

# 4

## Good practices for the management and restoration of ephemeral streams

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### 4.1. A proposal for good practices related to geomorphological dynamics

Segura (2014) and Segura and Sanchis (2015) warned us that in most projects geomorphological restoration is not addressed in all its complexity and there is frequently a lack of understanding of the hydrosedimentary dynamics in fluvial systems, even more so in the case of ephemeral ones. Other problems that they indicated were i) the difficulty in making historical images compatible as a reference when the dynamics are so intense and complex, ii) the impossibility of managing the sedimentary deficit by the hydrographic administration, unless the extraction of aggregates is prohibited definitively, and iii) the fact that restoration actions do not consider signs of recovery and the capacity of resilience of the channels, so there is no recognition that the cheapest and most effective strategy in ephemeral streams would be facilitating self-regeneration, because of their great energy. Currently, they are perceived from a similar perspective, given that there have hardly been any advances made in this area.

Taking into account that the geomorphic resilience of these channels is high in many cases, it is necessary to assess whether the elimination of the impacts –especially the direct ones, that is to say those carried out on the channel itself– could be enough to generate effective repercussions, counting on the fundamental recovery work acted out by floods (Segura, 2014; Calle et al., 2017). However, we should be aware that the low frequency of geomorphic impact floods could slow down response times. Thus, it is essential to extend research projects to be able to monitor changes, given that it is likely that in some cases active rehabilitation measures should be considered to speed up the work of the stream (Horacio, 2015).

## GOOD PRACTICE 1

## REMOVAL OF CHECK DAMS, BARRIERS AND TRANSVERSE OBSTACLES



**Figure 104.** Tracks that have a barrier effect and invade the channel in the Barranco de la Mata (Jubera, La Rioja)

OBJECTIVES	<ul style="list-style-type: none"> <li>• To recover the natural function and continuity of the fluvial system.</li> <li>• To recover hydrogeomorphological processes of the channel and bed.</li> <li>• To reduce the anthropic presence on the channel and riparian corridor, recovering the function and naturalness of the watercourse as a natural corridor.</li> <li>• Improve the longitudinal continuity of the riparian corridor.</li> <li>• Recovering floodplain functionality.</li> </ul>
ACTIONS	<ul style="list-style-type: none"> <li>• Making obstacles permeable so that they do not prevent the circulation of water and sediment.</li> <li>• Knocking down obstacles to allow trapped sediment to pass.</li> <li>• Educate about the importance and natural functioning of solid discharge and raise awareness about how this type of obstacle negatively affects the bed.</li> <li>• Create access for fish if there are fish populations in the ephemeral stream.</li> </ul>

AGENT	The State, through Hydrographic Confederations.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Insufficient budgets for these kinds of actions. A significant economic investment is required.</li> <li>• Construction management and careful handling of the machinery so as not to alter the morphology of the channel.</li> <li>• Natural regeneration of areas affected by machinery.</li> <li>• Problems of accessibility to isolated territories.</li> <li>• Possible pollution of sediments trapped in reservoirs.</li> </ul>
TIME, TREND, PROGNOSIS	A positive effect of this good practice would be a rapid naturalisation of the channel, especially if there are flow events with the capacity to mobilise sediments. With these processes, the longitudinal profile previously altered by these obstacles is reconstructed. The effects of this good practice are always positive, taking the stream one or several flow events to naturally regenerate its dynamics.

