove artificial obstructions to flow such as weirs and culverts.	
		SSD-IW-032	Actions identified by APT from walkover on main Eastern Yar: Remove weir or modify to facilitate fish passage; and removing sluice structures	
6	Increase in-channel morphological diversity	SSD-IW-025	Recommendations in 'East Wight Watercourses; 'Review and Project Identification', which includes: River Restoration	
		SSD-IW-031	Commission a similar report to that done on the Medina, "River Medina Habitat Assessment", to identify options on how and where to implement this mitigation measure, and all others which are not in place.	
		SSD-IW-032	Actions identified by APT from walkover on main Eastern Yar: De-silting and formalising flow splits; Marginal Planting; Vegetation management; River restoration; and Adding substrate on top of concrete bed	
		SSD-IW-033	Actions identified by APT from walkover on Arreton Stream: Remove artificial bank; Selective arboricultural; and Selective vegetation management	
		SSD-IW-034	Actions identified by APT from walkover on Scotchells Brook: Vegetation and arboricultural management	
		SSD-IW-035	A project is being developed which will identify and explore a number of possible options to improve habitat at Sandown Meadows near Alverstone.	
		SSD-IW-036	Geomorphological assessment undertaken	
		SSD-IW-037	Output from Eastern Yar River Restoration group formed. Taking a strategic overview to look at existing evidence and advice on projects to be implemented.	
		SSD-IW-038	The Yar Banks project: produce a riverbank management plan from which to prioritize bankside works - fell, coppice, pollard, clear, remove, fence, bund, ditch, etc	

		SSD-IW-108	Project ideas are being developed for the East Wight Partnership bid. Restoring and enhancing the management of sections of the watercourses for wildlife and public enjoyment and understanding.	
8	Re-opening existing culverts	SSD-IW-032	Actions identified by APT from walkover on main Eastern Yar: Culvert blocked or partially collapsed; repair or remove	
16	Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works	SSD-IW-032	Actions identified by APT from walkover on main Eastern Yar: Remove wire or modify to facilitate fish passage	
		SSD-IW-034	Actions identified by APT from walkover on Scotchells Brook: Modify weirs to allow fish access	
		SSD-IW-107	Fish passage and fish schemes being proposed under requirements of eel regs on EA owned structures. Fish pass at Bembridge Weir.	
20	Operational and structural changes to locks, sluices, weirs, beach control, etc	SSD-IW-032	See Actions Under MM 16	
		SSD-IW-034	See Actions Under MM 16	
		SSD-IW-107	See Actions Under MM 16	
33	Selective vegetation control regime		Vegetation management undertaken by a contractor, appropriate techniques and management already in place	
34	Appropriate vegetation control technique		Vegetation management undertaken by a contractor, appropriate techniques and management already in place	
35	Appropriate timing (vegetation control)		Vegetation management undertaken by a contractor, appropriate techniques and management already in place	
36	Appropriate techniques (invasive species)	SSD-IW-032	Actions identified by APT from walkover on main Eastern Yar: Crassula treatment	
		SSD-IW-033	Actions identified by APT from walkover on Arreton Stream: Invasive species treatment	
		SSD-IW-018	Pulling/ spraying non-invasive species Continued management of invasive species, specifically targeting Himalayan Balsam and Japanese Knotweed. This currently involves manual removal and/or spraying.	
37	Retain marginal aquatic and riparian habitats (channel alteration)		Vegetation management undertaken by a contractor, appropriate techniques and management already in place	
38	Sediment management strategies (develop and revise)	SSD-IW-025	Recommendations in 'East Wight Watercourses; 'Review and Project Identification', which includes: Raise bed levels using re-cycled bed gravels	
		SSD-IW-036	Geomorphological assessment undertaken: Sediment no longer dredged, potential to use gravels that were previously taken out to raise bed levels. Sediment on the banks has to be managed.	
41	Appropriate water level management strategies, including timing and volume of water moved		In Place	
54	Educate landowners on sensitive management practices (urbanisation)	SSD-IW-038	The Yar Banks project: produce a riverbank management plan from which to prioritize bankside works - fell, coppice, pollard, clear, remove, fence, bund, ditch, etc	

Map of Catchment –



Glossary

A&R	Analysis and reporting team
ASPT	Average Score Per Taxa
BIOSYS	Our main database for storing, manipulating and reporting data from freshwater and marine biological surveys at any taxonomic level
BMWP	Biological Monitoring Working Party
CEO	Combined emergency overflow
CSF	Catchment sensitive farming
CSM	Customer Self Monitoring (of STPs/WIMS sampling points)
CSO	Combined sewer overflow
D/S	Downstream
DO	Dissolved oxygen
EM	Environment management team
EP	Environmental planning team
FCS2	Fisheries Classification Scheme version 2
FRB	Fisheries recreation and biodiversity team
HEVI	HydroEcological Validation tool
LIFE	Lotic Invertebrate index for Flow Evaluation
NFPD	National Fish … Database
NTAXA	Number of taxa
P	Phosphate
RIVPACS	River InVertebrate Prediction and Classification System
RIVPACS	predicts the macro-invertebrate fauna at any site on a river from a small number of environmental parameters derived from maps or measured at the site.
SERBMP	South East River Basin Management Plan
SS	Suspended solids
STP	Sewage treatment plant
STW	Sewage Treatment works
U/S	Upstream
WB	Waterbody
WQIP	Water Quality Improvement Plan
WWTW	Waste water treatment works

A2 Wroxall Stream (GB107101006210)

Live Document – subject to change

Water Body Summary Sheet

Water Body Summary Information (Data based on SERBMP Dec 2009)

WATERBODY ID	WB NAME	CATCHMENT	WB TYPE	HMWB
GB107101006210	Wroxall Stream	Isle of Wight	River	No

WB COORDINATOR	AEP LEAD	CATCHMENTCOORDINATOR	DESK STUDY AUTHOR
Clare Payn	Eamonn St Lawrence	Peter Taylor	Sean McGrogan

Designations							
Bathing Water	Drinking Water	Shellfish Water	Freshwater Fish	Nitrates Directive	Urban Waste Water	Wild Birds Directive	Habitats and Species
No	No	No	No	Yes	No	No	No

Overall Ecological Status/Potential	Confidence WB is less than good	Elements Driving Classification	Other Failing Elements (element status)	Elements Passing
Moderate	Very Certain	Phosphate (Very Certain)	Quantity and Dynamics of Flow (Uncertain)	Invertebrates (Good), Ammonia (Phys-Chem & Annex 8), Dissolved Oxygen pH, Temperature, Copper, Zinc

Relevant Monitoring Points					
Diatoms	Macrophytes	Fish	Invertebrates	Physico-Chemical	Chemistry
Not Monitored	Not Monitored	Not Monitored	Bathingbourne, 42804 Upstream Wroxall STW, 42805	Bathingbourne Y0004421 Upstream of Wroxall STW, Y0004424	Upstream of Wroxall STW, Y0004424

Photographs of catchment

Last saved by emcswan 20/01/2015

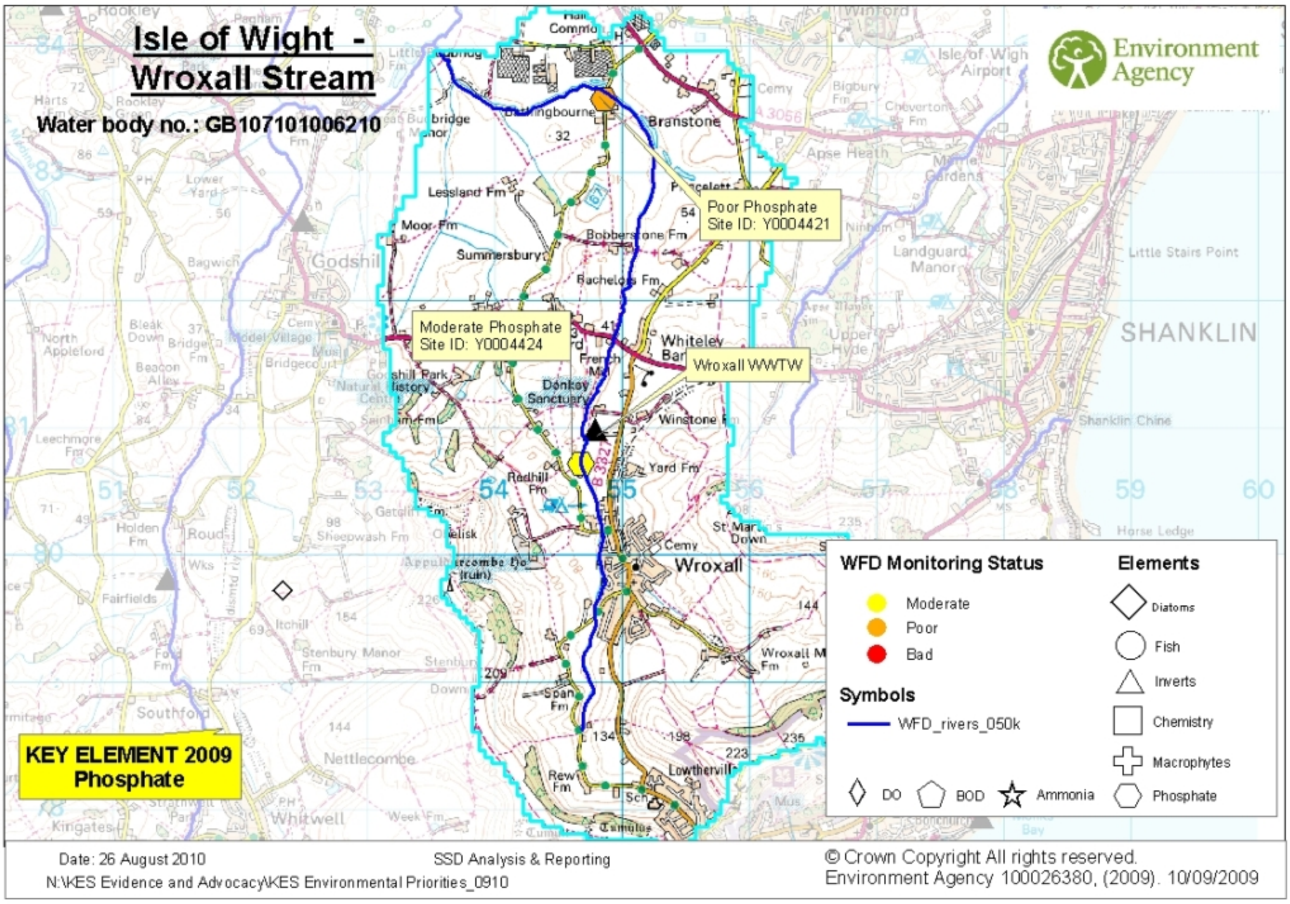
Situation
BACKGROUND = The Wroxall Stream is a tributary to the Eastern Yar. The stream flows from its source, North West of Ventor, for 7.21 km until it joins the Eastern Yar North East of Godshill. The stream is located in a Nitrate Vulnerable Zone and flows over four types of bedrock composed of mudstone, sandstone, siltstone and ferruginous sandstone. Wroxall Stream is located in a predominantly agriculturally intense area but it also flows through the town of Wroxall. Apart from flowing through numerous farms the stream also passes Wroxall STW and Wroxall donkey sanctuary. **STATUS =** The Wroxall Stream is at Moderate status with the status being driven by phosphates. The waterbody is failing for quantity and dynamics of flow which does not support good status. The waterbody is not predicted to improve by 2015 as it would be disproportionately expensive. **PRESSURES**- Wroxall Stream flows through a predominantly rural area and the intense agriculture surrounding the stream is causing a number of pressures. Firstly it is possible the farm land is causing diffuse pollution along the stretch. Secondly, the agricultural practices are contributing to increased siltation within the stream. There are four sewage discharge consents along the stretch, including a discharge from Wroxall STW. It is possible the combinations of these discharges are causing the elevated levels of phosphates observed. Misconnections in the sewage network towards the source of the stream have historically been a problem, however it is uncertain if these issues resolved. **FAILING ELEMENT OVERVIEW =** The following is a summary of the current situation for each failing element. This was last updated on **14th December 2011**. **Phosphate –** The phosphate classification has been based on two sites, Bathingbourne and Upstream Wroxall STW. Both sites have been classified using 2006 data, with Bathingbourne achieving poor status and Upstream Wroxall STW achieving moderate status. Since 2004 all samples at both sites have failed phosphate levels, with no samples containing low enough levels to achieve good status. Actions **SEO200** will investigate the causes of the poor water quality and identify suitable actions to address the problem. Potential sources could be the STW or arable farm land. The investigative monitoring prescribed in Action SE0200-2 confirmed that phosphate was exceeding acceptable concentrations both above and below the STW, and the water quality gets poorer as you progress downstream. High phosphate levels were found in both top tributaries. Monitoring is continuing above the STW throughout the summer 2014. **Invertebrates-** The invertebrate classification has been based on two sites, Bathingbourne and Upstream Wroxall STW. Currently both sites are passing but the classification appears to be inaccurate. Based on most recent 2008 data, Upstream Wroxall STW would still achieve good status but Bathingbourne would achieve a Moderate status. It is thought the Bathingbourne site is impacted by sedimentation as a result of the surrounding intense agricultural land. Further samples were collected from Bathingbourne in 2011 and were much improved. **Quantity and Dynamics of Flow-** The hydrology in Wroxall Stream has been assessed as not supporting good status. A water resources investigation has been completed which will identify relevant actions to improve the hydrology in the stream. **WATER RESOURCES =** WR WFD Stage 1 is a desktop study to confirm the flow compliance result is correct and ascertain whether the ecological monitoring sites are suitable for assessing abstraction impacts. The ecological status of suitable monitoring sites are noted. Those where flow non-compliance is confirmed and the ecological assessment indicates there is a potential hydroecological problem, progress to WR WFD Stage 2. WR WFD Stage 2 assesses the reasons for the failure and the water resource abstraction pressure upon the failing ecology. **Water Resource WFD Stage 1=** The flow compliance result in this waterbody has now been confirmed as indicating that it does not support ‘Good’ status. The ecology however has been confirmed at ‘Good’ status. ***This water body will <u>not</u> pass to WR WFD investigations Stage2 (Identify cause of failure)*** **Key Partners-** Southern Water may be a potential key partner if Wroxall STW discharge is found to be having a negative impact on the quality of Wroxall Stream. Similarly if sewage misconnections are still causing an impact on the stream then we will need to work closely with Southern Water to resolve this. It will also be necessary to work with The Wildlife Trust and Natural England as part of the Catchment Sensitive Farming Project to resolve diffuse pollution issues which may be impacting the stream.

