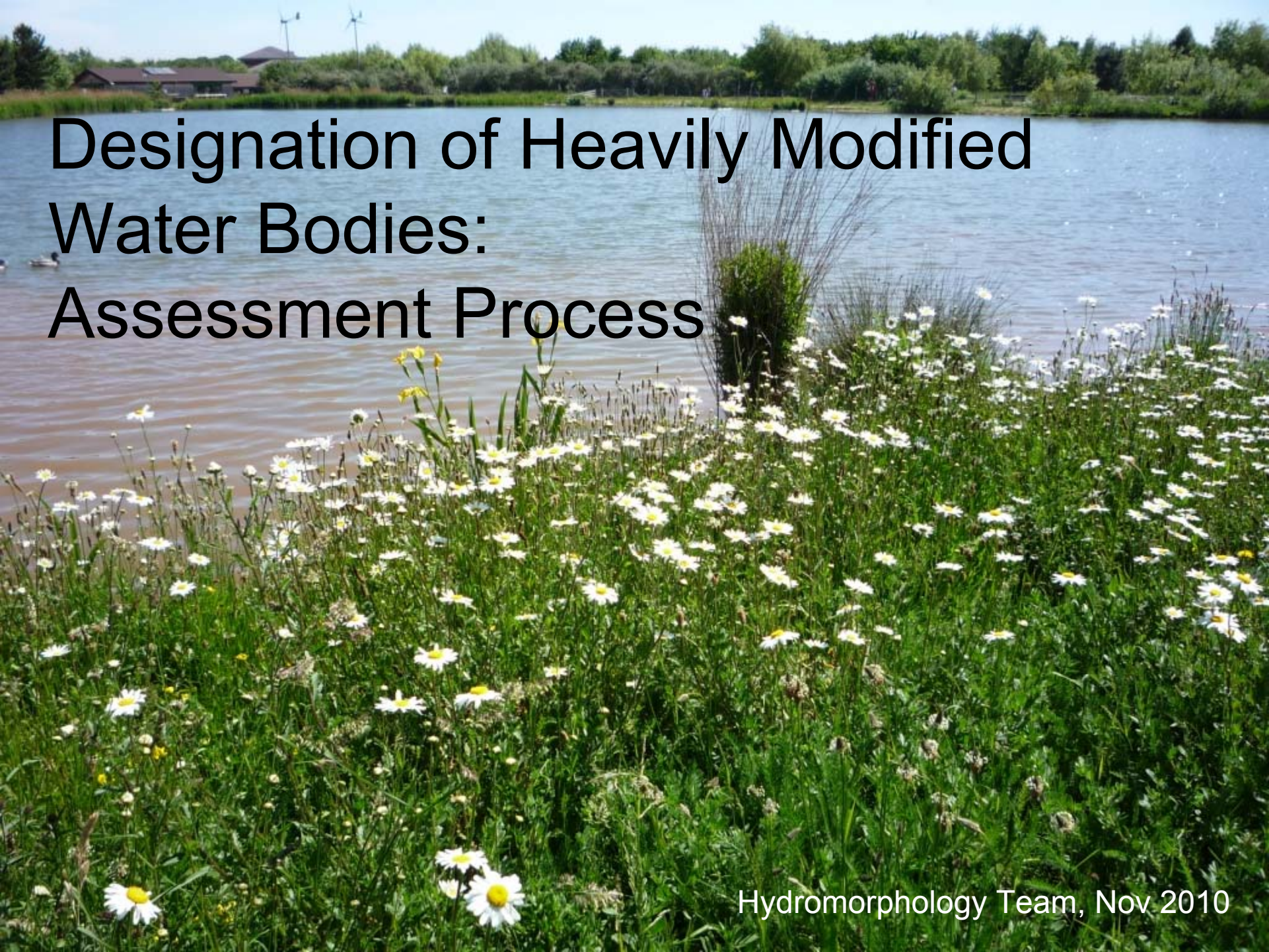

Designation of Heavily Modified Water Bodies: Assessment Process

Hydromorphology Team, Nov 2010

Click here for more information

1. Is the water body at moderate or worse *status* for morphology sensitive elements?

If yes or unsure Go To 2
If no the water body is not HMWB

2. Is there an existing use in the water body?

If yes Go To 3
If no the water body is not HMWB

3. What is the extent of physical modifications in the water body?

If there are physical modifications present Go To 4
If there are no modifications the water body is not HMWB

4. Do the physical modifications affect the status of the water body?

If yes Go To 5
If no the water body is not HMWB

5. Will restoration of the water body to GES significantly adversely affect the use or the wider environment?

If yes Go To 6
If no the water body is not HMWB

6. Are the physical modifications the only means to deliver the use?

If yes the water body in HMWB
If no the water body is not HMWB

Summary of the process to designate a HMWB.