**GOOD PRACTICE 2**    **REMOVAL OF FORDS AND OTHER ROAD-STREAM CROSSINGS**



Figure 105. Bridge of the C32 over the Río Foix (Cubelles, Barcelona). The location of the pillars in the active channel could have been avoided.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Locally recover natural flows of liquid and solid discharge.</li> <li>• Recover the longitudinal continuity of the channel and riparian corridor, also preventing access to the fords.</li> <li>• Recover natural hydrogeomorphological processes in the channel and especially in the bed.</li> <li>• Eliminate or reduce anthropogenic impacts by recovering the functionality and naturalness of the stream as a natural corridor.</li> <li>• Reduce risks, due to the vulnerability of these structures, which have often caused human losses due to their use during flooding.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Reduce the number of fords, reserving the minimum number of crossings possible. Study alternatives for cases with accessibility problems.</li> <li>• Construction of bridges as an alternative to fords, in places where the impact of the riparian corridor is minimal, thus reducing impacts on the functional quality of the system.</li> <li>• Take away access points from the fords that have been eliminated and modify those that remain operational to reduce damage in the riparian area.</li> </ul>
AGENT	Hydrographic Confederations (PHD) and in some cases road services
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Insufficient budgets for this type of action.</li> <li>• Careful handling of machinery so as not to alter the morphology of the channel.</li> <li>• Nature restoration in the areas affected by machinery.</li> <li>• As the number of fords is reduced, there may be an increase in infrastructure parallel to the channel in order to reach the nearest crossing.</li> <li>• Awareness of the population about the importance of carrying out a greater journey to reach a crossing.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice would have to be carried out immediately and its positive effects would be noticed in the following flood event, quickly making the bed more natural thanks to the movement and entrainment of bedload accumulated in the old fords. A state plan that provides generalised action in order to provide environmental improvement and risk reduction would be very appropriate.

## GOOD PRACTICE 3

## REMOVAL OF INTERNAL PATHS AND CLOSURE OF ACCESS POINTS



Figure 106. Channel of the Río Foix (Cubelles, Barcelona)

OBJECTIVES	<ul style="list-style-type: none"><li>• Avoid the processes of geomorphic disturbance in the channel (e.g. compaction, waterproofing, ...) and effects on the quality of the riparian space because of the passing of vehicles and their access points.</li><li>• Recover hydromorphological processes of flood and mobility of the solid discharge by restricting the compaction of the alluvial bed.</li><li>• Eliminate or reduce anthropogenic influences by recovering the functionality and naturalness of the stream as a natural corridor.</li><li>• Reduce or eliminate discontinuities in the habitats and in the distribution of species.</li><li>• Reduce risk, taking into account the vulnerability of these precarious paths.</li></ul>
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ACTION	<ul style="list-style-type: none"> <li>• Closure of the access points to the channel by means of sign posting, plant or anthropogenic barriers, placement of dead wood, large stones, etc. at some specific places.</li> <li>• Generate new infrastructure, which will satisfy the needs provided by internal paths, placing them outside the channel and as far as possible from the fluvial system, preventing them from following a path parallel to it and which might affect the floodplain, connectivity of the riparian space and the cross-sectional naturalness. When infrastructure cannot be installed outside the floodplain, avoid the use of impermeable infrastructures in order to minimize their impact on to the hydrogeomorphological processes of overflow and flooding.</li> <li>• Provide sediment in the channels where extraction has taken place to facilitate vehicle mobility.</li> <li>• Educate about the importance and natural functioning of the solid discharge and raise awareness about the negative effects of vehicles crossing the channel.</li> </ul>
AGENT	Hydrographic Cnfederations with the support of local administrations and the possible participation of volunteers.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Impossibility of locating the path outside the channel due to orographic conditions.</li> <li>• Presence of private properties on the channel banks.</li> <li>• Pressure from farmers and land owners because of the loss of surface area on the adjoining land where the new path could be located.</li> <li>• Insufficient budgets for the construction of new infrastructure.</li> </ul>
TIME, TREND, PROGNOSIS	<p>This good practice would have to be carried out immediately, despite the possible impediments when affecting private property. Its effects are positive, depending on the size of the path, affected area or level of sediment compaction. They would be noticed in the first reconstructive flood of the channel and could be fully recovered with a few flood events. This good practice should be linked to the correct land use planning in the flood space if the new path is located in this space when there is no other alternative. In turn, the route of the path could delimit the floodplain, in order to restrict the presence of incompatible land uses in this area, thus minimizing risk.</p>