Situation
ACTIONS TO REACH GOOD ECOLOGICAL STATUS/POTENTIAL – The Stage 3 Investigation process uses the evidence on the causes of failure within the waterbody to generate actions which, once implemented, will move the waterbody to Good Ecological Status/Potential. These Stage 3 actions will build upon the improvements which the RBMP Actions are currently delivering. See the table below for RBMP Actions, and Stage 3 Actions. This table of actions is not a finite list of actions that maybe required, and as our evidence and understanding of the waterbody continues to improve; actions may be changed, removed or replaced. Actions **SEO200** showed that although phosphate levels did significantly rise downstream of Wroxall STW, the levels above the works were still above that required for good status. Simcat modelling was undertaken and this indicated that approximately 44% of Phosphate in the waterbody came from STWs. There needs to be consideration of actions that will improve Wroxall STW effluent quality, with the aim to enhance the sanitary conditions of the watercourse downstream. We need to discuss with Southern Water the options that are available, e.g. phosphate stripping or putting in a reed bed **(SSD-IW-040)**. New Source Apportionment GIS will be used and plant and diatom sampling will assess phosphate impacts. Also need to work with Southern Water to identify misconnections in the catchment **(SSD-IW-041)**. Walkover survey has just been completed so it is hoped that this has indentified other sources of sedimentation and rural diffuse pollution. These are to be investigated and addressed **(SSD-IW-042).** Other issue Himalayan Balsam which is present along the stream, pulling/ spraying to be undertaken **(SSD-IW-018)**.

Action ID	Action Description	Progress	Team / Organisation
RBMP Action (Assigned in the South East RBMP)			
SE0200	Carry out investigative riverine and land based field work into the origins, causes of and solutions to pollution where we need to improve certainty. Outcome: Improve our understanding of problems, in order to take effective action to address them.	Ongoing	Land & Water
SE0306	Work with Natural England to target Catchment Sensitive Farming type activities and agri-environment schemes to ensure adoption of best farming practices. Outcome: Reduce diffuse pollution sources from agriculture within water bodies identified as being impacted or at risk.	Ongoing	Land & Water
Sub Actions			
SE0200-1	Carry out a desktop investigation and produce a summary sheet to confirm reasons for failure and identify appropriate actions	Completed	ART, EA
SE0200-2	Carry out additional investigative monitoring for physico-chemistry to establish the causes and location of the water quality problem.	Completed	S&C, EA
SE0200-3	Analyse data from action SEO200-2.	Completed	ART, EA
SE0200-4	Take action to resolve any issues identified in SE0200-3	Completed	EM, EA
SE0200-5	Take adhoc water quality samples at the three sites on the same day as outlined in the further investigational section of the internal summary sheet document.	Completed	S&C
SE0200-6	Analyse data from action SEO200-5.	Completed	ART
WB Add on RBMP Action			
SE0199	Carry out investigative riverine and land based field work into the origins, causes and solutions to sedimentation. Outcome: Improve our understanding of problems, in order to take effective action to address them.	Issues identified in walkover survey	EM, EA
SE0198	Carry out additional riverine sampling into the origins, causes of and solutions to pollution where we need to	Completed	ART

Action ID	Action Description	Progress	Team / Organisation
	improve certainty. Outcome: Improve our understanding of problems, in order to take effective action to address them.		
WB Add on RBMP Action (Sub Actions)			
SE0199-1	Work with A & R Team to investigate origins of sedimentation and diffuse pollution sources	Completed	EM, EA
SE0198-1	Sample invertebrate site 42804 in the spring and autumn to establish if the decline observed in 2009 is on-going.	Completed	S&C, EA
SE0198-2	Reclassify the invertebrate data for site 42804	Completed	ART, EA
Stage 3 Actions (the Pathway to good Ecological Status)			
SSD-IW-040	Consider what actions that will improve Wroxall STW effluent quality.		Land & Water Team & Region
SSD-IW-041	Working with Southern Water to identify and resolve the problem of misconnections. Historically has been a problem towards the source of the stream. A plan of action is required.		Land & Water Team
SSD-IW-042	Sedimentation and agricultural diffuse pollution have been identified as an issue in the waterbody. Catchment walkover has now been undertaken; issues identified to be addressed.		Land & Water Team
SSD-IW-018	Continued management of invasive species, specifically targeting Himalayan Balsam and Japanese Knotweed. This currently involves manual removal and/or spraying.		F & B

Map of Catchment –



Glossary

A&R	Analysis and reporting team
ASPT	Average Score Per Taxa
BIOSYS	Our main database for storing, manipulating and reporting data from freshwater and marine biological surveys at any taxonomic level
BMWP	Biological Monitoring Working Party
CEO	Combined emergency overflow
CSF	Catchment sensitive farming
CSM	Customer Self Monitoring (of STPs/WIMS sampling points)
CSO	Combined sewer overflow
D/S	Downstream
DO	Dissolved oxygen
EM	Environment management team
EP	Environmental planning team
FCS2	Fisheries Classification Scheme version 2
FRB	Fisheries recreation and biodiversity team
HEVI	HydroEcological Validation tool
LIFE	Lotic Invertebrate index for Flow Evaluation
NFPD	National Fish … Database
NTAXA	Number of taxa
P	Phosphate
RIVPACS	River InVertebrate Prediction and Classification System
RIVPACS	predicts the macro-invertebrate fauna at any site on a river from a small number of environmental parameters derived from maps or measured at the site.
SERBMP	South East River Basin Management Plan
SS	Suspended solids
STP	Sewage treatment plant
STW	Sewage Treatment works
U/S	Upstream
WB	Waterbody
WQIP	Water Quality Improvement Plan
WWTW	Waste water treatment works

Appendix B

Workshop Outputs

Contents

B1 Stakeholder Workshop – 11 November 2014 **1**

B2 Landowner workshop – 10 December 2014 **2**

B1 Stakeholder Workshop – 11 November 2014

A1

P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

ARUP

13 Fitzroy Street
London W1T 4BQ
Tel +44 20 7636 1531 Fax +44 20 7580 3924
www.arup.com

Metres 0 65 130 260

Client
IoW Council

Job Title

Upper E Yar
Pressures and Opportunities

Scale at A1
1:5,000

Job No
Drawing Status

Drawing No
001

Issue
P1

MXD Location

A1

P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

ARUP

13 Fitzroy Street
London W1T 4BQ
Tel +44 20 7636 1531 Fax +44 20 7580 3924
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Metres
0 65 130 260

Client
IoW Council

Job Title

Upper E Yar
Pressures and Opportunities

Scale at A1
1:5,000

Job No

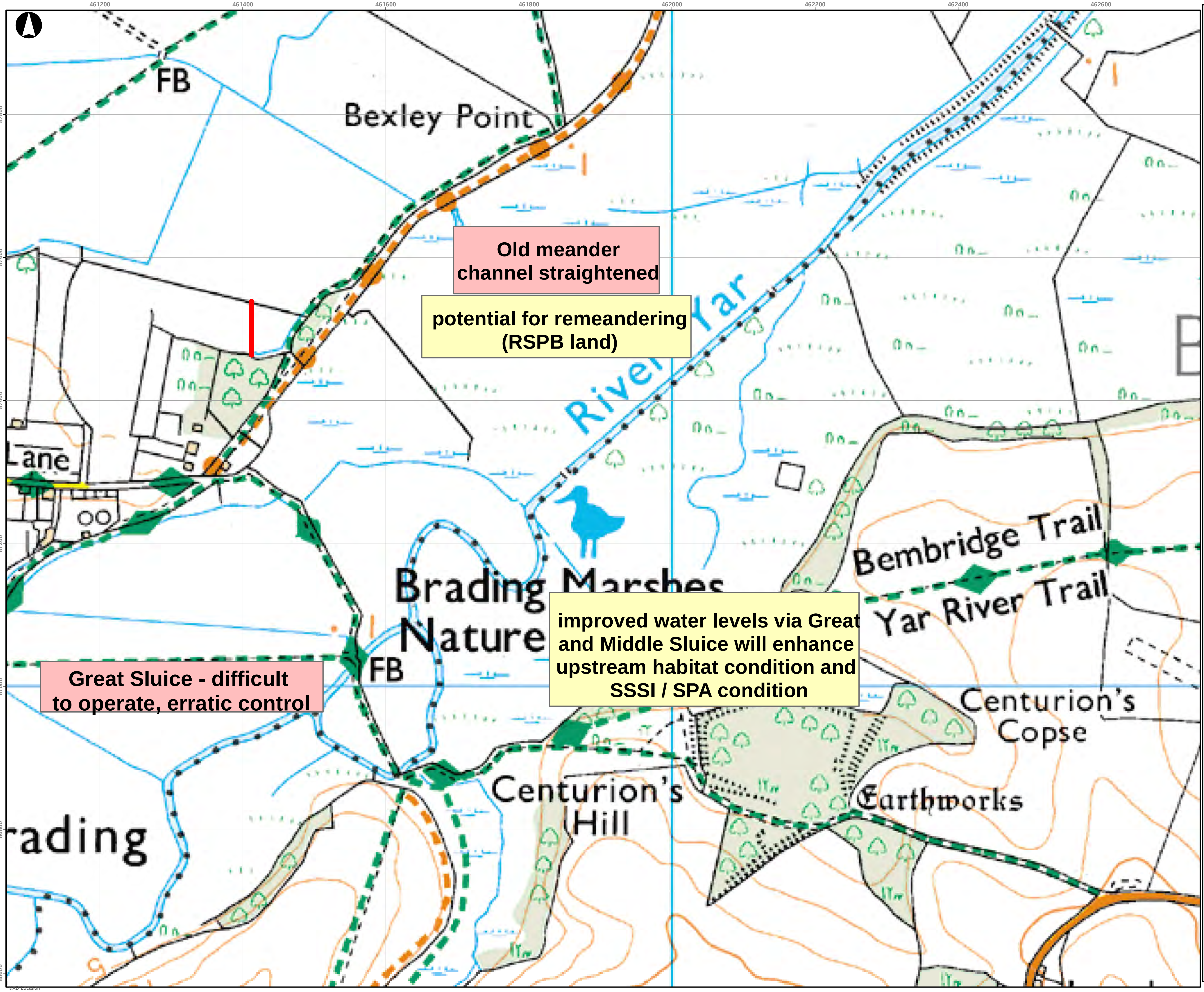
Drawing Status

Drawing No
001

Issue
P1

MXD Location

A3



19/11/2014 18:16:55

P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

Metres
0 65 130 260

ARUP

Rose Wharf
78 East Street
Leeds
LS9 8EE
United Kingdom

Client
IoW Council

Job Title
E Yar River Restoration Plan

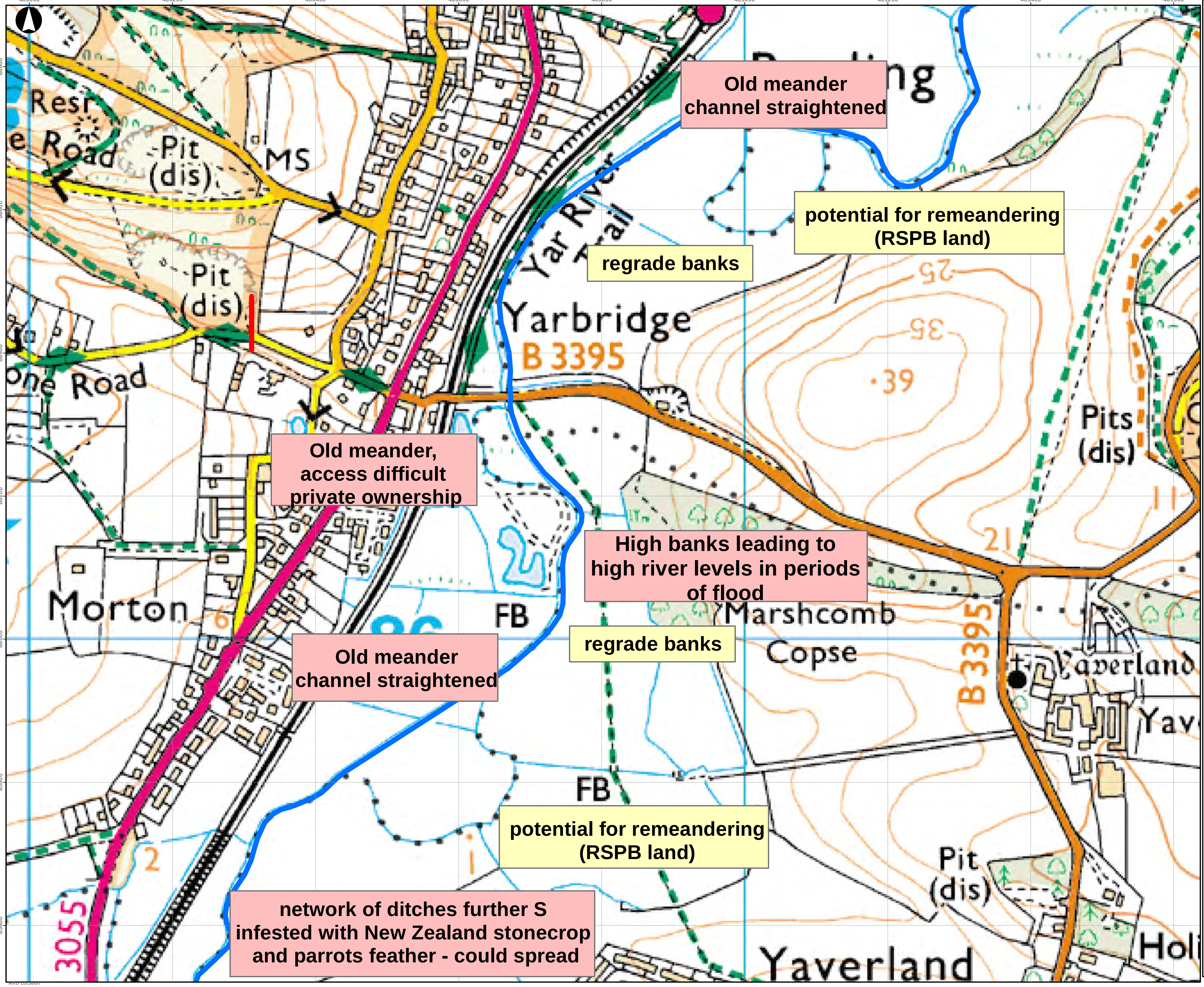
E Yar
Pressures and Opportunities

Scale at A3
1:5,000

Job No	Drawing Status
239428-00	o

Drawing No	Issue
001	P1

A3



P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

Metres
0 65 130 260

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LS9 8EE
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E Yar
Pressures and Opportunities