Please follow the process through for each water body.

Click on the information button to go directly to the relevant section.

This guidance has been adapted from the detailed process used previously to the review of designations in 2010/11. The original guidance is on the O drive O:/hydromorphology/review of designation 2010_11/useful info/Detailed_Ass_v0.6g.doc

1. Is the water body at moderate or worse *status* for sensitive elements?

This step is to determine if the water body is at currently at good (or high) ecological status. If this is the case the water body cannot be designated as HMWB, but we need to be sure that hydromorphological pressure are being reflected in the ecological status.

Using current ecological classification results identify if

- There are no hydromorph sensitive elements at less than good ecological status and
- There are two or more hydromorph sensitive elements are at good or high ecological status.

Consider if the biological results accurately representing the hydromorphological condition across the whole water body? e.g. does the sampling site in the water body avoid the hydromorphology pressures, and so does not pick up the resultant impacts on ecology?

Where it is considered that the biology is at good or high ecological status and this is an accurate reflection of the hydromorphological condition the water body cannot be designated HMWB. If the ecological status, does not reflect hydromorphological pressures and impacts the water body is taken forward to stage 2.

Hydro morphologically sensitive biological elements are:

Fish; - Macrophytes &- Invertebrates

Click Click here for next step step in the process

2. Is there an existing use in the water body?

The aim of this step is to identify the specified **uses** that occur within the water body in a semi-quantitative way. The assessment is based on expert opinion, using the best available information.

If approximately <33% of the water body is used for a specified use then it is recorded as Present. If approximately >33% of the water body is used for a specified use that it is considered Extensive within the water body. If there is no specified use then Absent is recorded.

It is important to note that a water body can have many uses, and many of these uses can be extensive. The assessments of the extent of specified use on a water body are set using arbitrary thresholds. No detailed empirical or theoretical information exists to justify these threshold levels at the present time.

If it considered by that **no specified uses** exist in the water body then it is **not considered as a HMWB.** Where one or more uses is identified the water body is taken forward to stage 3.

For the detailed assessment of water bodies there are 11 specified uses;

1. Wider Environment 2. Navigation 3. Recreation 4. Drinking water supply 5. Power Generation 6. Irrigation 7. Water Regulation 8. Flood Protection 9. Land Drainage 10. Urbanisation 11. Other Equally Important sustainable human development activities

For more detailed definitions of the specified uses click on the links

As water bodies will probably have more than one use, it is possible for several specified uses to be extensive within that water body.

Click here for next step in the process

Possible uses a AWB/HMWB can be designated for

1. The Wider Environment

The CIS guidance document no.4 (European Commission, 2003) considers the wider environment to include the natural environment and the human environment including archaeology, heritage, landscape and geomorphology.

2. Navigation inc. Port Facilities

Navigation in this instance is ***limited to commercial navigations and ports used for commerce***, for example where the water body is dredged to maintain access for commercial vessels to ports, harbours and marinas. Recreational navigations are considered under the recreation specified use. For the purposes of navigation modifications such as straightening and deepening of the channel, and the inclusion of structures such as bank reinforcement, embankments and floating quays and marinas are usually present. These modifications subsequently are recorded in Step 3

3. Recreation

Recreation includes activities such as yachting (navigation for recreational purposes), angling, and cycling and hiking along the banks of the water body thus putting pressure on the water body. However, only recreational activities that require or result in physical modification to the water body are relevant and should be included as a specified use. Although recreation is not usually the main use in a water body it can have significant impacts on the hydromorphology. Most of the modifications resulting from recreation affect the banks and riparian zone including marinas, tow paths, picnic and recreation areas, land reclamation, and infrastructure.

4. Drinking water supply

Drinking water supply specified use applies to water storage reservoirs that are used to supply clean drinking waters to the population (also see Strategic Transfers and Impoundment Releases)

5. Power Generation

Power generation in this instance refers to hydropower schemes. Power generation has many associated physical alterations to the river channel such as dams, storage reservoirs and impoundments (weirs etc.).

6. Irrigation

Irrigation as a specified use in this instance refers to water bodies where water is diverted and either from a natural channel at an artificial discharge or via man-made channels for the purposes of agricultural/food production.

