Annex 2.3.2 Criteria for Reference conditions

General statement	AT	DE	ES	FR	IT	SI
REFCOND-Guidance High status or reference conditions is a state in the present or in the past corresponding to very low pressure, without the effects of major industrialisation, urbanisation and intensification of agriculture, and with only very minor modification of physico-chemistry, hydromorpology and biology.	X	X	X	X		
Suggestion for GIG						
Totally unaffected sites do not exist anymore (at least due to the world wide atmospheric deposition).	X	X	X	X		X
If an historic database has to be used this should be from the mid-19th century (time period without intensive industries, hydraulic engineering and agriculture) with the possible exception of Ireland in relation to agricultural land cover, when a later period should be used to avoid the pre-famine peak.	X					X
Selection criteria for reference sites are based on « anthropic pressures », that must be « null or very low » (with the only exception of artificial or heavily modified water bodies); as nearly pristine state is unlikely to be encountered, (except perhaps in some mountain national parks), the problem is to define a very low pressure level that lead to insignificant or very low impact at the ecosystem level. « Insignificant impact » could be understood as « hardly distinguishable from natural variability » at the level of the biological elements. A first validation of « very low impact » can be searched at the level of abiotic parameters (physico-chemistry and hydro-morphology).		X	X	X		X
In a first stage, biological elements are not considered as a selection criteria.	X	X	X	X		X
In a second stage, those sites whose aquatic communities exhibit statistically low biological values are carefully checked for pressures, and dubious sites are eliminated. Impacts on rivers or within the catchment do not affect the original characteristics, so that the aquatic community is only altered minimally. That should be the type-specific communities and conditions.	X	X	X	X		X
If, after checking, no significant pressure is encountered, these sites are considered as representative of the type's natural variability.	X	X	X	X		X
Pressures are evaluated at three spatial scales : the watershed of the site, the reach scale (i.e. the water body), and the sampling site itself.				X		X
For each pressure criteria, two thresholds are defined - a « reference » threshold, below which a site is considered as « probably reference » : - a « rejection » threshold, corresponding to a high probability of significant impact, above which a site is eliminated.	X	X	X	X		X
Sites that have all criteria below the reference threshold are considered as reference sites; sites having most criteria below the reference threshold and only some parameters between the reference and rejection threshold are « possible reference sites ». For these sites, only few possible pressures exceed the « very low » level. These sites could be conserved only after carefully checking the cumulative effects of the pressures, with local expertise.	X	X	X	X		X
Impacts on rivers or within the catchment area should have only local effects to be considered in Reference State..	X		X	X		X
A river stretch that is considered as a reference site must be situated within one fish region and at least a minimum population has to be guaranteed, proposed minimum length: > 1 km for small rivers (stream order 1- 3), > 5 km for medium-size r. (stream order 4 - 5), > 10 km for large rivers (stream order > 6)	X	X	?	X		
A proposed minimum length of a river stretch:						X

for catchment area 10 - 100 km^2 → 0,5 km for catchment area 100 - 1000 km^2 → 1 km for catchment area 1000 - 2500 km^2 → 2 km for catchment area >2500 km^2 → 5 km						
Four different pressure indicators have been used to select RC sites. Data for these analyses were obtained from CORINE Land Cover (SIG) on a river drainage network of 500x500 m **The chosen sites, selected following this method, have been specially visited to check their suitability.**			X			
Diffuse source pollution						
Land-use intensification: Agriculture, forestry	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Pre-intensive agriculture or impacts compatible with pressures pre-dating any recent land-use intensification. Pressures pre-dating any recent intensification in airborne inputs that could lead to water acidification	X	X	X	X		
Suggestion for GIG The share of anthropogenic land use in the catchment area (agriculture, afforestation, settlements) must be small and shows only local effects. In case of type-specific floodplains lateral and vertical connectivity has to be maintained; Floodplains of reference sites must not be changed by anthropogenic uses The land use upstream the reference site must comply with the following criteria:	X	X	X	X		X
Urban areas ≤ 4% in lowlands, < 0.1 % in highlands.	X	X				
Industrial areas ≤ 2%	X	X				
Intensive farming ≤ 10% (but none in the riparian zone)	X	X				
Irrigated fields ≤ 10%	X	X				
Vineyards, orchards : < 1% of the of the catchment area, and not situated in the riparian zone.	X	X		X		
Arable land (crops, ploughing) : <20% of the catchment area in general. In lowlands agricultural landscapes, sites with 20% to 50% of cropland can be considered if - there is no significant risk of soil erosion - valley floors are mainly occupied by pastures or semi-natural vegetation, and riparian corridors are globally preserved Between 20%and 50% of intensive agriculture, a validation with physico-chemical parameters at the site scale is strongly recommended.	X	X		X		
Cattle breeding: only non-intensive (outdoor) cattle breeding; < 1.25 animal units per ha the of the catchment area	X	X		X		
The cover of natural areas in the catchment area (after Corine Land Cover) to the reference site is: • > 70 % or • > 50 %, if at least 50 m from the edge of the riverbed (on both banks) of double riverbed width (for rivers wider that 25 m) there are no agricultural or urban areas (after Corine Land Cover).						X
Forestry : no sign of acidification due to coniferous plantation (on siliceous bedrock).	X	X		X		
Where forest is expected in reference time (in mid-19th century), there should be an appropriate cover of forest – this may be more than 50 % or there must be considerable natural riparian forest belt.	X					
Eutrophication : no sign of plant proliferation (macrophytes, algae) ; very low Phosphorus (value?). Nitrates : < 5mg/l of NO3.	X			X		
Catchment "naturalness" based on land uses (RC sites show more than 70% of catchment surface with natural uses).			X			
Reach scale:	X	X		X		