**GOOD PRACTICE 4** | **PROHIBITION OF DREDGING, REMOTION OR ALLUVIUM EXTRACTION**



Figure 107. Bed gravel extraction in the Desedan Torrente (Longarone, Italy)

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Reduce sediment deficits that cause this type of action, recovering transport and the sedimentation processes downstream.</li> <li>• Prevent alteration of bedforms and banks caused by the entry of machinery and by the actions themselves, which destroy the channel and its geomorphic units.</li> <li>• Allow the stream to reconstruct its longitudinal morphological equilibrium.</li> <li>• Recover the ecological processes and living beings in the benthic and hyporheic zones.</li> </ul>
<p>ACTION</p>	<ul style="list-style-type: none"> <li>• Promulgate regulations at state level for prohibiting dredging and the extraction of aggregates that include sanctioning procedures. Also prohibit the movement and dumping of dredged sediments in any channel.</li> </ul>

	<ul style="list-style-type: none"> <li>• Replace and enhance the location of this type of action on high terraces, outside the current active channel.</li> <li>• Provide sediment in channels where the dredging and extraction actions have been of such magnitude that the stream presents a notable sediment deficit and is unable to recover in the short / medium term, and in reaches where the balance has been broken even if the extractions have only been occasional.</li> </ul>
AGENT	The State through the Hydrographic Confederations. It should involve extraction companies being obliged to change their location and working way.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Pressure from extractive companies to continue executing these actions.</li> <li>• An increase in clandestine extractions of aggregates can be foreseen if the extraction is limited to the upper terraces.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice would have to be carried out immediately, since its positive effects would already be noticed in the following extraordinary flood. Depending on the magnitude of extraction, complete recovery could take several flood events.

**GOOD PRACTICE 5****RECOVERY OF AREAS AFFECTED BY EXTRACTIONS AND THE PROVISION OF SEDIMENTS IN DEFICIT REACHES**

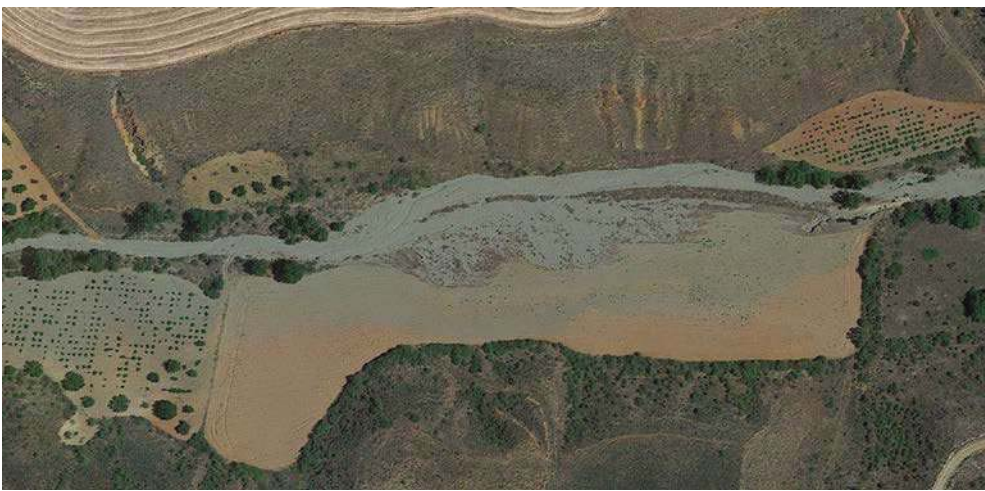
**Figure 108.** Natural alluvial bedforms in the Rambla de la Viuda (Costur, Castelló)