Possible uses a AWB/HMWB can be designated for

7. Water Regulation, subdivided into i) Strategic Water Transfer and ii) Impoundment Releases

Elements of the Water Resources Infrastructure will qualify as artificial or heavily modified water bodies. These include reservoirs providing water storage for drinking water or irrigation (see Irrigation and Drinking Water Supply); they also include water regulation activities. Whilst reservoirs are easily defined on morphological grounds some water regulation activities might principally result in changes to the hydrological rather than morphological regime. The purpose of the transfer or the impoundment release could principally be for the environment or it could be to support downstream activities like navigation or abstraction for drinking-water supply. However they are all included as the activity "water regulation" subdivided into the modification "strategic transfers" or "impoundment releases". Some more advice on water resources designation is on the O drive . O:/hydromorphology/review of designation 2010_11/useful info\ " Water Resources HMWB v1.1 guidance RJA 04-2008"

i) Strategic Transfers

Where water is not immediately used at the point of abstraction but is transferred elsewhere there is potential for significant alteration of the hydrological regime in the intervening water bodies. Piped transfers can form part of this strategic transfer but only if some element of the scheme has the potential to support significant aquatic ecology (e.g. a piped water supply distribution network would not qualify if it did not at some point discharge to a water body).

ii) Impoundment Releases:

Major impoundments will have their own associated activities – typically drinking water supply and flood protection through the creation of a reservoir immediately upstream of the impoundment. In many cases the hydrological regime immediately downstream of the impoundment will be regulated through controlled releases.

Possible uses a AWB/HMWB can be designated for

8. Flood Protection

For the purpose of detailed assessment flood protection refers to **all** modifications that are used for flood protection.

9. Land Drainage

Land drainage is concerned with those uses that are undertaken to remove water from the land for purposes that allow land development (land reclamation) or to allow optimal water levels to be maintained for agricultural purposes.

10. Urbanisation

Urbanisation in the context of the detailed assessment is defined as built up areas used for either residential or commercial uses. This includes small hamlets comprising of only several houses. However, individual isolated properties that occur in a water body should not be considered as part of the urbanisation specified use.

11. Other Equally Important Sustainable Human Development Activities

There is no agreed definition of what constitutes an equally important sustainable human development activity within Europe. The exact definition for an activity falling under sustainable development will thus depend on the time, scale, involved stakeholders and information available. Examples of such equally important sustainable development activities may include uses such as Forestry and Fisheries. If other equally important sustainable human development activities are believed to occur in the water body, please state the type of activity and the extent in the proforma.

3. What is the extent of physical modifications in the water body?

This step involves the identification of those physical modifications.
If there are **no** physical modifications that could result in changes to the hydromorphology that are long-term and alter the morphological and hydrological characteristics substantially and have a specified use then the water body is **Not HMWB**. If one of the uses identified in stage 2 has no associated modifications it should be removed from the designation.
Where there are identified modifications the water body is taken forward to stage 4.

IMPORTANT: Only modifications that are associated with the identified specified use(s) should be assessed.
The extent of modification within a water body is assessed in a semi-quantitative manner as present, extensive, absent or unknown.

For point modifications such as weirs, dams sluices and impoundments the number of modifications within the water body is used to determine whether the structures are present or extensive within the water body. For linear features such as embankments and reinforcement to banks the extent is measured as a percent of the water body length.

Where if the feature is:
approximately ≤33% of the total water body length/area then it is recorded as **present,**
approximately ≥33% of the total water body length/area then it is recorded as **extensive**.
Definitions of modifications and the extent of these modifications are shown in the following tables.

Click here for next step in the process

Modification	Definition	Definitions of Extent			
		Absent	**Present**	**Extensive**	**Unknown**
Culverts	Major culverts that substantially alter the character of the water body as individual or cumulatively from many small culverts including those under minor roads.	Modification is known **not** to be present in the water body	Approximately ≤33% of the total water body length culverted	Approximately ≥33% of the total water body length culverted	Presence of the modification is **unknown** within the water body
Weirs	Only include weirs that have a specified use such as water regulation, flood protection etc.	Modification is known **not** to be present in the water body	≤ 5 weirs per water body that either individually or cumulatively, substantially alter the water bodies character.	≥ 6 weirs per water that either individually or cumulatively substantially alter the water bodies character.	Presence of the modification is **unknown** within the water body
Locks	Functioning locks that are used maintain water levels and allow passage of vessels.	Modification is known **not** to be present in the water body	≤ 5 locks per water body	≥ 6 locks per water body	Presence of the modification is **unknown** within the water body
Dams and Impoundments	All structures that have a specified use (e.g. water regulation, Irrigation etc) that restrict the flow of water resulting in the impoundment of water upstream.	Modification is known not to be present	≤ 3 dams or impoundments within water body. **Note: Where one dam or impoundment in its own right substantially alters the character of a water body then record the modification as extensive.**	≥ 4 dams or impoundments within water body.	Presence of the modification is **unknown** within the water body