Small streams: Order 1- 3: 1 km **Medium streams: Order 4-5: 5 km** **Large rivers Order ≥ 6: 10 km**						
Reach scale: 10 - 100 $km^2 \rightarrow$ 0,5 km 100 - 1000 $km^2 \rightarrow$ 1 km 1000 - 2500 $km^2 \rightarrow$ 2 km >2500 $km^2 \rightarrow$ 5 km						X

Point source pollution						
Specific synthetic pollutants	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance: Pressures resulting in concentrations close to zero or at least below the limits of detection of the most advanced analytical techniques in general use (A Selection process for relevant pollutants in a river basin is presented as an example of best practice in section 6 of the guidance document from Working Group 2.1, IMPRESS).	X	X	X			
Suggestion for GIG						
Substances mentioned in Annex X and/or in annex VIII of the WFD should have concentrations at least below the limits of detection Measured values of other anthropogenic, synthetic substances below quality objectives, near natural background concentrations, except for those from atmospheric sources. The impact of atmospheric pollution on reference river stretches must not be detectable (e.g. as depletion of the aquatic community due to acidification)	X	X	X			X
For small streams : no known toxic pollution discharge.	X	X		X		
For larger streams and rivers : no suspected toxic pollution discharge; if (actual or ancient) toxic pollution sources exist in the basin, ratio PEC / PNEC < 1.				X		
In agricultural areas, sites with a known pollution risk by pesticides (according to existing risk maps) are avoided.	X	X		X		
Human activities with influence on physic-chemistry and hydrology, based on ratio water demand / natural contribution (RC sites should have next limits: urban = 3 %; industrial = 1,5 %; irrigation = 10 %).			X			
Spec. non-synthetic pollutants	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Natural background level/load (see reference above)	X	X	X			
Suggestion for GIG						
Only minor impairments of the physical and chemical conditions, this means: Near-natural background values– if this can be can estimated; if not, the limit of detection (quantitative) can be used tentatively.	X	X	X			X
No discharge of specific non-synthetic pollutants upstream in the river.	X	X	X	X		
Other effluents/discharges (urban pollution)	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance No or very local discharges with only very minor ecological effects.	X	X	X	X		
Suggestion for GIG	X		X			
Only minor impairments of the physical and chemical conditions, this means: Near-natural background values	X	X	X	X		
saprobiol. water quality class (according to ecoregions): alps <I-II (used only as exclusion criteria)	X	X				X
Concentrations comply with all quality objectives	X	X	X			
No known industrial cause of particular pollution (e.g. NaCl, thermal pollution, etc…)	X	X	X	X		
Criteria to estimate very low levels of point source pollution: Very low level of urbanisation, evaluated by the percentage area of artificial land cover in the catchment (CLC class 1). The following thresholds can be used:	X	X		X		

"Reference" threshold: < 0.4% of artificial land cover in the catchment. "Rejection" threshold: 0.8 % of artificial land cover in the catchment. Above 0.8%, a validation with physico-chemical parameters at the site scale is necessary.						
Domestic pollution :						
For small streams : no known point source discharge, or very localised impact with self purification.	X	X		X		
For larger streams and rivers : very low point source discharge level; to be validated with physico-chemical parameters	X			X		