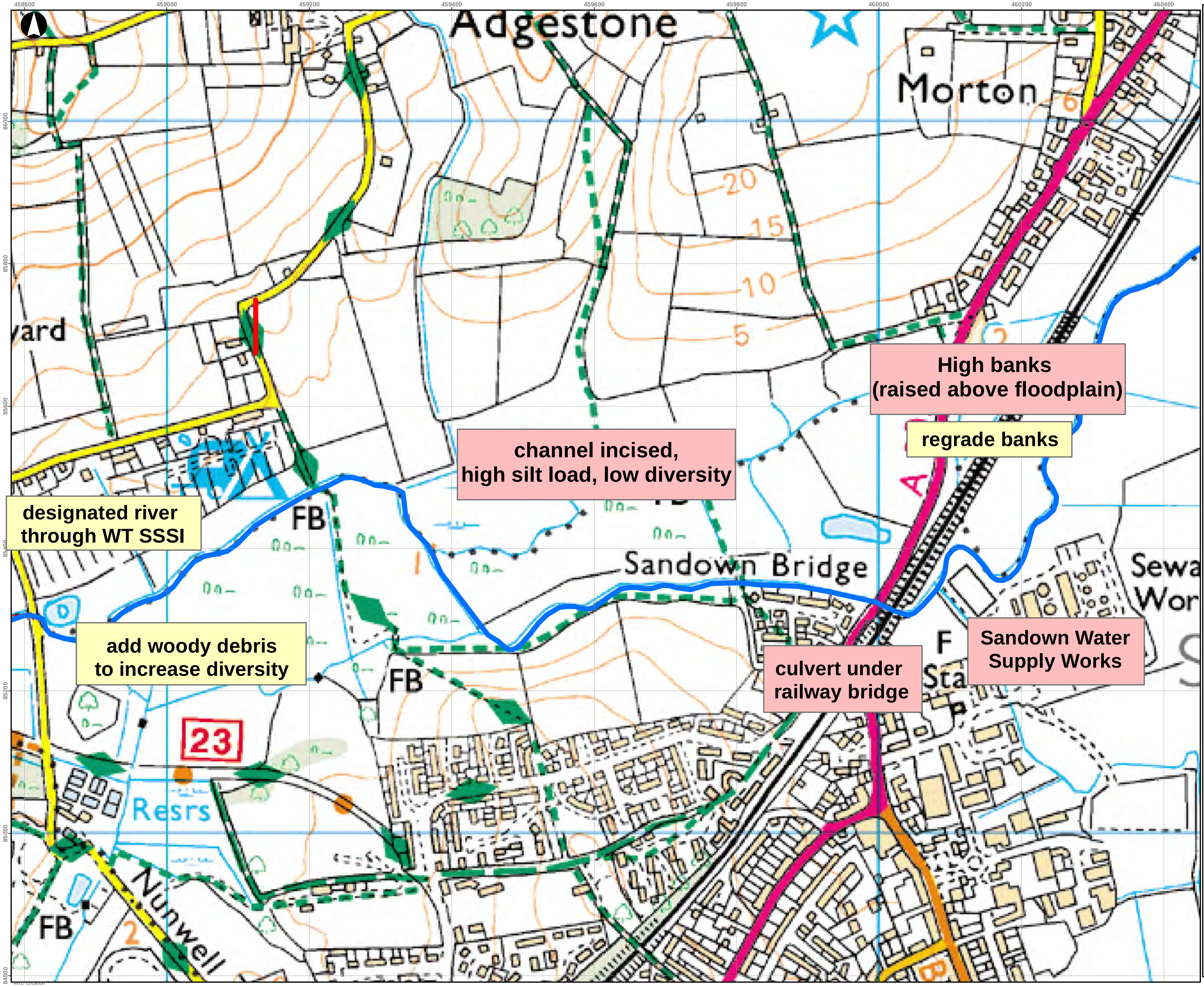
Scale at A3
1:5,000

Job No	Drawing Status
239428-00	o

Drawing No	Issue
001	P1

19/11/2014 18:16:55

A3



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P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

Metres
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IoW Council

Job Title
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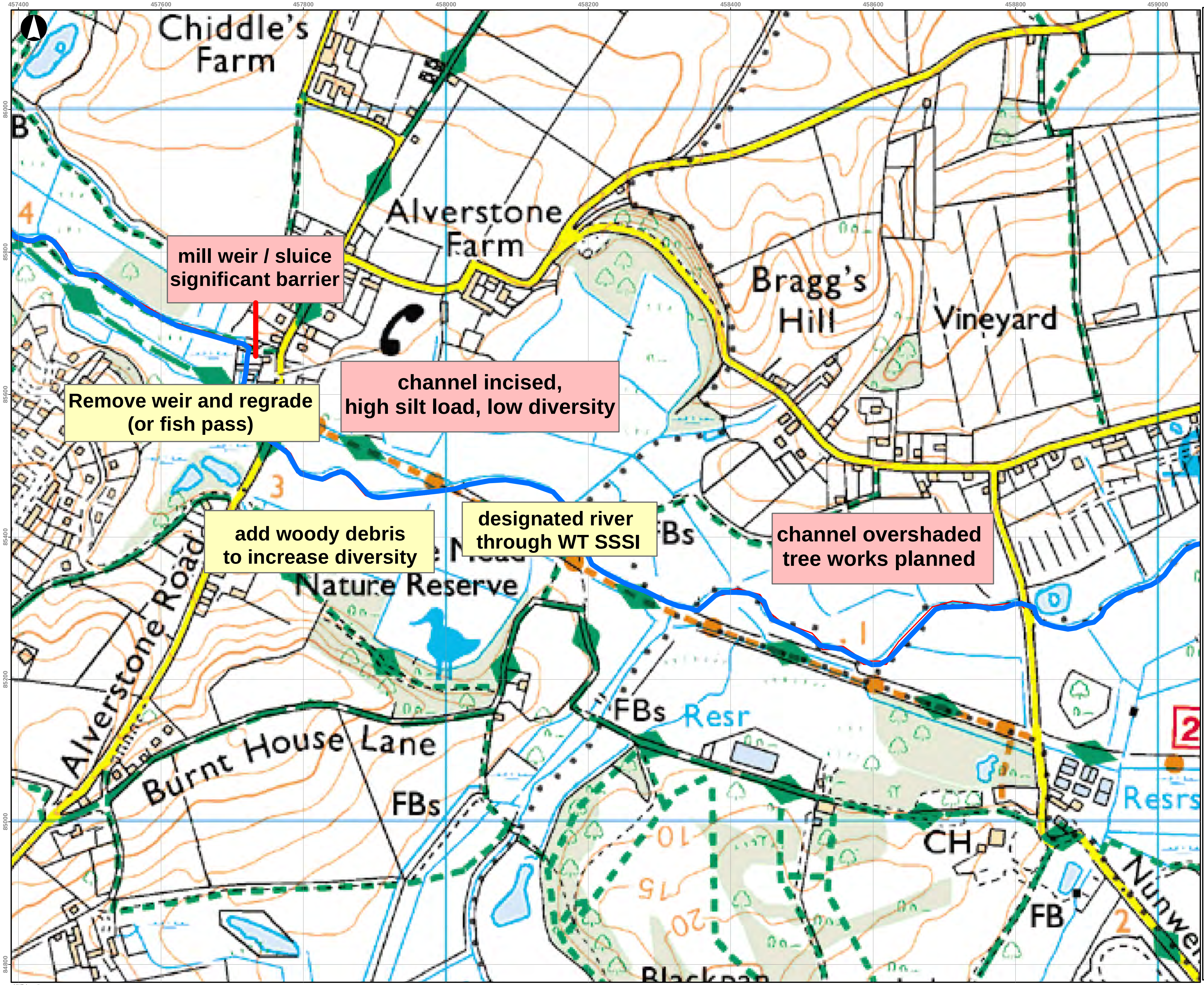
E Yar
Pressures and Opportunities

Scale at A3
1:5,000

Job No	Drawing Status
239428-00	o

Drawing No	Issue
001	P1

A3



MXD Location

19/11/2014 18:16:55

P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

Metres
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Job Title
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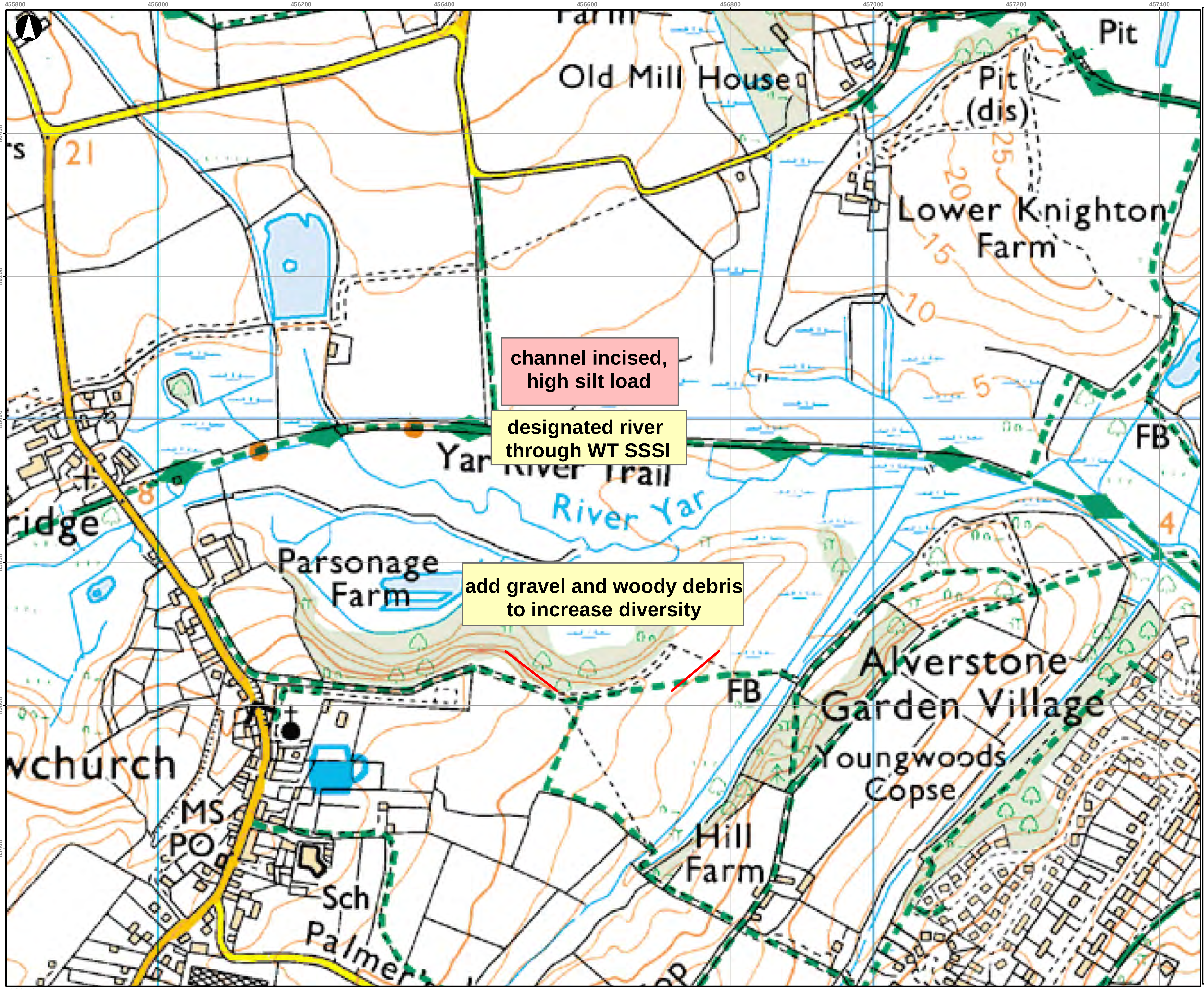
E Yar
Pressures and Opportunities

Scale at A3
1:5,000

Job No	Drawing Status
239428-00	**o**

Drawing No	Issue
001	**P1**

A3



MXD Location

P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

Metres
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IoW Council

Job Title
E Yar River Restoration Plan

E Yar
Pressures and Opportunities

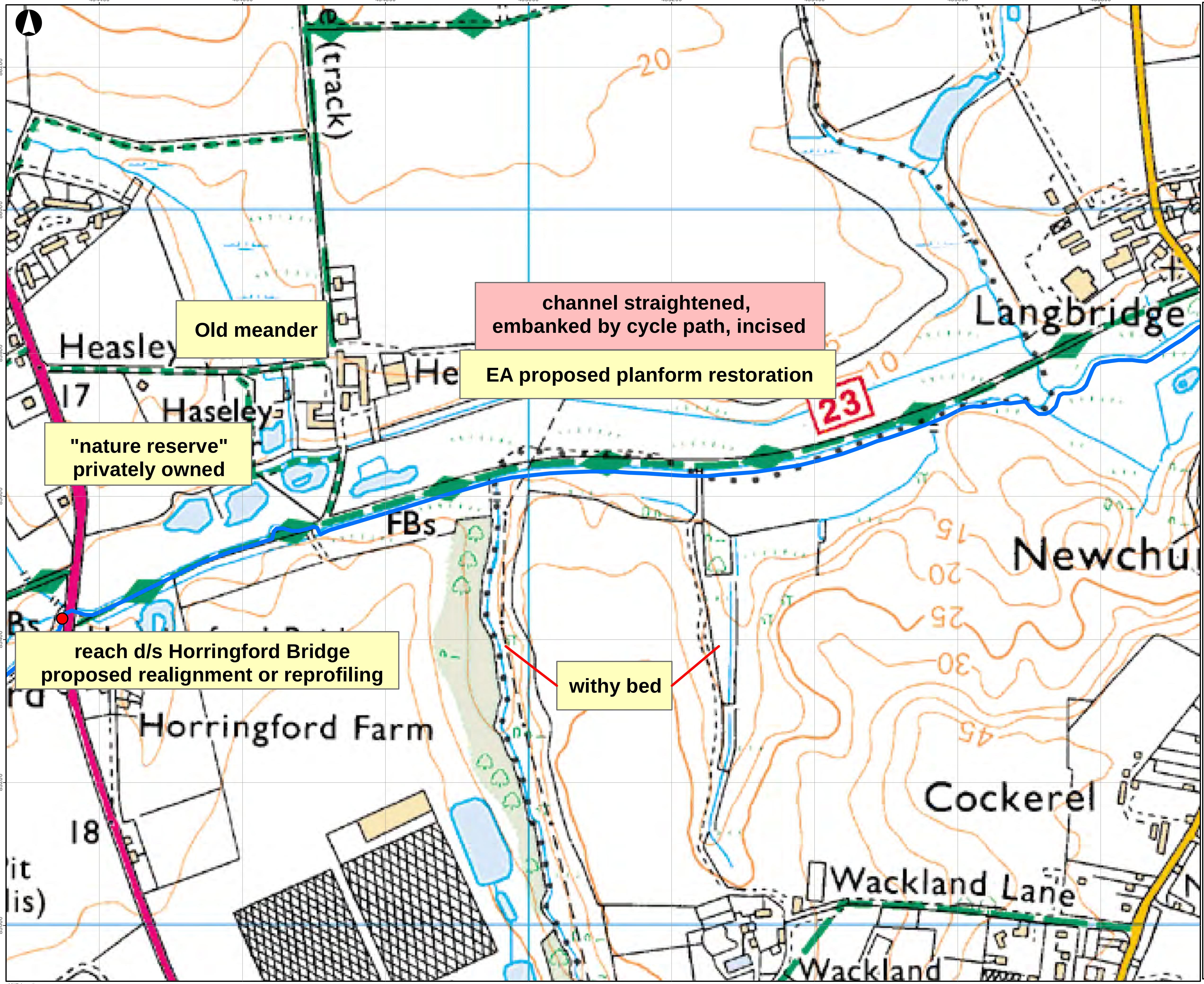
Scale at A3
1:5,000

Job No	Drawing Status
239428-00	**o**

Drawing No	Issue
001	**P1**

19/11/2014 18:16:55

A3



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P1	01-02-08	MM	RM	EP
Issue	Date	By	Chkd	Appd