Physical modifications

Modification	Definition	Definitions of Extent			
Sluices	Only include Sluices that have a specified use e.g. Water Regulation, Irrigation, Land Drainage. and that either singularly or cumulatively result in a substantial alteration in the character of the water body.	Modification is known **not** to be present the water body	≤ 5 Sluices per water body	≥ 6 sluices per water body	Presence of the modification is **unknown** within the water body
Marinas	Permanent moorings and marinas that still have a specified use.	Modification is known **not** to be present in the water body.	≤ 3 Marinas per water body. **Note: Where one marina in its own right substantially alters the character of a water body then record the modification as extensive.**	≥ 4 Marinas per water body.	Presence of the modification is **unknown** within the water body
Channel Realignment (CR)	Original channel has been either straightened or moved. Includes creation of new channels e.g. flood by-pass channels.	Modification is known **not** to be present in the water body	Approximately ≤33% of the total water body length realigned	Approximately ≥33% of the total water body length realigned	Presence of the modification is **unknown** within the water body
Bed resectioned /deepened (RS)	Channel bed resection or re-profiled to increase conveyance.	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length resectioned / dredged or deepened	Approximately ≥33% of the total water body length resectioned/dredged or deepened	Presence of the modification is **unknown** within the water body

Physical modifications

Modification	Definition	Definitions of Extent			
		Absent	Present	Extensive	Unknown
Bed material removal (BM)	Activities including gravel and aggregate extraction and dredging.	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length has been subjected to gravel and aggregate extraction and dredging.	Approximately ≥33% of the total water body length has been subjected to gravel and aggregate extraction and dredging	Presence of the modification is **unknown** within the water body
Bank reinforcement (BR)	Bank reinforcements such as hard engineering (i.e. Concrete revetments) and soft/bio-engineering such as Geo-textiles, and coir rolls.	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length with reinforced banks	Approximately ≥33% of the total water body length with reinforced banks.	Presence of the modification is **unknown** within the water body
Embankments (EM)	Embankment that occur at or very close to bank top (within 5 m of bank top).	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length Embanked.	Approximately ≥33% of the total water body length Embanked.	Presence of the modification is **unknown** within the water body
Set back embankments (SBE)	Embankments that are set back away from the bank top creating a two-stage channel (>5m from bank top).	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length with Set back embankments.	Approximately ≥33% of the total water body length set back embankments.	Presence of the modification is **unknown** within the water body
Flood defence structures (FDS)	Other Flood defence structures that are recorded in NFCDD or from other sources..	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length with other structures used for Flood defence purposes.	Approximately ≥33% of the total water body length with other structures used for Flood defence purposes. .	Presence of the modification is **unknown** within the water body

Physical modifications

Modification	Definition	Definitions of Extent			
		Absent	Present	Extensive	Unknown
Flood storage area (FSA)	Area used for Flood Storage.	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length used as a FSA.	Approximately ≥33% of the total water body length used as a FSA	Presence of the modification is **unknown** within the water body
Land drainage inc. drainage ditches (LD)	Created drainage channels for agricultural and residential purposes (e.g. SUDS). Drainage channels for Flood defence purposes should be recorded under Flood Defence structures. This definition should also be used for areas that are controlled by an IDB.	Modification is known **not** to be present in the water body.	Approximately ≤33% of the total water body length is comprised of land drains/ditches or IDB.	Approximately ≥33% of the total water body length is comprised of land drains/ditches or IDB.	Presence of the modification is **unknown** within the water body
Buildings/Bridges/ Roads/Railways (BBR)	All tarmac roads (do not include small unmetalled tracks). All large bridges excluding small foot bridges that do not have a substantial impact on the hydromorphology. Urban areas including hamlets and towns.	Modification is known **not** to be present in the water body.	Occasional buildings/hamlets and associated minor roads and infrastructure along rivers or the banks of lake water bodies	Riverine water bodies flow through many villages or towns/cities and have large number roads/railways either crossing the water body or running closely alongside.	Presence of the modification is **unknown** within the water body
Altered Hydrological Regime	Where the hydrological regime of the water body is substantially altered by a specified use such as Water Regulation.	Modification is known **not** to be present in the water body.	Altered hydrological regime affects approximately ≤33% of the water body	Altered hydrological regime affects approximately ≥33% of the water body	Presence of the modification is **unknown** within the water body

Physical modifications

4. Do the physical modifications affect the status of the water body?

This step involves bringing together the information regarding morphological modifications and ecological status of the water body in order to assess how morphological modifications are affecting ecological status. Where water bodies are thought to be able to **achieve GES with existing hydromorphological modifications**, the water body is not HMWB. Even though there are hydromorphological modifications in a water body, these may not be causing an ecological impact and the current condition may be due to other pressures. Where the hydromorphological conditions to affect the status the water body is taken forward to stage 5.