Morphological alterations						
River morphology	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Level of direct morphological alteration, e.g. artificial instream and bank structures, river profiles, and lateral connectivity compatible with ecosystem adaptation and recovery to a level of biodiversity and ecological functioning equivalent to unmodified, natural water bodies	X	X	X	X		
Suggestion for GIG						
The ideal type-specific hydromorphological conditions (enclosing the elements mentioned in annex V of the WFD).	X					
The reference site is classified in the hydromorphological class 1 or class 1-2.	X					X
1) at the reach scale (expert evaluation):						
Flow slowing: < 10% of the reach is affected by flow slowing (hydraulic effects of weirs, sluices, etc…). Natural waterflow with own dynamic potential with no or very minor anthropogenic influence subnatural waterflow with high potential to regenerate without human action in near future a natural flow.	X	X		X		
Channelisation: < 10% of the reach is affected by "hard works" (like modification of longitudinal and / or transverse profiles, narrow embankment, loss of lateral connectivity…), otherwise, bed and banks composed of natural materials	X	X		X		
Connection to groundwater: Total lateral and vertical connection	X	X				
Stabilisation: < 20% of the reach is affected by "soft works" (like bank protection on one side, distant dikes, bank maintenance, not affecting the longitudinal and / or transverse profile, and lateral connectivity globally maintained…). If both types of works are combined, < 10% of the reach must be affected.	X	X		X		
River continuity: The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms (especially in rivers with natural fish populations) and sediment transport	X	X		X		
Substrate conditions: Correspond to related typology	X	X				
River profile and variation in width and depth: Correspond to related typology	X	X				
2) at the site scale (expert evaluation):						
The site is not situated in a zone directly impacted by a nearby artificial structure upstream or downstream.	X	X	X	X		
Only small water constructions with little local effects can be accepted	X	X		X		
unaffected by any structures outside the site;	X	X		X		
Lateral connectivity and freedom of lateral movement	X	X	X			
Lacking any instream structural modifications (weirs or dams) that affect the longitudinal connectivity and natural movement of sediment, bed-l load, water and biota (except for natural waterfalls).	X	X				
Pressures on bed river morphology based on land uses (canalised river stretches, urban stretches or reservoirs are excluded from RC sites)			X			

Criteria for the estimation of impact produced by small weirs downstream is actually being discussed. A maximum height of 2-3m and a light slope for the weirs could be some possible limits to be considered as having no significant impact downstream						
Water abstraction	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Levels of abstraction resulting in only very minor reductions in flow levels or lake level changes having no more than very minor effects on the quality elements	**X**	**X**	**X**	**X**		
Suggestion for GIG						
At the basin scale: No dams significantly altering the low flow regime; low flow alteration < 20% of the monthly minimum flow.			**X**	**X**		
At the reach scale:						
- No significant water abstraction (< 20% of low flow discharge). Actual flows vary by no more than 5% from natural flows using low flows.						
- Only very minor reductions in flow levels changes having no more than very minor effects on the quality elements. Absence of significant reduction levels upstream.						
The water abstraction is less than 10% of the natural flow.						**X**
Flow regulation	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Levels of regulation resulting in only very minor reductions in flow levels or lake level changes having no more than very minor effects on the quality elements. Flow regulation that has he potential to recover to natural flow in near future.	**X**	**X**	**X**	**X**		
Suggestion for GIG						
At the basin scale:						
- No dams modifying significantly the hydrological regime (flow regulation) : e.g. suppression of frequent floods (<5 years) with anomalous development of vegetation in the channel, or low flow alteration (< to + or - 20% modification of monthly minimum flow discharge).	**X**	**X**	**X**	**X**		
- No dams modifying significantly the sedimentological regime (sediment retention) leading to morphological alterations, e.g. rivers with evident signs of incision (e.g. incision > 0.2m * stream order, bare bed rock appearing…).	**X**	**X**	**X**	**X**		
No change of the natural (type specific) annual flow characteristics	**X**	**X**	**X**	**X**		
At the reach scale						
- No by-passed section with residual flow (legal minimum discharge)	**X**	**X**	**X**	**X**		
- No significant hydropower peaking effect (ratio Q hydropeaking / Q baseflow < 2)	**X**	**X**	**X**	**X**		
- Absence of significant flow regulation upstream.	**X**	**X**	**X**	**X**		
Hydrological disturbances by flow regulation for RC sites: total volume in reservoirs / annual natural contribution > 15 %	**X**		**X**			
Riparian zone vegetation	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Having adjacent natural vegetation appropriate to the type and geographical location of the river.	**X**	**X**	**X**	**X**		
Suggestion for GIG						
definition of the riparian zone: the minimum width of the riparian zone (or corridor) to be considered is 30m for small streams (order 1-3), 50m for medium size rivers (order 4 - 5) and 100 m for larger rivers (order ≥ 6)				**X**		
At the reach scale:						
- In agricultural landscape (croplands): natural vegetation degraded or absent on less than 10% of the reach.	**X**	**X**		**X**		