OBJECTIVES	<ul style="list-style-type: none"> <li>• Recover functionality in flooding processes.</li> <li>• Naturalise the mobility and transport of the solid discharge along the channel</li> <li>• Avoid bed incision, headwater erosion, bank instability and the risk of removing structure footings.</li> <li>• Recover the natural processes and forms in this type of stream.</li> <li>• Reduce risk by preventing possible counterproductive processes in flooding situations.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Provide sediment and distribute it properly in the channels where extractions have been undertaken. It is necessary for there to be construction management with geomorphological knowledge and the use of machinery that only generates minimal impacts. If contributions of fluvial sediments from other foreign areas are made to the channel, it is necessary to respect and not damage the existing alluvial forms in that reach. It is necessary to take into account characteristics such as the grain-size, roundness index, and lithological nature of the provided sediment, which have to be in accordance with those of the sediment present in the reach, where it is going to be introduced. Whenever possible, sediments from the river itself will be used, taken from a nearby point, extracted for example from a fluvial terrace.</li> <li>• Have sediment banks in each sub-basin to be able to carry out this type of action.</li> <li>• Sediment inputs trapped in reservoirs. Program periodic drainage of dam beds in order to facilitate the mobility and continuity of the solid discharge fed by the sediments retained in them.</li> <li>• Occasionally it may be appropriate to provide dead wood.</li> <li>• Combine this practice with the removal or permeabilization of transverse and lateral obstacles, since these cause a disconnection between the bed and banks, and prevent the arrival of new sediment to the channel.</li> <li>• Revegetate the riparian corridors using autochthonous species that have been affected by extraction.</li> <li>• Raise awareness among the local population about the value and functions of the bedload and involvement in voluntary activities.</li> </ul>
AGENT	<ul style="list-style-type: none"> <li>• Hydrographical Confederations.</li> <li>• Private sector: the extraction companies themselves can collaborate.</li> <li>• Local volunteers.</li> </ul>

<p>CONDITIONING FACTORS</p>	<ul style="list-style-type: none"> <li>• Very limited budget availability for this type of action.</li> <li>• Cost of sediment transport.</li> <li>• Pressure exerted by extraction companies so that extraction can continue in channels.</li> <li>• Possible pollution of sediment trapped in reservoirs.</li> </ul>
<p>TIME, TREND, PROGNOSIS</p>	<p>This good practice should be implemented immediately, and its action should be directly related to the previous good practice. The positive effects would be felt in the following large flood; however, they will vary depending on the magnitude of the extraction and the effectiveness of the subsequent recovery.</p>

**GOOD PRACTICE 6**    **PROHIBITION OF POST-FLOOD ACTIONS**



**Figure 109.** Overflow caused by a flood in the Gully of La Parra (San Martín del Río, Teruel). The channel needs and seeks more space, since which was occupied by farmland. We must not act against these natural processes. Unfortunately, when they are registered, the channel is usually redirected and undergoes overall morphological changes.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Prevent disturbance in bedforms and banks caused by the entry of machinery and by actions that destroy the channel and its morphology.</li> <li>• To appreciate the regenerative role of floods, as builders of a wide variety of geomorphic units and habitats.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Prevent the common false sense of security that leads to irresponsible and reckless actions downstream.</li> <li>• Educate about the natural functioning of the stream and about the futility and impact of actions that seek to increase the drainage cross-section area temporarily and without justification.</li> </ul>
ACTIONS	<ul style="list-style-type: none"> <li>• Enact a statewide prohibition law that includes sanctioning procedures for clandestine actions.</li> <li>• Reassign to good practices the budgets allocated to these negative traditional actions.</li> </ul>
AGENT	Hydrographic Confederations as environmental guarantors of fluvial channels.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Powerful social inertia, reflected in continuous demands supported by political and economic interests, which only attribute negative effects to floods and falsely assign to sediment and vegetation a disturbing role on the flow.</li> <li>• Low budgets for this type of action.</li> <li>• Pressure from extraction companies to continue carrying out these actions.</li> <li>• Existence of transverse obstacles in the channel that can present problems during floods and for which alternative actions must be sought.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice would have to be carried out immediately and its positive effects would be felt in the first reconstructive flood of the channel. Associated with an adequate management of the land uses in flood-prone areas and with environmental education, post-flooding action should be totally suppressed in the short term and eliminated from people's imagination.