This step involves assessing how the morphological modifications to the water body are assumed to affect the ecological status. In general the link between the physical modifications in water bodies and the impact on the biota is not easily defined in UK river and lake water bodies. Consequently, this step will involve assessors applying expert judgement in considering the linkages between the morphological modifications and the ecological status.

Many hydromorphological modifications have the potential to have an impact of the ecology at a range of spatial scales. As a consequence the ecological impacts of hydromorphological modifications may be remote from the source of the modification. The designation of HMWBs is carried out on a water body by water body basis. This causes problems when the impact is remote from the water body. Consequently, for the purposes of the assessment process these remote sources of modification are concerned only with significant modifications in the hydrological regime which are recorded in step 3.

Click here for next step in the process

5. Will restoration of the water body to GES significantly adversely affect the use or the wider environment?

This step is to identify if the water body can be restored to Good Ecological Status (GES) without a significant adverse effect on the identified use(s) or the wider environment. If the water body can reach GES though restoration measures then it cannot be designated as a HMWB. If the water body cannot reach GES with and adverse impact on wider environment or use it is taken forward to stage 6

Restoration measures can be identified from the lists given at the end of the document.

For Guidance on assessing the ***effects of restoration measures on the Wider Environment click here***

For guidance on assessing the ***effects of restoration measures on Specified uses click here***

Click here for next step in the process

Assessing the effects of restoration measures on the Wider Environment

Applies to pHMWB only

In this step the impacts of the proposed restoration measures on the wider environment are qualitatively assessed.

Water bodies can be designated Artificial or Heavily Modified if restoration of the modified water body has a significant adverse effect on the wider environment. This provision was included in the Directive in recognition that some physical modifications often have important secondary roles or positive “side-effects”.

In some cases it will not be beneficial to the environment or to society to restore the water body to its natural condition because this may damage important environmental features. In the EU Commission AWB and HMWB guidance the wider environment is considered to include the natural environment and the human environment including archaeology, heritage, landscape and geomorphology.

Examples of "restoration measures" that have an adverse effect on the wider environment include:

The restoration of flood plains may threaten a specific landscape and biodiversity that has developed over the years as a result of the elimination of the floods in the riparian zones and former floodplains.

The removal of a dam may lead to the elimination of wetlands that have developed in connection to the water storage.

Building a channel around a physical obstacle to improve ecological continuum to allow fish migration, may use considerable energy, damage an archaeological site and produce waste materials and therefore may not be appropriate in relation to the benefit.

A historical modification, such as a mill or a weir which no longer has a current specified use, may now have aesthetic or historical value. This feature should not necessarily be removed and some may wish to designate the affected water body as HMWB.

The relative importance of the improvement which would be delivered by the restoration measures relative to the effect on the wider environment has to be considered here. It would not be appropriate if a large environmental improvement programme was prevented because of a significant adverse effect on a small component of the wider environment.

For example a reservoir that serves no current purpose but which has resulted in a valuable wetland. A restoration measure of removing the dam would result in losing the wetland, but it would allow fish migration for a large river length (region). In this example, the fish migration would probably represent a larger improvement to the environment than the loss of wetland, but this obviously depends on the specific circumstances and expert opinion that can only be decided at an area/regional level.

The fist component of this step is to identify the potential adverse effects of the proposed restoration measures. If it is found that the restoration measures **would have** adverse effects on the wider environment then the water body proceeds to Step 6 (“Other Means”).

If it is found that restoration measures **will NOT have a significant adverse effect**, or the effect on the wider environment is **unknown** then the water body is taken forward **for assessment of the effects on restoration on specified use**.

Assessing the effects of restoration measures on Specified uses

Applies to pHMWB only

In this step the magnitude (and direction) of the impact(s) of restoration measures on the use(s) of the water body is qualitatively assessed.