Metres
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ARUP

Rose Wharf
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United Kingdom

Client
IoW Council

Job Title
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**E Yar
Pressures and Opportunities**

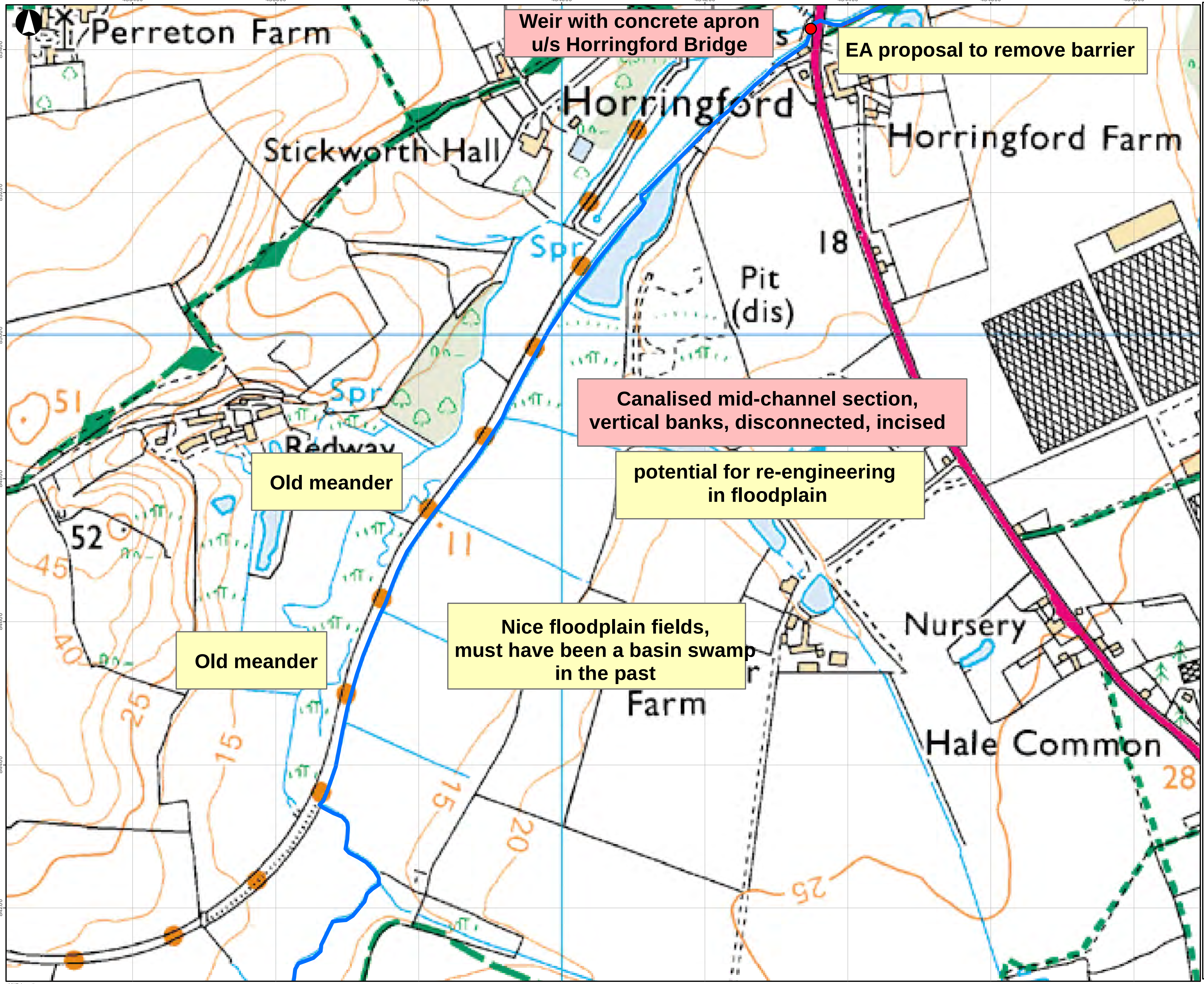
Scale at A3
1:5,000

Job No	Drawing Status
239428-00	**o**

Drawing No	Issue
001	**P1**

MXD Location

A3



MXD Location

19/11/2014 18:16:55

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Issue	Date	By	Chkd	Appd

Metres
0 65 130 260

ARUP

Rose Wharf
78 East Street
Leeds
LS9 8EE
United Kingdom

Client
IoW Council

Job Title
E Yar River Restoration Plan

E Yar
Pressures and Opportunities

Scale at A3
1:5,000

Job No
239428-00

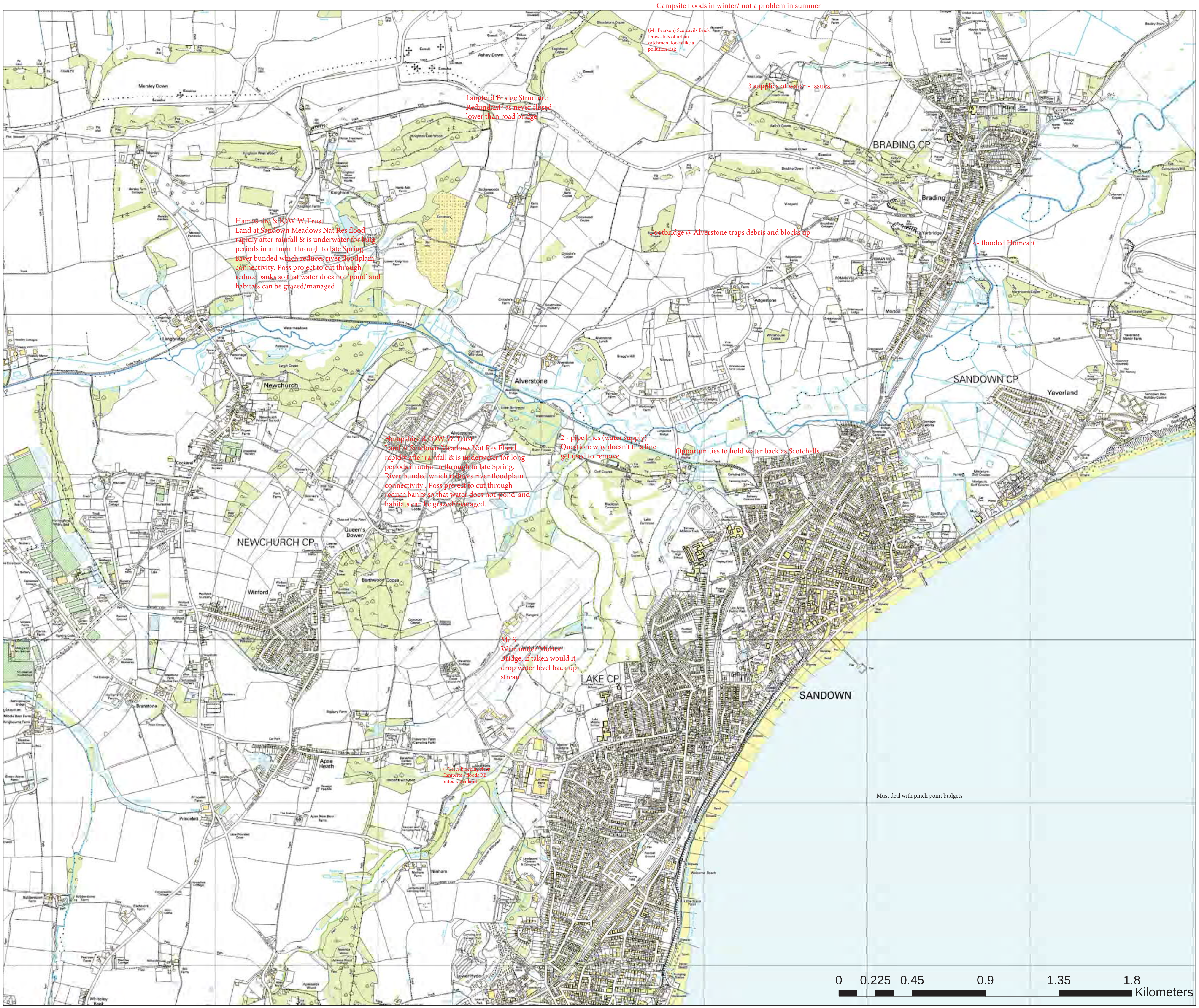
Drawing Status
o

Drawing No
001

Issue
P1

B2 Landowner workshop – 10 December 2014


Legend
Eastern_Yar__Upper
Eastern_Yar_Lower
Scotchells_Brook
Wroxall_Stream
N
ST HELENS CP
St Helens
BEMBRIDGE CP
Bembridge
BRADING CP
Brading
SANDOWN CP
Yaverland
Bembridge Airport
Bembridge Down
Culver Down
Sandown Bay
Better pennig of +0.3
MOD Winter+0.0
MOD Spring ->
^
Restore
Meanders
Better Penning +0.4 MOD ->
Restore Meander
Restore Meander
When railway built, the land was ?reclaimed &
now gets stuck.
Possibility to turn back into wetland? or
attenuation to ponds
Stream runs from Downs 'little park fm under West St into sinc.
Pantiles? west stunder 23 comes out under
decking at Bugil Pub comes out near Cliff
Close in ditch.
4.
All water from Bembridge Down flows under Nicholas Close &
under railway
No 6 & 7 flooded
1.
2. Whoae responsibility are mains/pipes under old railway line
Culverts and assoxiated Ditches (Island Line) at Moreton,
are they maintained?
3. Flooding issues down Coach Lane
Used to be ditch along Coach
Lane. New Culvert (2000) under
main road.
Vicarage Lane Floods
When floods, river bank is
visible! its left higher from
years of dredging
Footpath from Quay Lane to
railway station scrub,
gardens, car parks taken over
what would have been water
storage area
0 0.225 0.45 0.9 1.35 1.8
Kilometers



Legend

- Eastern_Yar__Upper
- Eastern_Yar_Lower
- Scotchells_Brook
- Wroxall_Stream

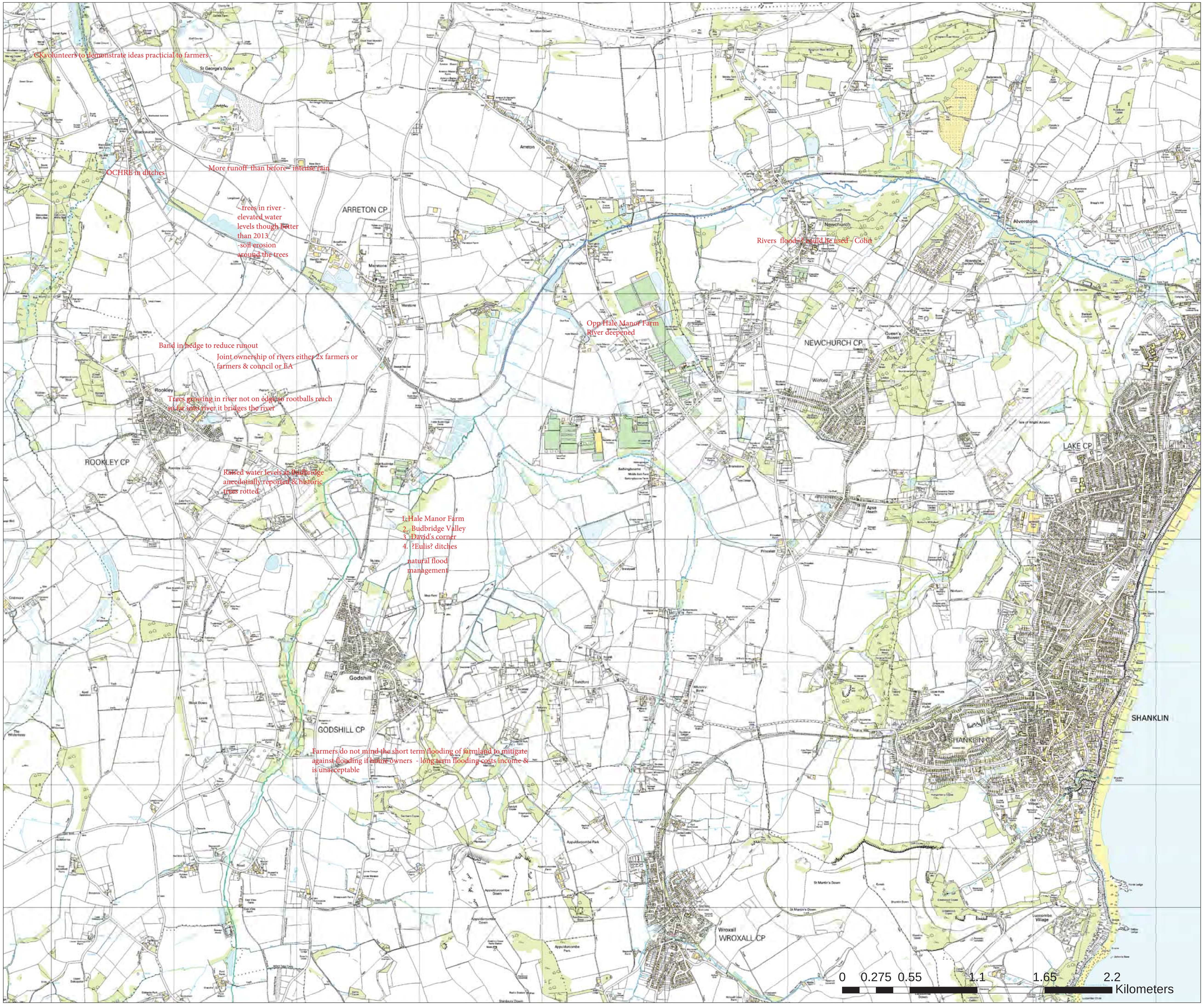
N

NW of Alverstone, Abandoned water meadow? Natural England

South East of Scotchells E Yar - Longmeadow was good grazing, now wet even in summer - adjacent to the field is rising land now under water - IP

Strange open drainage- some take circuitous path to build and keep waterfront of river

Water from high land south east of Scotchells now flow under culvert into river rather than along south side - NW IP



Legend

- Eastern_Yar__Upper
- Eastern_Yar_Lower
- Scotchells_Brook
- Wroxall_Stream

N

Anecdotal evidence showed the sluice gate in 1984 slowed the water & 1st eg of flooding right up to Arreton Valley

Request from EA to farmer to remove small weir at Blackwater? on Medina. Farmer happy to help but then told to pay £50 & fill in form to apply to do it & also to reapply fir his irrigation extraction point, which would be last thru the works - **Weir remains in situ**

Appendix C

Geomorphological Walkover

Contents

C1 Methodology 1

C2 Walkover data 2

C1 Methodology

Geomorphological walkover

A fluvial walkover audit was undertaken to classify the channel into reaches based upon the dominant geomorphological characteristics. The audit field mapping of key geomorphological features and human pressures and included a photographic survey. This assessment was used to characterise the watercourse into separate units based on key indicators, including bed and bank material (where visible), channel gradient, cross-sectional shape and dimensions, dominant processes, riparian character, etc.