## GOOD PRACTICE 7

## RESIZING AND PERMEABILISING BRIDGES, FORDS AND ROAD-STREAM CROSSINGS



**Figure 110.** The flood in the Rambla de Cariñena, as a result of the storm Gloria episode (January 2020), destroyed the ford of the Virgen de Lagunas, rendering the only existing pipe under it useless. Apparently, this ford is illegal and it is the local owners who rebuild it after each flood.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Recover the fluvial continuity and the functionality of floods.</li> <li>• Naturalise sediment mobility and the transport of liquid and solid discharge.</li> <li>• Reduce the vulnerability of these structures and thus reduce risk.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Replace precarious fords drained by small culverts or pipes with higher fords and drainage pontoons.</li> <li>• Replace fords with bridges with as few support points as possible on the bed.</li> <li>• Make bridges permeable in the lateral areas of the channel (riparian corridor, floodplain).</li> <li>• Make roads permeable when they cross the flood plain.</li> </ul>

AGENT	<ul style="list-style-type: none"> <li>• The State through the Hydrographical Confederations.</li> <li>• The competent road services in each case.</li> <li>• The private sector can also participate.</li> </ul>
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Resizing and permeabilization are complex tasks which require a project and a significant economic investment, and sometimes also require an environmental assessment procedure.</li> <li>• Convergence of different administrations.</li> </ul>
TIME, TREND, PROGNOSIS	<p>The effects of this good practice are always positive, although depending on the infrastructure to be resized or made permeable, and the actions and rehabilitation works carried out, the ephemeral stream may take one or several flood events to renaturalise its operation. The risk reduction is evident once the work has been concluded.</p>

**GOOD PRACTICE 8** | **DIVERTING STRUCTURES, COLLECTORS AND DRAINS, AND MOVING THEM AWAY FROM THE CHANNEL**



**Figure 111.** Pipes and collectors lead to a further narrowing of the Río Seco channel (Hoz de la Vieja, Teruel)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Reduce anthropogenic pressures on the fluvial system by avoiding the interaction of these structures with hydromorphological functioning.</li> <li>• Reduce risks by reducing exposure to these structures.</li> <li>• Enable decanalisation of the channel, which was sometimes channelled to protect these structures, and, therefore, the fluvial dynamics.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Move all types of structures (gas pipelines, oil pipelines, power lines, collectors, wastewater discharge pipes, irrigation canals, culverts, etc.) away from the channel and its banks.</li> <li>• Eliminate defense structures that protect channel banks.</li> </ul>
AGENT	The owners and managers of each of the structures
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Integration in urban planning and land management.</li> <li>• Significant economic cost of the actions.</li> </ul>
TIME, TREND, PROGNOSIS	Very necessary and urgent action that should be promoted by the State through legislation and regulations. Its effects would be immediate in reducing risk and would be slower and more gradual in achieving the naturalisation of fluvial functioning.