The CIS guidance (2003) states that adverse effects on the specified use(s) to be a loss of important services (e.g. Flood Protection) or losses in production (e.g. Hydropower). The guidance also states that ,"a significant adverse effect should not be small or unnoticeable but should make a notable difference to the use". In some instances restoration measures may be possible without having a significant impact on the intend uses provided by the modifications. For example, it may be possible to carry out river restoration that improves ecological status but does not cause significant impact on modifications for flood defence purposes.

What are the adverse effects?

Several possible adverse effects can occur:

Increased capital/operating costs: will the implementation of "restoration measures" result in some increased capital/operating costs for the specified use

Reduced incomes/revenues: will the implementation of "restoration measures" result in reduction in incomes/revenues derived from the specified use

Losses in production or services fulfilled by the specified use: will the implementation of "restoration measures" result in losses in production for the specified use (e.g. less KWatts produced by hydropower station)? Will the implementation of "restoration measures" result in losses in services fulfilled by the specified use (e.g. fewer visitors in recreation area)

Degeneration: will the implementation of "restoration measures" result in degeneration (closure of areas of residential/industrial/commercial property) for the specified use

Losses in jobs: will the implementation of "restoration measures" result in losses in jobs for the specified use

Appraisal of significance of adverse effect

Consider the following to determine if the effect is significant:

How long will it take for the main adverse effect to occur?

How long will the main adverse effect last?

Likely significance of adverse effect for all identified effects

If it is found that the restoration measures **would have** adverse effects on the wider environment then the water body proceeds to Step 6 ("Other Means").

If it is found that restoration measures **will NOT have a significant adverse effect**, or the effect on the wider environment is **unknown** then the water body **is not a HMWB.**

6. Are the physical modifications the only means to deliver the use?

This strep is to identify if there are “other means” for providing the intended use benefits, which were identified in step 2. The term “other means” relates to the replacement or displacement of the existing specified use or broader policy options.

In considering the identification of “Other Means” it is important to distinguish between restoration measures and “Other Means”. “Other Means” are ‘activities that will deliver beneficial objectives of the modified characteristics of the water body and involve the replacement or displacement of the existing specified use. Restoration measures are those measures that involve changes to the specified use in order to achieve GES.

Other means may include the following:

- Displacement of the specified use to another water body. For example, the replacement of a hydropower station with a new one (in another water body) where it causes less environmental damage.
- Replacement of the existing specified use with an alternative to deliver the beneficial objectives. For example, replacing hydropower with other energy sources, or replacing navigation with rail and road transport at lower environmental costs, alternative flood defence strategies such as restoration of upstream flood-plains to remove flood defence hard engineering downstream, i.e. soft-engineering as opposed to hard-engineering solutions.

If it is concluded that there are other mean please contact the Hydromorphology team for assistance to complete this assessment. If there are no other means the water body **can be designated as HMWB.**

WFD Hydromorphology Measures: Grouped by type, use this list to identify possible restoration measures 1.

Measure type	Specific measure	Description
Working with Physical Form and Function	Removal of hard engineering structures (e.g. naturalisation)	Remove existing hard structures (e.g. concrete bank protection, concrete beds, sea walls) to allow natural processes to re-establish
	Managed Realignment of flood defences	Breach, remove or set back existing flood defences and allow previously defended areas to become inundated, recreating coastal and estuarine flood zones and/or restoring connectivity with floodplain
	Managed Retreat	Allow the coastline to erode naturally (applies to defended and undefended coastline)
	Recreate a sinuous river channel (re-meandering)	Recreate a sinuous channel in artificially straightened river reaches to provide an approximation of a natural planform
	Narrow over-wide channels	Instigate narrowing of over-wide channels using structures and/or vegetation to encourage sedimentation along channel margins
	Create low flow (2-stage) channels in over-widened/overdeepended channels	Create low-flow channel in over widened channel (could be meandering, through use of deflectors)
	Reconnect and restore relict channels and backwaters	Reconnect cut off meanders and abandoned secondary channels to increase water conveyance and habitat quality, and restore backwater habitats by removing encroaching vegetation
	Recreation of gravel bars and riffles using permanent and/or temporary bed structures	Install structures to encourage sediment accretion, localised diversity in channel bedforms
	Bank reprofiling	Reduce bank slopes to reduce erosion, encourage stabilisation and improve marginal habitat
	Cliff reprofiling	Reduce angle of cliff slope to reduce erosion, encourage stabilisation and improve marginal habitat
	Beach reprofiling	Modify profile of beach
	River bed raising or lowering (regrading)	Regrade bed to raise levels in overdeepened chanels of lower levels in overwidened channels
	Beach Recharge	Introduce sediment (e.g. from dredging) to areas where erosion is a problem
	Replenishment of mobile sediments	Introduce sediment from the mobile load (fine sediments, gravel), e.g. to recreate bars and riffles
	Adopt strategic options and policies promoting natural recovery	Apply policies to encourage natural recovery of water bodies (e.g. promote removal of unnecessary structures)
	Use of engineering techniques to assist natural recovery	Assist natural recovery of water body with use of sympathetic engineering techniques (e.g. replacement of hard defences)
Structural Modification	Replace existing structures with new structural designs to minimise impact hydromorphological impact (avoid like for like)	Use improved design when replacing structures (e.g. use clear-span bridges instead of tiered structures)
	Replace hard defence with soft engineering	Replace existing hard structures with soft / bioengineered solutions
	Modify existing structures	Modify existing structures to reduce pressure (e.g. add culvert, reverse sluice, lower defence, alter dimensions, change orientation or profile) and/or to allow free passage of wildlife
	Construct breach or spillways	Install structures that allow controlled release of water through existing defences
	Implement Tidal Exchange Systems	Insertion of pipes in sea defences to allow controlled exchange of tidal water with the purpose of increasing elevation of land behind defences
	Reinstate natural outfall level	Allow release from impounding structures once water reaches natural level of outfall
	Install fish pass	Install fish pass to allow free passage around structure
	Use soft engineering techniques	Use soft engineering techniques instead of hard engineering (e.g. timber piling, coir matting, willow mattresses, fibre rolls, grassed composites, fabric cell revetments with pockets for vegetation establishment, and open cell lattice revetments with gaps for planting)