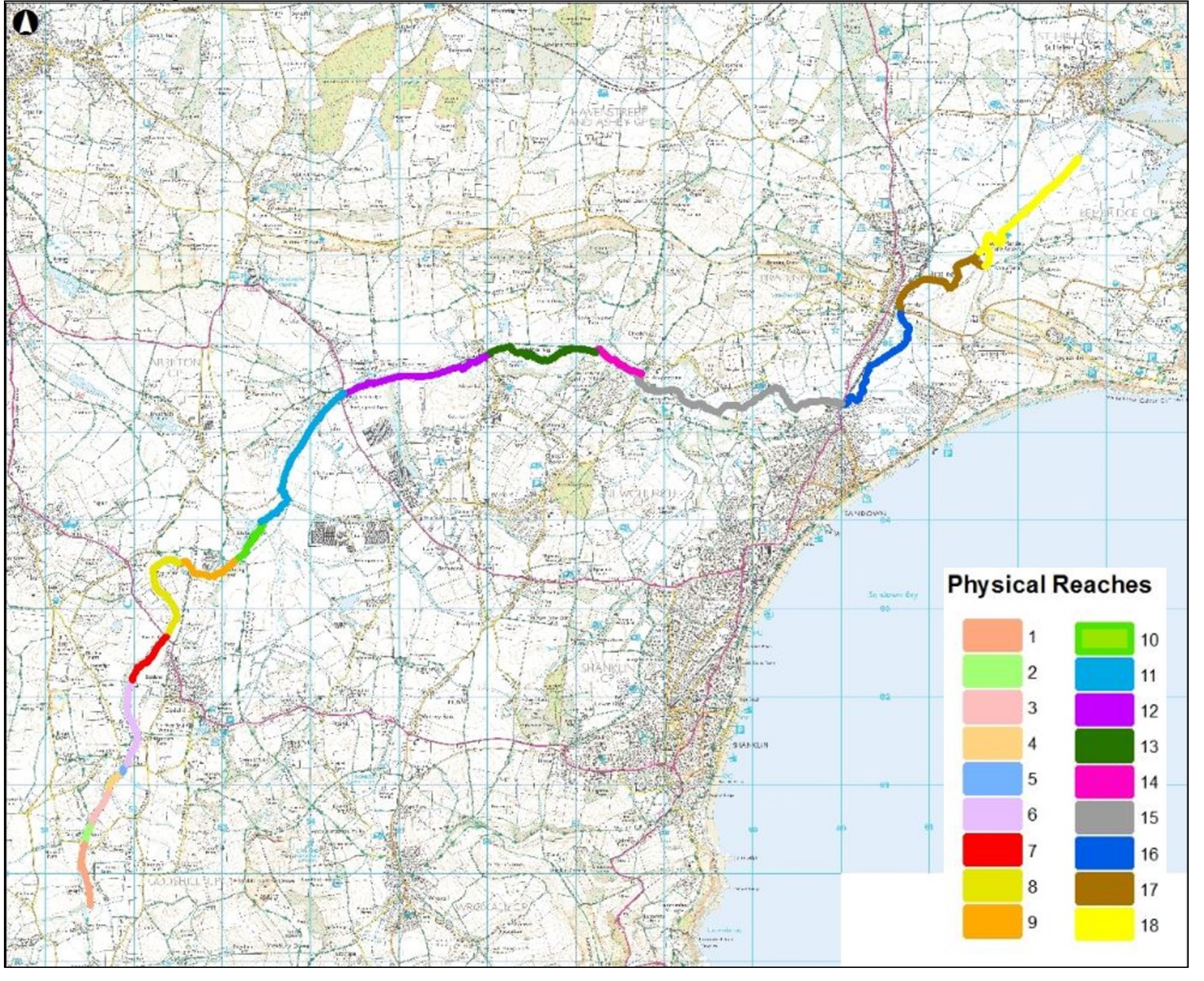
Field data was recorded on predesigned forms (pro-forma) and baseline maps on hand held tablets, to respectively record main geomorphological features. The information recorded in the field was then post-processed and transferred into GIS and relevant spreadsheets.

Example maps from the walkover are presented below. Relevant GIS shapefiles with attribute data including erosion, bank protection, bank vegetation, in-channel features and photograph locations are provided separately.

C2 Walkover data

Example maps from the walkover are presented below. Relevant shapefiles with attribute data including erosion, bank protection, bank vegetation, in-channel features and photograph locations will be provided separately.

Geomorphological reaches

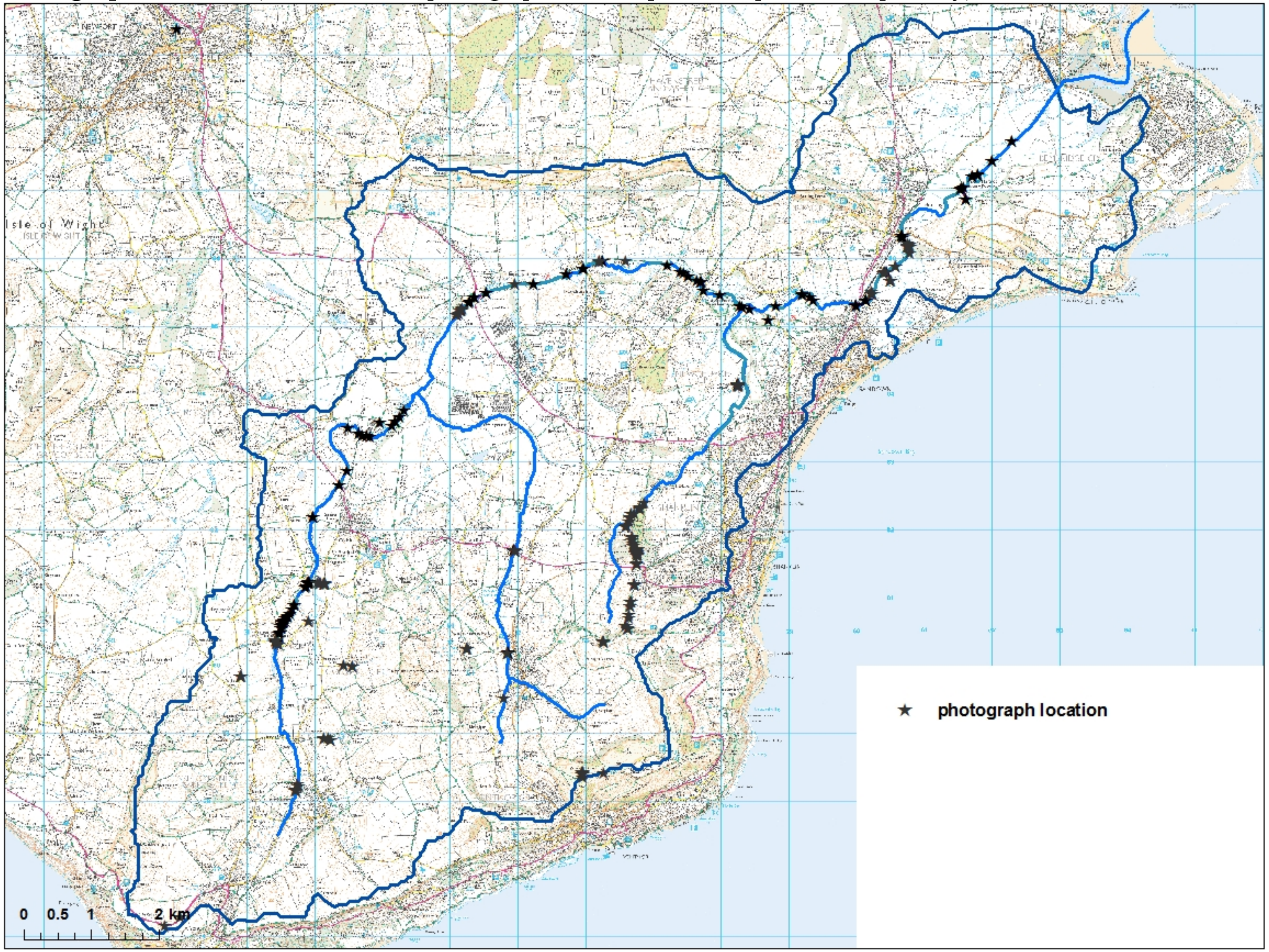


Observed bank erosion

Structures


structures
Bridge
Culvert
LWD
Outfall
Pipe
Weir/sluice
0 0.5 1 2 km

Photograph locations (Georeferenced photographs and shapefile are provided separately)

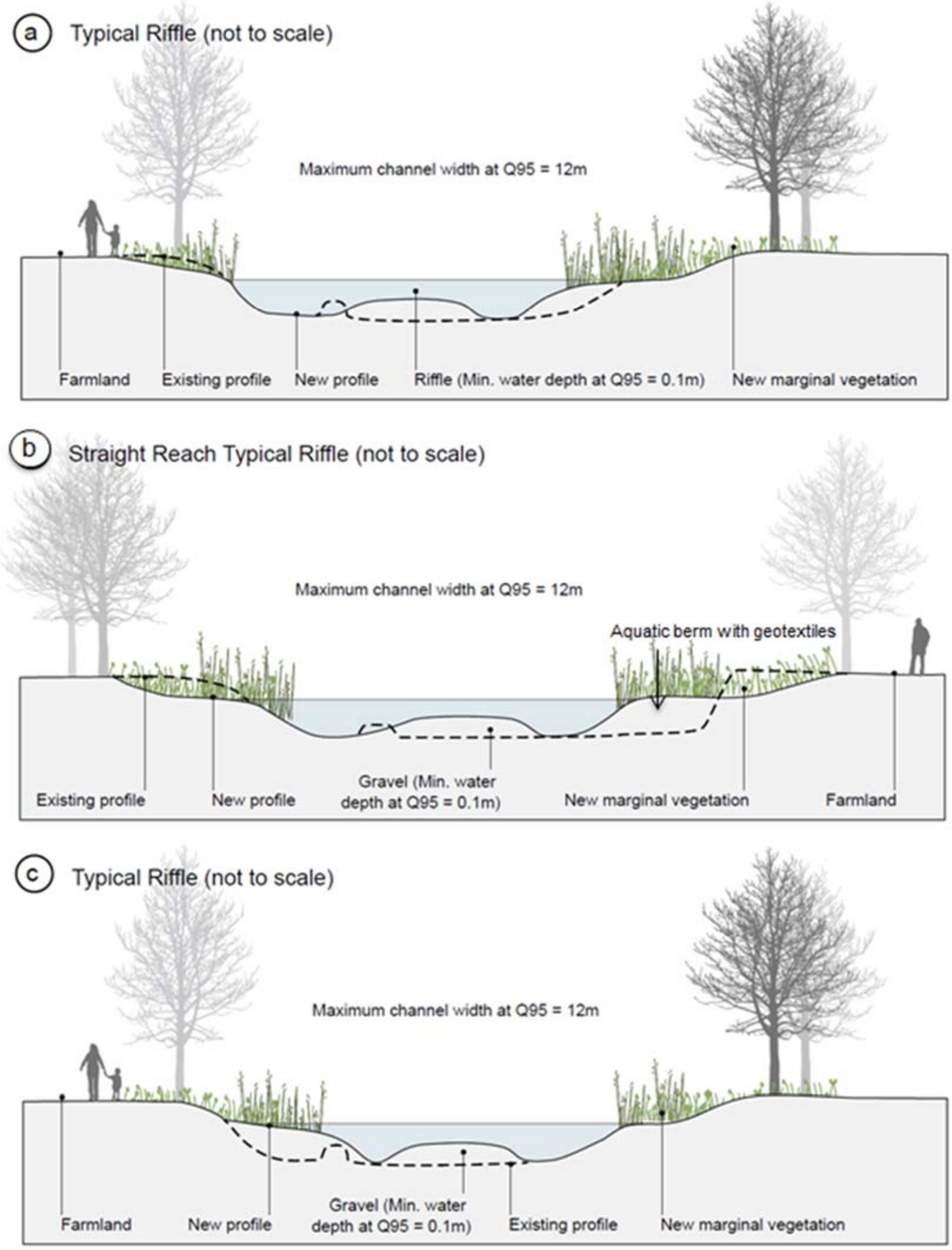


Appendix D

Examples of Restoration Techniques

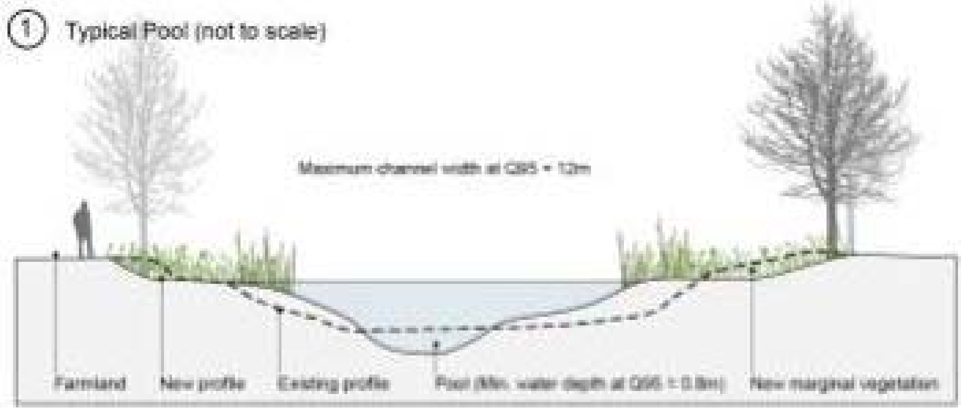
D1 Examples of Restoration Techniques

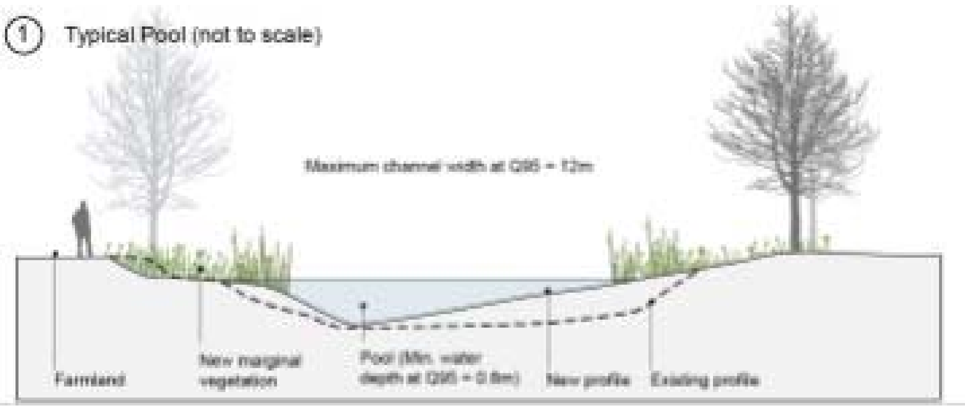
Bank reprofiling



(a) maintaining channel capacity, (b) maintaining channel capacity and combined with aquatic berms and (c) with channel narrowing.