- In non agricultural landscape: valley floor and riparian corridor mainly occupied by natural vegetation and / or natural pastures.	X	X		X		
At the site scale :						
The site is (almost) entirely bordered by the type specific natural (or semi-natural) vegetation. No direct impact of cattle trampling.	X	X		X		X
Riparian vegetation zone continuity: uninterrupted or with few interruptions	X	X		X		
Lateral connectivity with natural terrestrial adjacent vegetation maintained	X	X	X	X		
No direct impact of cattle trampling.						
None of the following land uses within 5m of the bank-top: broadleaf/mixed plantation; coniferous plantation, orchard, improved grassland, tilled land, suburban/urban, irrigated land, artificial open water, parkland and gardens, more than 30% rough pasture.		X				
QBR (Quality Riparian Forest Index)>75			X			

Biological pressures						
Introductions of alien species	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Introductions compatible with very minor impairment of the indigenous biota by introduction of fish, crustacea, mussels or any other kind of plants and animals**.** No impairment by invasive plant or animal species.	X	X	X	X		
Suggestion for GIG						
At the site scale, no invasive species, but alien species not in invasive stage are tolerated.	X		X	X		
No major impairment of the aquatic community by anthropogenic impacts or by alien species	X		X			X
Reproduction of aquatic organisms has to be ensured.	X		X			
Proposed definition of alien species : non indigenous species recently introduced (i.e. during the XXth century) or in early stage of dissemination in the river reach, not known to present a risk of being invasive. Proposed definition of invasive species : alien species in stage of active colonisation, which are quantitatively predominant in their respective community, and whose development significantly alter the composition and abundance of the type specific communities. These species, by direct or indirect effects, can induce a risk of extinction of indigenous biota, and alter the global ecosystem functioning.						
Fisheries and aquaculture	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends Stocking of non indigenous fish should not significantly affect the structure and functioning of the ecosystem No impact from fish farming	X	X	X	X		
Suggestion for GIG						
Reference is made from actual and historical data based on step wise regression	X					
No or only minimal stocking of fish and must have no impact on the ecosystem functioning	X		X			X
No intensive fishery	X	X	X	X		
Minimal presence of exotic species, which must have no impact on the ecosystem functioning	X		X			
Fisheries, fish management: no significant impact on fish population.	X		X	X		
No direct pollution by aquaculture plants	X	X	X	X		
No impact from aquaculture	X	X	X			

Fishing is limited and must have no impact on the ecosystem functioning	X		X	X		
There is very little or no impact from fishery. The reference site is chosen on the section of the river that is either not used for fishing or it is categorised as protected water						X
Biomanipulation	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance No biomanipulation	X	X	X			
Suggestion for GIG						
No biomanipulation.	X	X	X	X		X

Other pressures						
Recreation uses	**AT**	**DE**	**ES**	**FR**	**IT**	**SI**
REFCOND-Guidance No intensive use of reference sites for recreation purposes (no intensive camping, swimming, boating, etc.)	X	X	X			
Suggestion for GIG						
No nearby intensive recreational use at the site scale: No official bathing site, no boating and minor recreational uses from camp sites.	X		X	X		
Recreational uses (such as camping, swimming, boating, etc.) should lead to very minor or no impairment of ecosystem.	X		X	X		X

ITALY

Explanation for missing reference criteria :

Italy does not have identified the reference sites at the moments but the sites selection is at the moment in process. For the intercalibration a range of high quality class sites were chosen according to the Italian monitoring standard which is based on the macroinvertebrates community (Indice Biotico Esteso)

When physico-chemical data are available, the chemical values fulfill the following reference criteria (minimum quality requirements used as “exclusion criteria”, proposed for the Central Baltic type R-C3 Medium mountains, siliceous). If exceeded, reference sites should be excluded.

Parameter			
BOD_5	mg/l	mean	2
		90th perc	2,75
Dissolved Oxygen	% saturation	mean	95-105
		10-90 perc	90-110
$N\text{-}NH_4$	mg/l	mean	0,05
		90-perc	0,12
$P\text{-}PO_4$ (or SRP)	µg/l	mean	20
$N\text{-}NO_3$	mg/l	mean	2

ITALY

Italy has evaluated the above table and the way the parameters are expressed (mean and 90th perc.) and those figures can not be compare with the Italian way of assess the physico-

chemical status of rivers which is based on the 75th perc. using also the total phosphorus instead of P-PO4. Moreover for each parameter there is not a limit figure which define the bad or good status but different interval associated to 5 quality classes. The physico-chemical status is calculated with a combination of (dissolved oxygen, BOD_5, COD, $N\text{-}NH_4$, $N\text{-}NO_3$, P total), of microbiological data (Escherichia coli). This table can not be at the moment used for selecting reference sites but there are ongoing investigation in order to verify and re-calculate the physical chemical status of the Italian rivers using the mean or the 90th perc.