WFD Hydromorphology Measures: Grouped by type, use this list to identify possible restoration measures 2.

Measure type	Specific measure	Description
Operations and Maintenance	Cessation of maintenance	Cease maintenance of structures to allow natural conditions to develop
	Develop/review appropriate dredging strategy (timing, selective dredging, phasing, extent, technique)	Develop dredging strategy that minimises hydromorphological damage
	Develop/review appropriate vegetation management plans	Develop vegetation management strategy that minimises hydromorphological damage [M3a}
	Change technique to manage and minimise disturbance to hydromorphology (access and operation)	Minimise damage by adopting controlled management procedures for all works on water body (e.g. limited access points, working from one bank only, use of floating pontoons whilst recharging sediment, use of silt curtains and low turbidity suction dredgers whilst dredging, and use low-impact vegetation management techniques such as hand picking, selective cutting, boat-mounted apparatus, and long-reach excavators)
	Retain marginal vegetation	Retain habitats in marginal zones to reduce erosion and maintain bank stability
	Control or eradicate invasive species causing hydromorphological impact	Remove non-native invasive species that can cause hydromorphological as well as ecological damage (e.g. signal crayfish and Japanese knotweed cause structural damage; Himalayan balsam and giant hogweed enhance winter erosion). Allow natural recovery, or assist natural recovery, e.g. by spraying seed mix on cleared areas
	Install silt, sand or gravel traps	Remove excess sediments through use of suitable sediment traps
	Strategic placement of dredged material (e.g. creation of shallow water zones or gravel bars)	Use dredged materials to improve hydromorphological quality (e.g. creation of shallow water zones or gravel bars)
	Dewater the navigation channels whilst maintenance takes place	Drain non-adjacent sections prior to undertaking maintenance works to minimise morphological and ecological impacts (phased dewatering)
	Change operational regime of weirs and locks	Restore more natural discharge regime (natural variations to rainfall rather than controlled variations), e.g. by opening locks and weirs
Land management	Removal of stock	Remove livestock from areas of concern - use of a carefully chosen 'sacrifice field' where damage will have the least impact
	Reduce stocking densities	Reduce numbers of livestock in areas of concern or during wet conditions to limit damage to soil structure and reduce sediment yield
	Reduce grazing time (daily and/or over the season)	Limit grazing time in areas where erosion or soil compaction may be a problem
	Introduction of stock-proof fencing (reduce bank side erosion)	Reduce bank erosion by restricting livestock access
	Improve river crossings for livestock and farm access	Reduce damage to water body by installing bridges for livestock and farm machinery
	Establish/relocate feed and water troughs to reduce erosion	Create drinking ponds to provide livestock with water and reduce trampling of river and lake banks
	Cultivate land for crop establishment in spring rather than autumn	Cultivate land early to minimise erosion and establish ground cover in winter
	Adopt minimal cultivation systems	Establish crops which require minimal cultivation, to minimise soil erosion, runoff generation and compaction by farm machinery
	Cultivate and drill across slope	Cultivate in line with contours to reduce channelling of runoff
	Leave autumn seedbeds rough	Leave rough vegetation to protect seedbeds which are vulnerable to erosion
	Avoid tramlines over winter	Avoid use of tramlines in arable fields to minimise erosion during the winter, e.g. by cultivating winter cereals without the use of tramlines or by establishing paths for spraying once the crops have become established
	Loosen compacted soil layers	Break up compacted soil to increase infiltration and reduce surface runoff and sediment yield
	Establish in-field sediment buffer strips	Leave uncropped areas (grass or natural vegetation) as a barrier to surface water and sediment runoff
	Cease maintenance of field drainage systems	Allow sediment and vegetation to build up in field drainage systems to reduce conveyance to water bodies
	Re-site gateways away from high-risk areas	Move gateways away from areas where soils erosion, compaction and runoff are problems
	Re-route informal vehicle and livestock access ways across slope	Move pathways across slope to minimise erosion through creation of downslope flow pathways