Pools with bank reprofiling

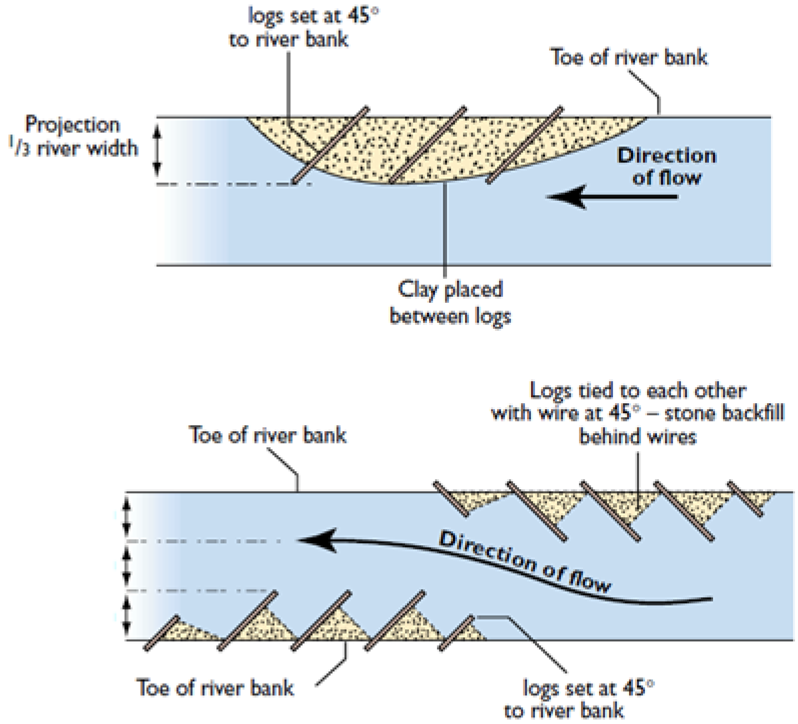




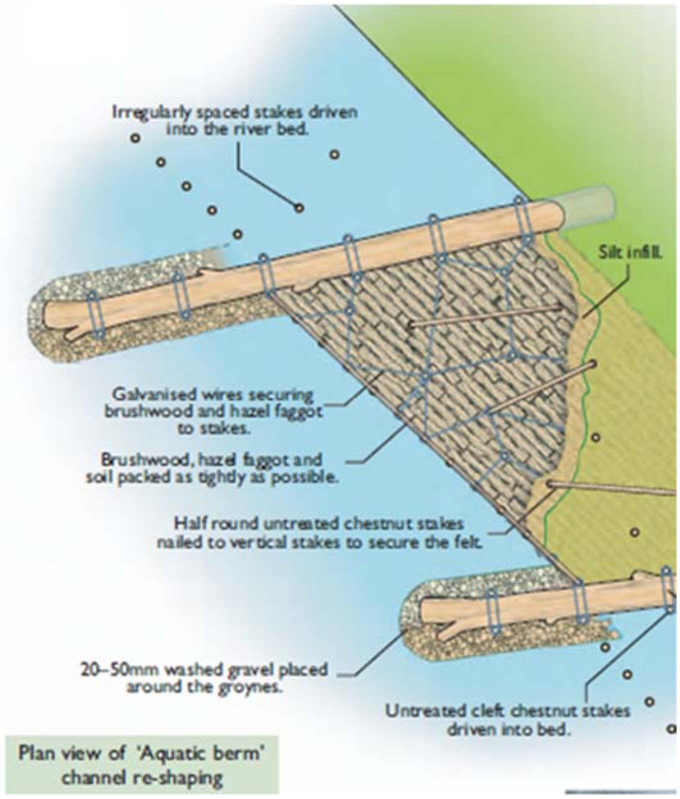
(1) maintaining channel capacity, (2) with channel narrowing.

Installation of more engineered in-channel structures

Flow deflectors (RRC, 1999)



Aquatic berms (STREAM Project)

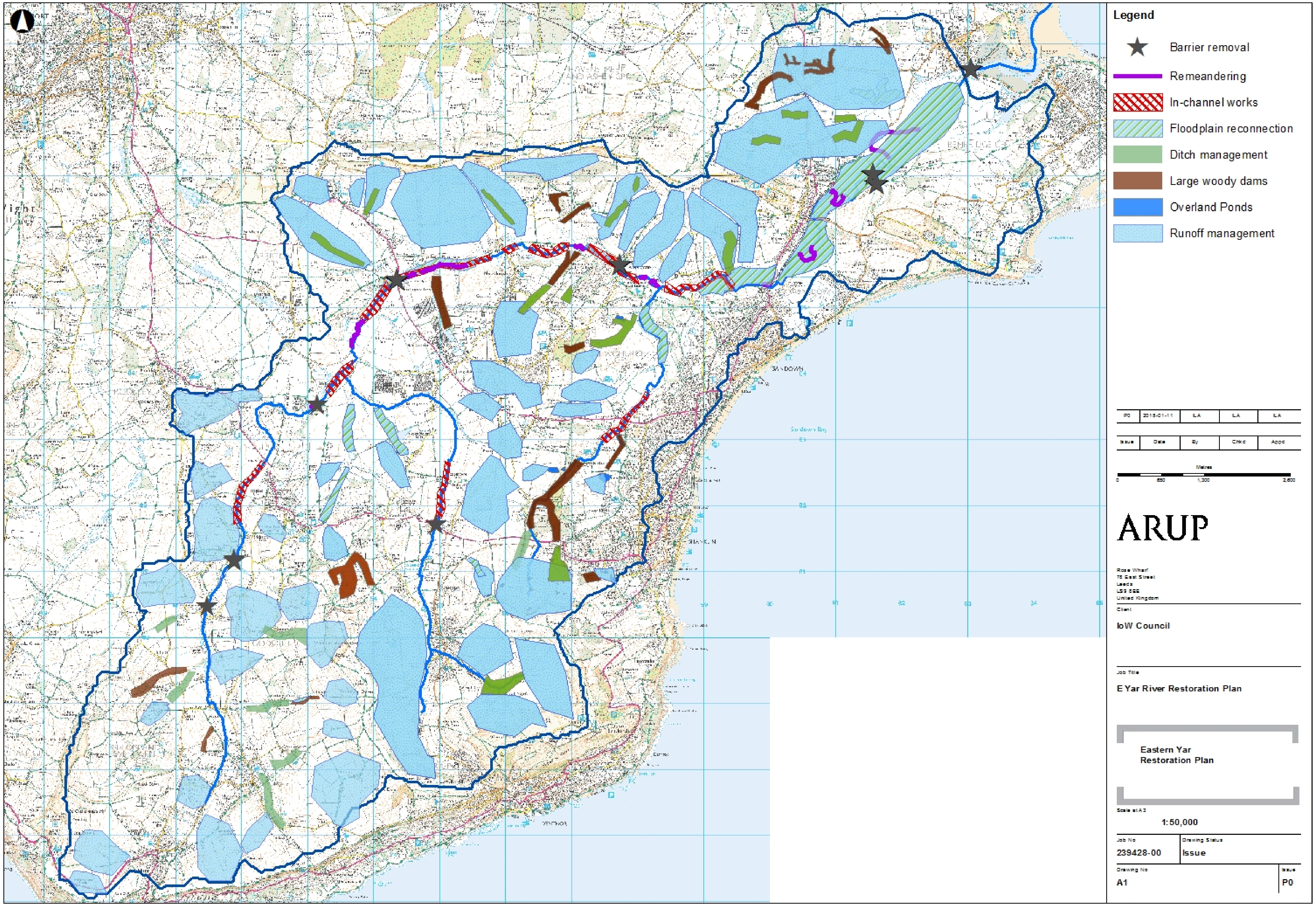


Remeandering straightened channels

Appendix E

Restoration Plan

A3


Legend
Barrier removal
Remeandering
In-channel works
Floodplain reconnection
Ditch management
Large woody dams
Overland Ponds
Runoff management
SANDOWN
Sandown Bay
SHANKLIN
VENTNOR
P0
2015-01-11
ILA
ILA
ILA
Issue
Date
By
Chkd
Appd
Metres
0
650
1,300
2,600
ARUP
Rose Wharf
78 East Street
Leeds
LS9 8EE
United Kingdom
Client
IoW Council
Job Title
E Yar River Restoration Plan
Eastern Yar
Restoration Plan
Scale at A3
1:50,000
Job No
239428-00
Drawing Status
Issue
Drawing No
A1
Issue
P0