#### GOOD PRACTICE 9 DECANALISATION



Figure 112. The Rambla de Albuñol (Granada)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Not protecting banks and allowing erosion to affect them, as this can be a key (sometimes unique) contribution to sediment transport in the channel.</li> <li>• Therefore, recover erosion, transport and deposition processes in the system and dynamize the stream, returning planform freedom to the channel so this can move laterally.</li> <li>• Increase the width of the drainage cross-section.</li> <li>• Reduce flow velocity at the flood stage.</li> <li>• Eliminate hard lateral structures that prevent the nesting of bird species and the development of natural vegetation.</li> <li>• Reduce risks due to a false sense of security and do not transfer the hazard to downstream reaches.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Decanalise the channel planform by removing lateral structures.</li> <li>• Unearth and discover the channel, preventing its narrowing and the hazard from the flow at the flood phase, caused by increased energy.</li> <li>• If necessary, revegetate the riparian corridors with native species that have been affected by canalisation.</li> <li>• Educate about the importance and natural functioning of ephemeral streams and raise awareness about how channelling negatively affects the bed.</li> </ul>
AGENT	Hydrographic Confederations and sometimes the local administration.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Attention to lateral subsurface flows.</li> <li>• Existence of budgets for this type of action.</li> <li>• Careful handling of machinery so as not to alter the morphology of the channel.</li> <li>• Opposition of private property owners of the channel's side lands.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice would have to be carried out immediately and its positive effects would be felt in the first reconstructive flood of the channel. This action should improve the stream dynamics and should be linked to the correct management of land uses in the floodplain.

**GOOD PRACTICE 10**

**NATURALISATION OF THE CHANNEL AND RECONSTRUCTION OF CHANNEL PLANFORMS AND ALLUVIAL BEDFORMS**



**Figure 113.** Action of urbanisation and “fluvial park” in the Barranco Valvadera (Bergasa, La Rioja), which has altered its original morphology. We must try to avoid these actions and restore natural geomorphic units.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Recovery of natural geomorphological processes, fluvial dynamics and ecological processes.</li> <li>• Recover ancient fluvial planforms and channel patterns, which may have been altered by human action.</li> <li>• Return the natural patrimony and geodiversity.</li> <li>• Prevent linear bed incision and downcutting processes caused by the canalisation, artificial neck cutoffs and simplifications of fluvial planforms that have generated an increase in the bed slope.</li> </ul>
<p>ACTION</p>	<ul style="list-style-type: none"> <li>• Reconnections to reopen old channel routes, through the movement and removal of sediments.</li> <li>• Cancellation of artificial meander cutoffs (chute and neck cutoffs) and anthropogenic rectifications of the planform.</li> </ul>



AGENT	Hydrographic Confederations as environmental guarantors of fluvial channels. They can be integrated into the National River Restoration Strategy.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Insufficient budgets for this type of action.</li> <li>• When making a reconnection between the old channel and the current one they could be at different heights. This difference in the local base level of both channels can be reduced or suppressed with sediments from the streams themselves if possible.</li> </ul>
TIME, TREND, PROGNOSIS	In ephemeral streams it is necessary to wait in the medium term and after several flood events for the consolidation of recovery processes. It is very important to monitor the actions in case they do not have a positive outcome, so it is essential to follow the principles of adaptive management.

**GOOD PRACTICE 11**      **ELIMINATION OF PLANTATIONS AND CROPS WITHIN THE ACTIVE CHANNEL**



Figure 114. Planting within the channel of the Barranco de La Nava (Aguilar de Río Alhama, La Rioja)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Reactivate sediment mobilisation, flood flows and geomorphological processes.</li> <li>• Return the necessary space to the ephemeral stream to develop its fluvial dynamics in a natural way.</li> <li>• Recover the active channel and riparian corridor.</li> <li>• Naturalise ecological processes.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Reduce risk by eliminating exposure to these elements and avoid increasing the hazard they generate in some fluvial sectors.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• In the event of possible invasions by private property, expropriate the land, as it is within the Public Hydraulic Domain (PHD) defined by the Water Law and regulated by Royal Decree 9/2008.</li> <li>• Removal of possible longitudinal or transverse obstacles linked to the protection or consolidation of these plantations and crops.</li> <li>• Eliminate plantations and crops.</li> </ul>
AGENT	Hydrographic Confederations and regional services for the protection of the natural environment.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Pressure from companies and individuals which for decades have been occupying the grounds of the PHD.</li> <li>• Insufficient budgets for expropriating the land.</li> <li>• It can be an unpopular measure for the local population.</li> <li>• Sometimes it is the local or regional administrations that have carried out these actions.</li> </ul>
TIME, TREND, PROGNOSIS	Although a long bureaucratic process is necessary for carrying out this good practice, it should be brought about immediately and the watercourse by itself would be capable of recovering from the impacts generated. Its positive effects would soon manifest themselves after a few flood events, provided that they have enough magnitude to move sediment. This good practice can be very effective in fluvial reaches in plains, which can reach very high levels of naturalness.