WFD Hydromorphology Measures: Grouped by type, use this list to identify possible restoration measures 3.

Measure type	Specific measure	Description
Water Management	Introduce minimum flow limits	Prevent flows falling below a specified level (below which hydromorphological quality may be impaired)
	Introduce compensatory flows (not just at low flow levels)	Maintain flow levels by introducing flow from other water bodies
	Regulate abstraction and discharge	Regulate abstraction and discharge to maintain flow regimes and avoid unnecessary high or low flows
	Reduce abstraction	Encourage use of efficient sustainable irrigation systems and raw water storage areas
	Implementation of SUDS	Implement Sustainable Urban Drainage Systems - permeable rather than impermeable surfaces, buffer strips to manage runoff, etc.
	Establish and maintain artificial (constructed) wetlands for use as sediment traps	Create areas of wetland vegetation in suitable areas to help retain sediment and associated contaminants (grants available for farmers)
	Water efficiency planning (domestic, business, industry, agriculture)	Improve efficiency of water usage - limit abstraction and maintain river flows
Habitat Creation	Introduce riparian vegetation/green corridors	Introduce riparian vegetation to reduce water and sediment inwash, provide shade, introduce organic material and provide habitat
	Introduce lakeside vegetation	Introduce lakeside vegetation to reduce water and sediment inwash, provide shade, introduce organic material and provide habitat
	Encourage saltmarsh recovery	Encourage recovery of saltmarsh vegetation to protect coast from erosion
	Create reed fringes	Create reed fringes around water body to dissipate wave energy and reduce erosion
	Create compensation habitats	Create habitats to replace those that are lost or damaged, e.g. aquatic, riparian, offline pond (with no direct connections to other water bodies)
	Creation of shallow margin in front of hard defence	Create shallow margin habitats in front of existing defences using soft engineering techniques/double row piling to encourage vegetation in slow flow areas
Development Control and Planning	Update policy and process guidance to take account of hydromorphology	Ensure that existing guidance and instructions are updated in order to avoid or minimise hydromorphological impacts
	Limit further development of the bank and/or near-shore zone	Limit new development in areas adjacent to a water body, to minimise hydromorphological pressures and impacts
	Avoid or limit development in the floodplain	Prevent unnecessary floodplain development to minimise hydromorphological pressures and impacts
	Regulation of in-channel structures	Regulate construction, maintenance and operation of in-channel structures, to minimise hydromorphological pressures and impacts
	Regulation of development in the marine environment	Regulate development in the coastal and marine environment to minimise hydromorphological pressures and impacts
	Develop and apply a set of General Binding Rules for riparian/lakeside landowners	Develop and apply General Binding Rules, covering best practices for all riparian agricultural activities (livestock and agriculture)
Navigation	Limit boat traffic movement	Restrict access in sensitive areas or at sensitive times, e.g. by setting annual movement limits
	Limit number of mooring permits available	Employ limits to reduce no of vessels mooring to reduce pressure
	Restrict speed	Introduce speed limits to reduce morphological damage, e.g. from boat wash. Should be 3mph in most constricted and sensitive areas
	Lateral zoning to concentrate boats within a central channel	Confine boats to centre of channel to reduce boat wash effects on banks, e.g. through use of marker posts or buoys
	Avoid or prevent mooring in sensitive areas	Careful planning of mooring facilities to avoid and/or prevent sensitive sites
	Design moorings for ecological benefit	Employ design to promote ecological benefit and reduce impacts of scour
	Encourage use of environmentally friendly vessel design	Introduce shallow draft vessels with shrouded props, modified hulls and speedometers to reduce the hydromorphological impacts of boat movement

For more information please contact the hydromorphology team
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