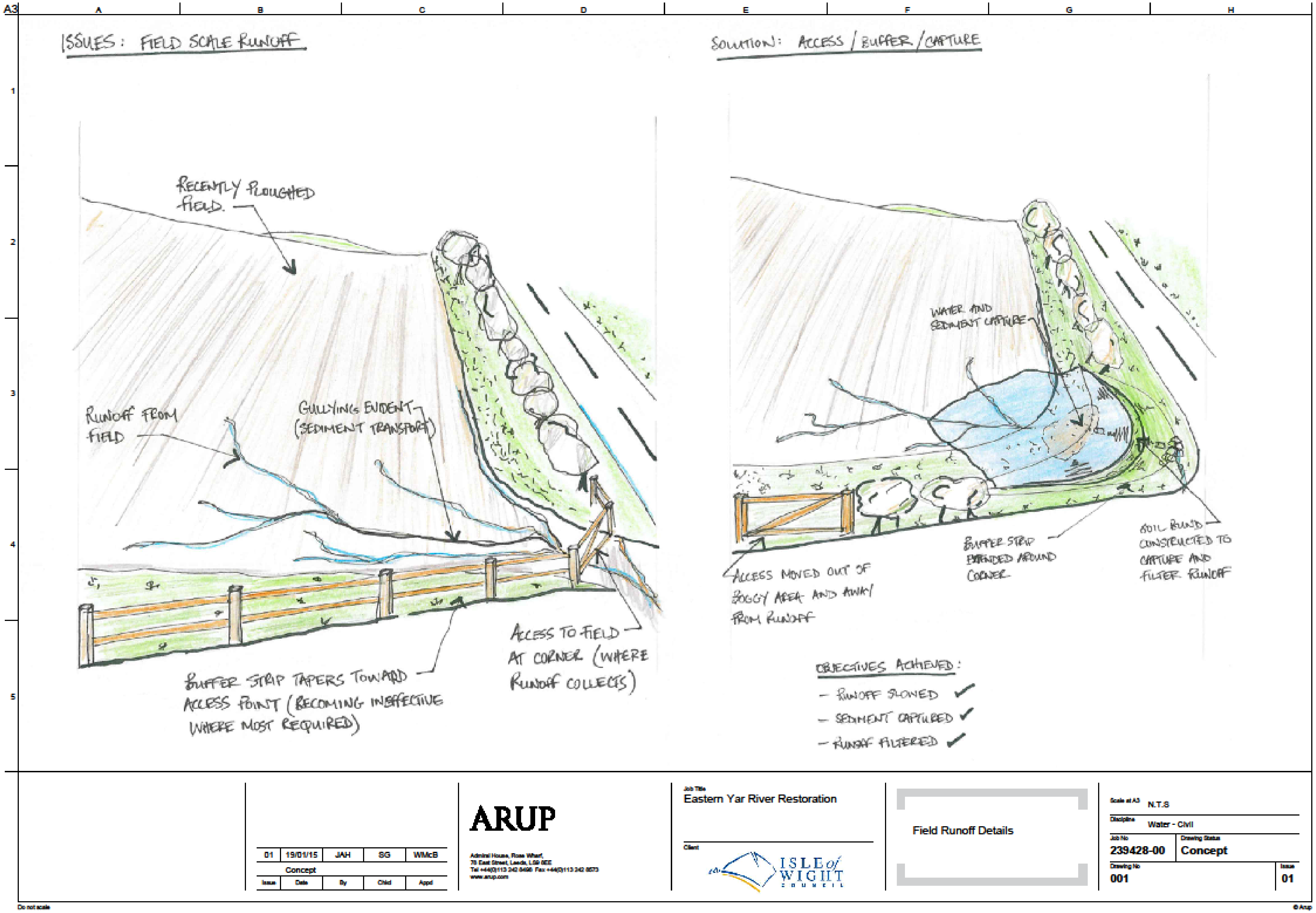
Appendix F

Concept sketches

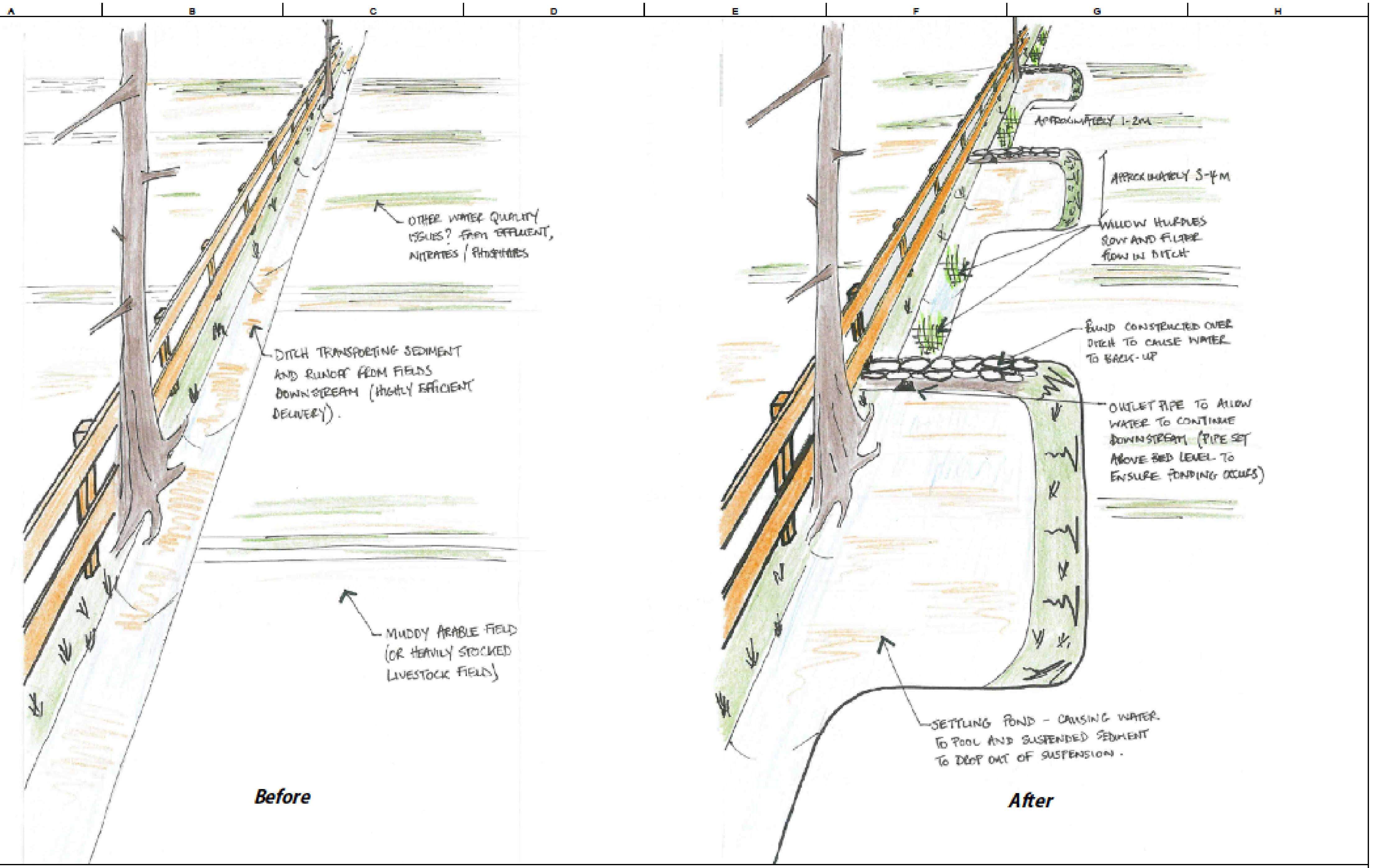
Contents

F1	**Field Runoff**	**1**
F2	**Ditch Management**	**2**
F3	**Road Runoff**	**3**
F4	**Large Woody Debris**	**4**
F5	**Channel Morphology**	**5**
F6	**Floodplain Connectivity**	**7**

F1 Field Runoff



F2 Ditch Management



Issue	Date	By	Chkd	Appd
01	19/01/15	JAH	SG	WMcB
	Concept			

ARUP

Admiral House, Rose Wharf,
78 East Street, Leeds, LS9 8EE
Tel +44(0)113 242 8498 Fax +44(0)113 242 8573
www.arup.com

Job Title
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Client
ISLE of WIGHT COUNCIL

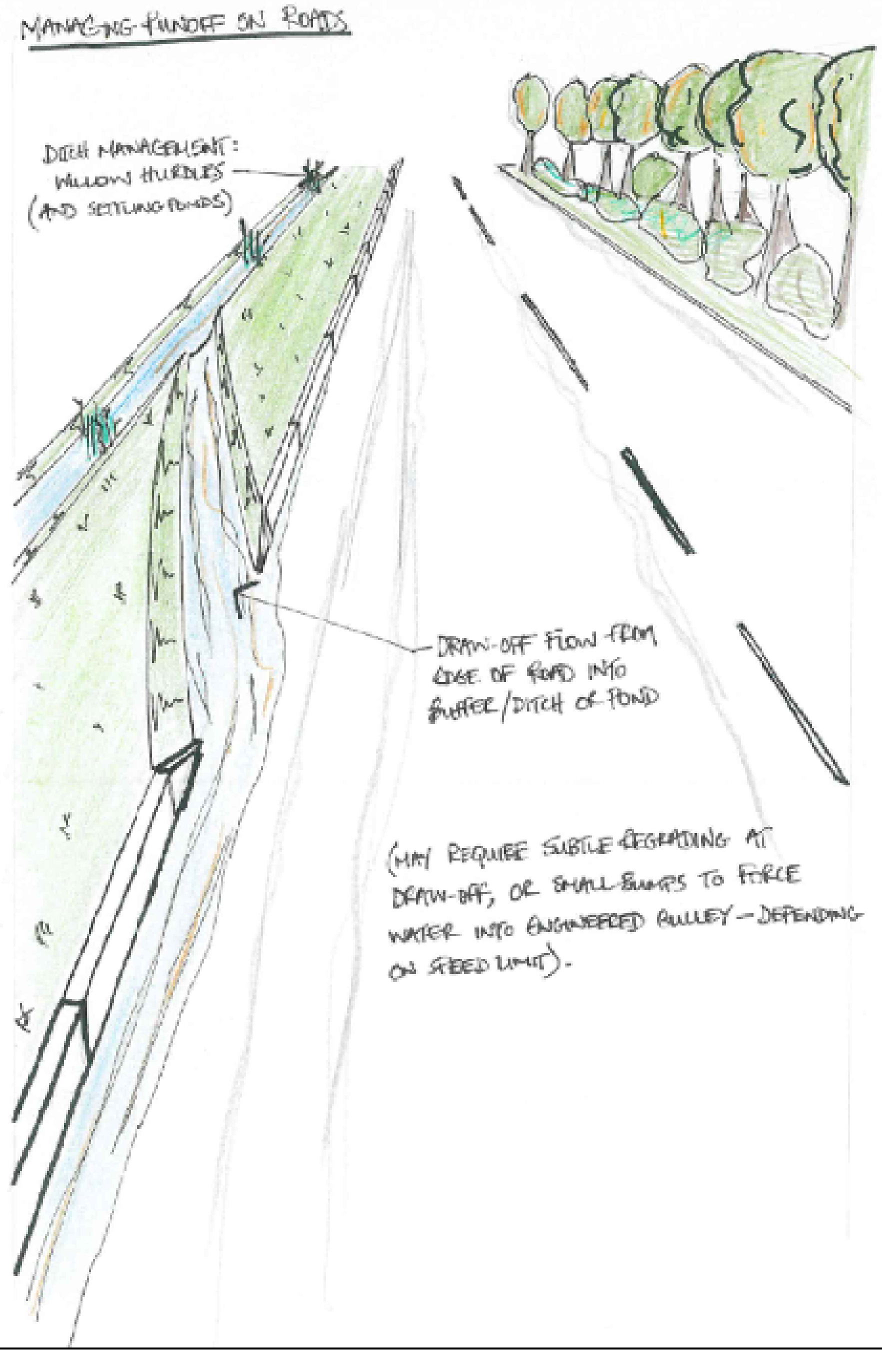
Ditch Management Details

Scale at A3: N.T.S
Discipline: Water - Civil
Job No: 239428-00
Drawing Status: Concept
Drawing No: 002
Issue: 01

Do not scale

© Arup

F3 Road Runoff – road diverted onto managed ditch



Issue	Date	By	Chkd	Appd
01	19/01/15	JAH	SG	WMcB
	Concept			

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Job Title
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Client
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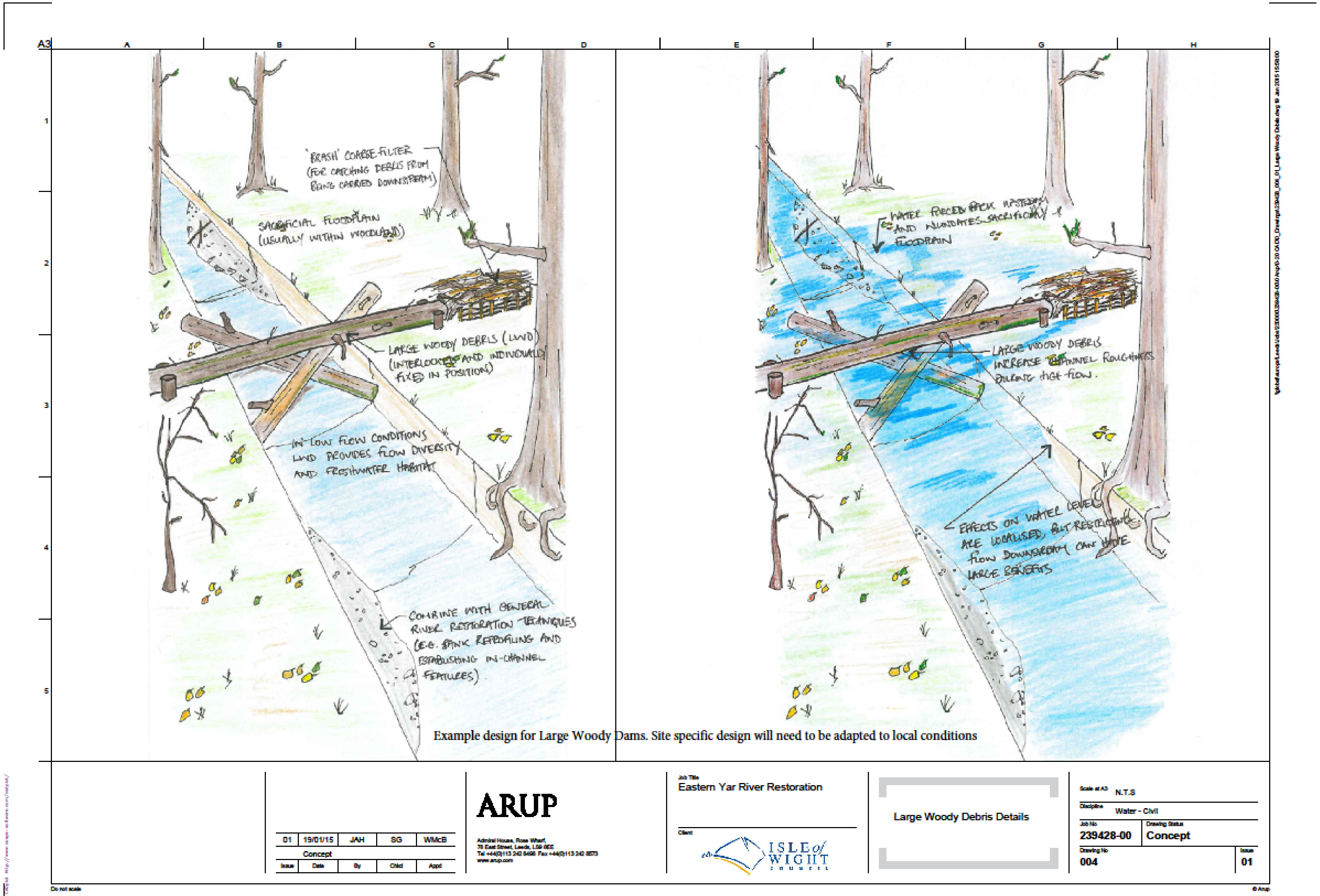
Road Runoff Details

Scale at A3 N.T.S
Discipline Water - Civil
Job No 239428-00
Drawing Status Concept
Drawing No 003
Issue 01

Do not scale

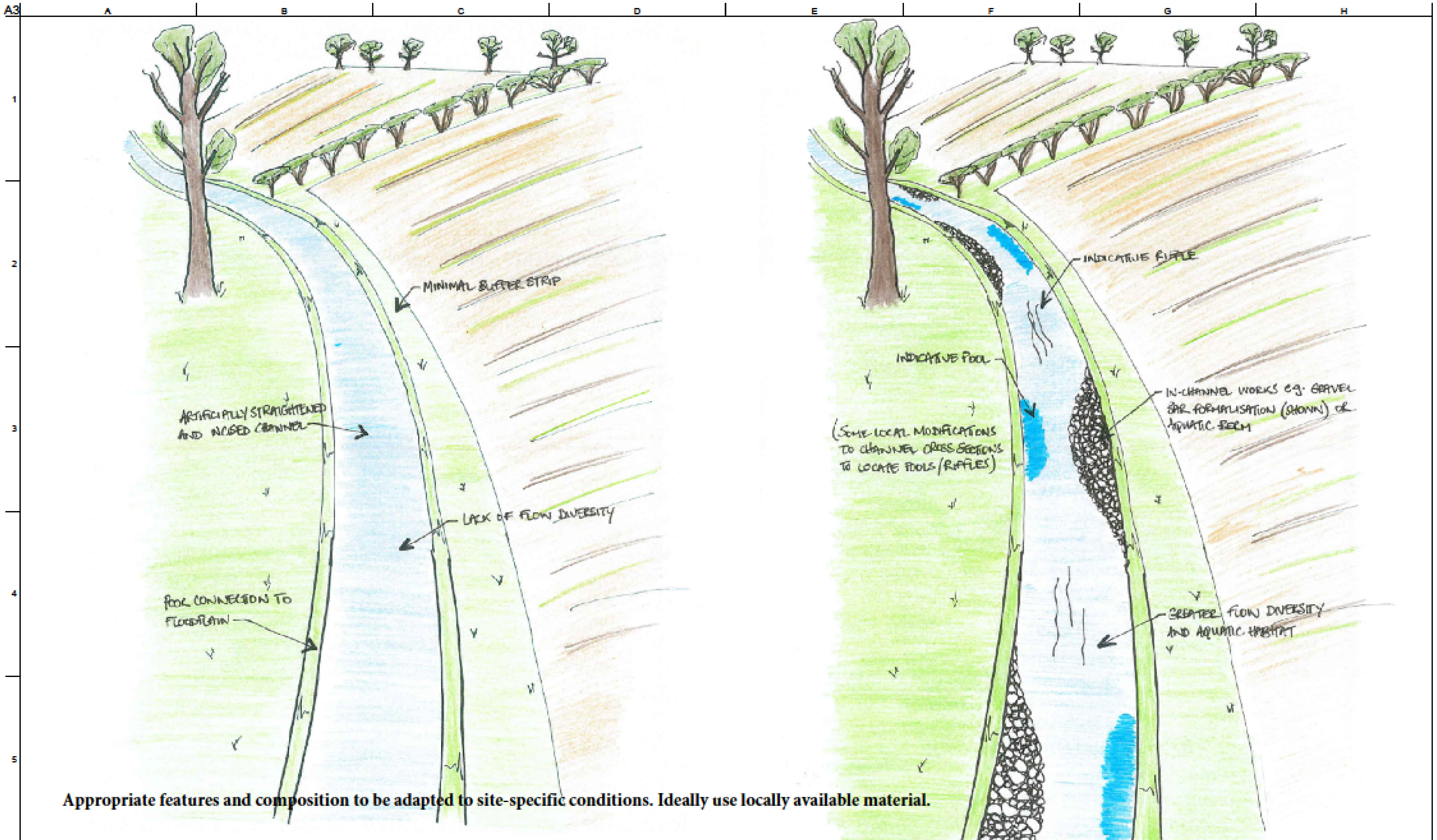
F4 Large Woody Debris



Example design for Large Woody Dams. Site specific design will need to be adapted to local conditions

F5 Channel Morphology

In-channel features



Appropriate features and composition to be adapted to site-specific conditions. Ideally use locally available material.

Issue	Date	By	Chkd	Appd
01	19/01/15	JAH	SG	WMcB
Concept				

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78 East Street, Leeds, LS9 8EE
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www.arup.com

Job Title: Eastern Yar River Restoration

Client: ISLE of WIGHT COUNCIL

Channel Morphology 1 Details

Scale at A3: N.T.S
Discipline: Water - Civil
Job No: 239428-00
Drawing Status: Concept
Drawing No: 005
Issue: 01

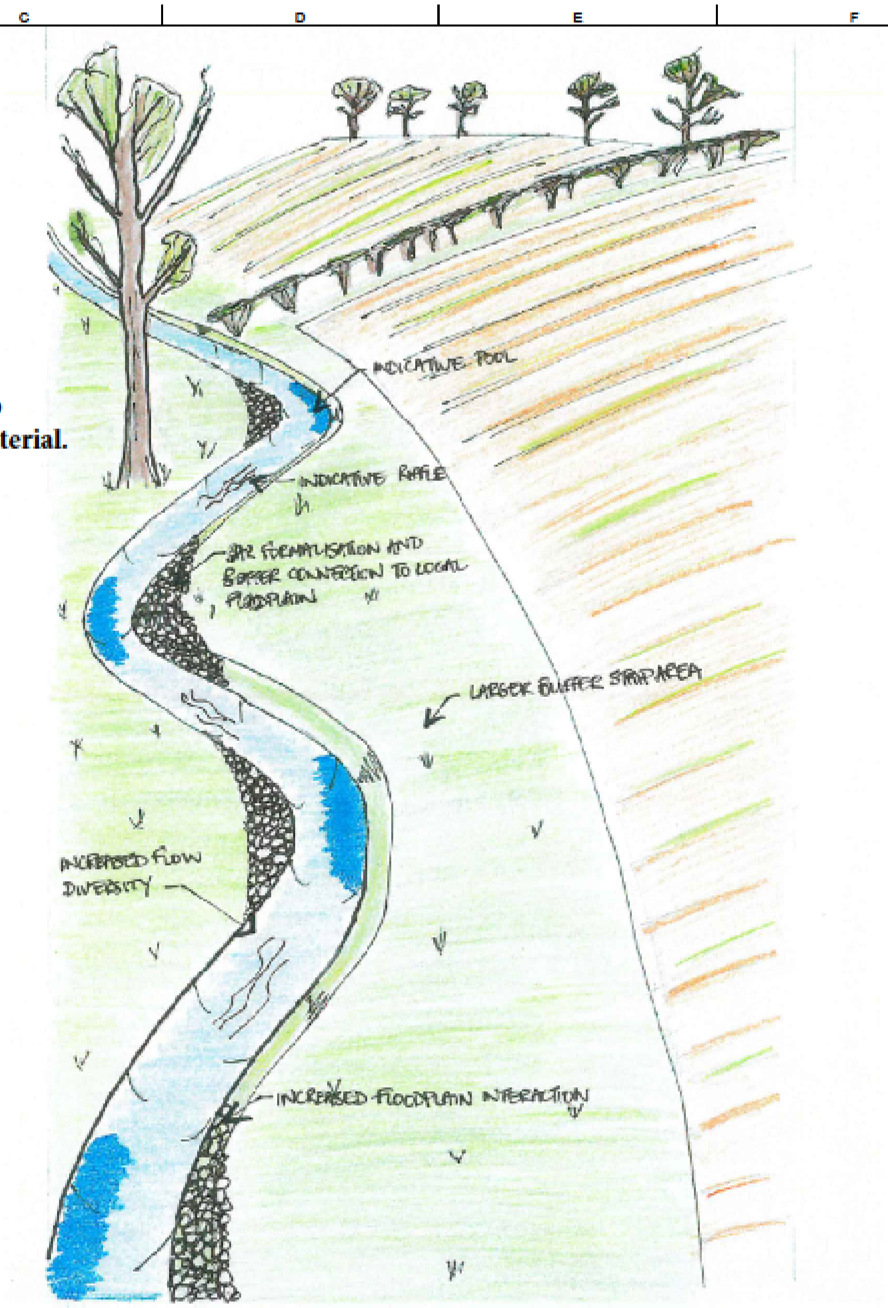
Do not scale

© Arup

Increased sinuosity + in-channel features

A3 | A | B | C | D | E | F | G | H

Appropriate features and composition to be adapted to site-specific conditions. Ideally use locally available material.



Issue	Date	By	Chkd	Appd
01	19/01/15	JAH	SG	WMcB
	Concept			

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Job Title
Eastern Yar River Restoration

Client
ISLE of WIGHT COUNCIL

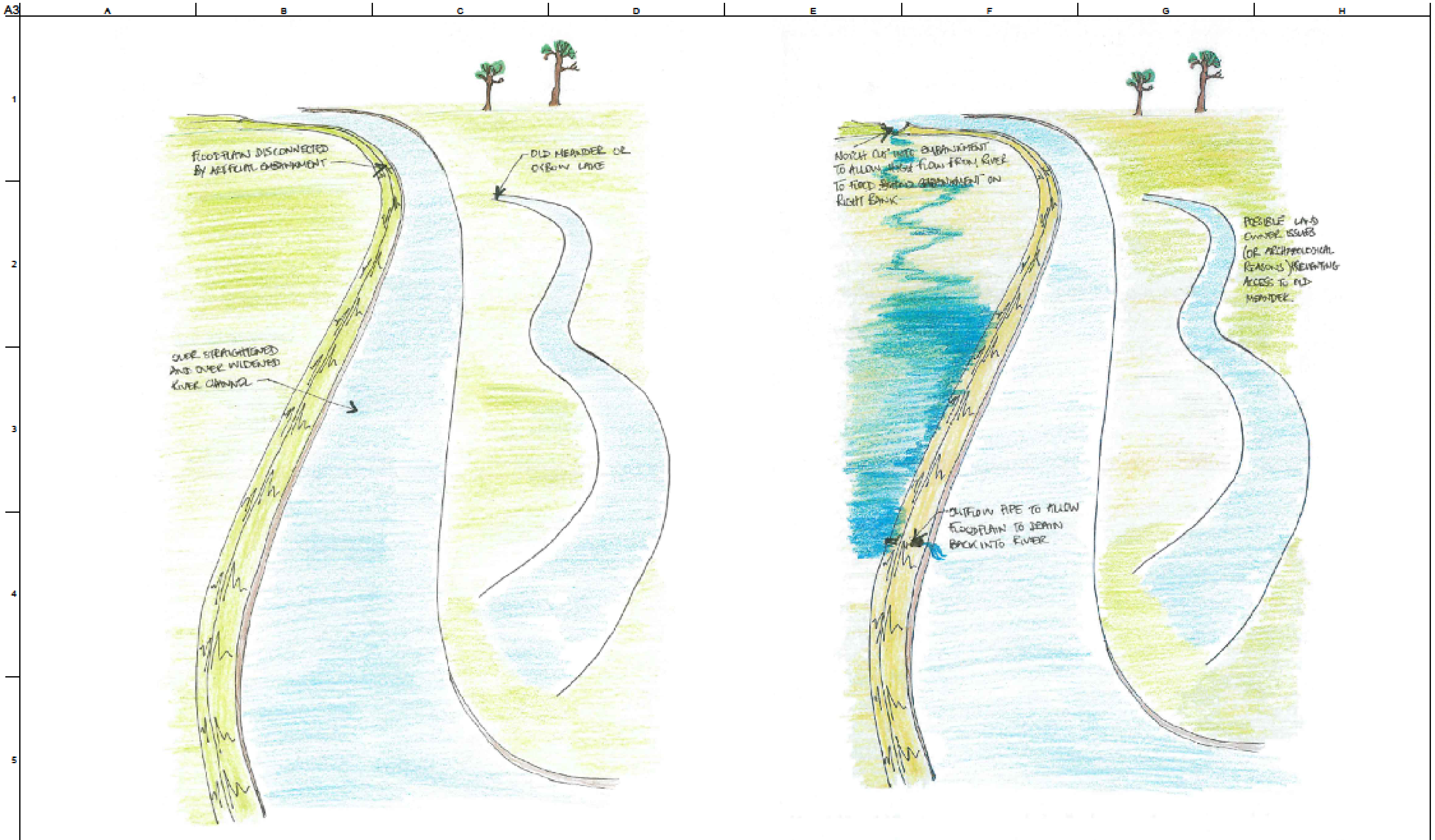
Channel Morphology 2 Details

Scale at A3: N.T.S
Discipline: Water - Civil
Job No: 239428-00
Drawing Status: Concept
Drawing No: 006
Issue: 01

Do not scale

F6 Floodplain Connectivity

Floodplain Storage



Issue	Date	By	Chkd	Appd
01	19/01/15	JAH	SG	WMcB
	Concept			

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78 East Street, Leeds, LS9 8EE
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www.arup.com

Job Title
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Client
ISLE of WIGHT COUNCIL

Floodplain Connectivity Details

Scale at A3: N.T.S

Discipline: Water - Civil

Job No: 239428-00

Drawing Status: Concept

Drawing No: 007

Issue: 01

Do not scale

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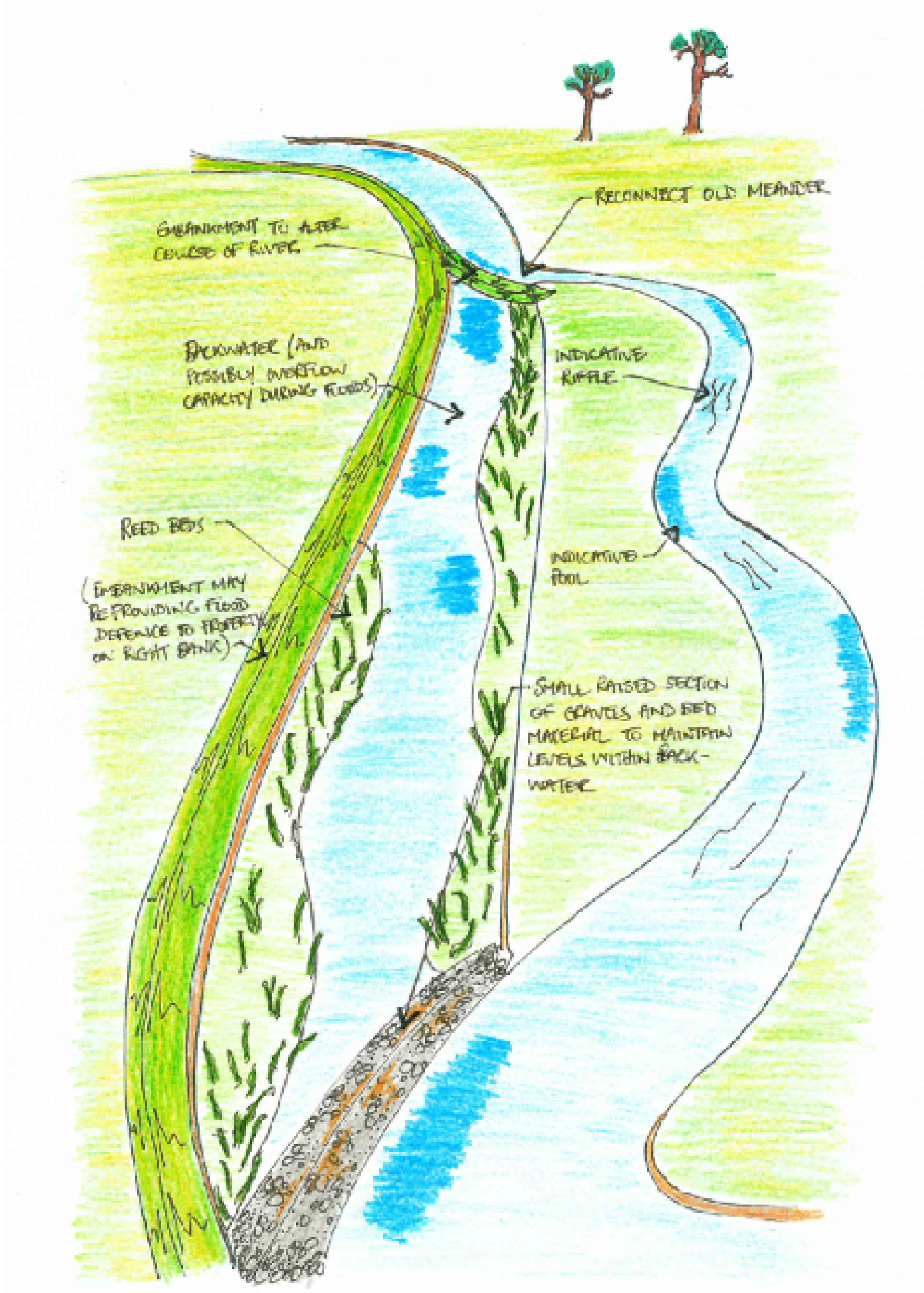
Reconnected Meander



Issue	Date	By	Chkd	Appd
01	19/01/15	JAH	SG	WMcB
Concept				

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Admiral House, Rose Wharf, 78 East Street, Leeds, LS9 8EE
Tel +44(0)113 242 8498 Fax +44(0)113 242 8573
www.arup.com

Job Title: Eastern Yar River Restoration

Client: Isle of Wight Council

Re-connected Meander Details

Scale at A3: N.T.S
Discipline: Water - Civil
Job No: 239428-00
Drawing Status: Concept
Drawing No: 008
Issue: 01

Do not scale

© Arup

Appendix G

Generic costs of restoration

G1 Cost Guidelines

Cost guidelines based on existing schemes (costs will vary depending on location and specific site conditions):

Bank reprofiling	£20/m
Riffle/bar creation	£50/m
Restoring old meanders	£50-70/m (it would be less where the old channel doesn't need to be fully dug out)
Increased sinuosity	£50-100/m
Floodplain reconnection	£20-100/m
Narrowing the low flow channel	£80/m