#### 4.2. A proposal for good practices for ecological functioning

This block of good practices focuses on the recovery of naturalness using an ecosystem approach. The measures in the previous block constitute the basis for achieving good fluvial functioning, and involve the reconstruction of the habitats, but sometimes it is necessary and urgent to act directly on the species, either promoting appropriate ones, or eliminating the invasive ones.

In most cases it is advisable to combine several of these good practices, as well as associate them with those of the previous block. The success of the recovery project will be based on this integration of measures which should always be adapted to the local situation and, as far as possible, implemented with minimal intervention, and with most work concentrated on the fluvial system.

**GOOD PRACTICE 12**    **REMOVAL OF REEDS (*Arundo donax*)**



**Figure 115.** Example in a permanent river (River Segura in Molina de Segura, Murcia) of treatment for the elimination of reeds on both channel banks.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Control of monospecific reed formations (<i>Arundo donax</i>) and the progressive reduction of their presence.</li> <li>• Increase in the diversity of habitats and, consequently, of plant and animal species (biodiversity).</li> <li>• Increase in pollinisers and therefore in pollination.</li> <li>• Increase drainage capacity during floods.</li> </ul>
<p>ACTION</p>	<ul style="list-style-type: none"> <li>• Delimit the area of the ephemeral stream where action needs to be taken.</li> <li>• There are several effective methods for reed removal (chemical, physical, mechanical and promotion of competition) with different levels of effectiveness and damage to other plant and animal species (Deltoro et al., 2021). The one that seems most effective at present is to cover the stands of the reeds with a black plastic material, once they have been cut, for at least 10 months.</li> </ul>

AGENT	Due they are spaces of hydraulic public domain, the powers of action correspond to the Hydrographic Confederations.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• The use of one or other method of reed removal depends on the characteristics of the reed field.</li> <li>• It is always advisable to use methods that do not harm other species.</li> </ul>
TIME, TREND, PROGNOSIS	The time of action for the removal of the reeds depends on the method used. In any case, several years must elapse (>3 years) for the results to be acceptable. Bear in mind that it is an invasive species, whose eradication requires a lot of effort and money.

**GOOD PRACTICE 13**

**PROTECTION MEASURES FOR AUTOCHTHONOUS SPECIES**



Figure 116. The Rambla de Alarba (Morata de Jiloca, Zaragoza)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Maintain the natural biodiversity of the ephemeral stream and its environment.</li> <li>• Contribute to reduce sediment movement and transport.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Increase capacity to capture carbon.</li> <li>• Increase the ability to regulate the local climate by cooling in summer.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Limit grazing.</li> <li>• Limit the passing of all kinds of vehicles in the channel.</li> <li>• Establish and apply public protection figures.</li> </ul>
AGENT	It can be approached from the biodiversity protection services of the Autonomous Communities. It also has significant potential to be integrated into local initiatives and voluntary activities.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Grazing, common in these streams, is usually a serious inconvenience for the maintenance and protection of these autochthonous species.</li> <li>• Activities such as trekking, moto-cross or all-terrain vehicles deeply damage the native vegetation.</li> <li>• Similarly, environmental education becomes a key argument to inform the general public about the need to maintain these species.</li> </ul>
TIME, TREND, PROGNOSIS	It depends, on the one hand, on the effectiveness of the channel use limitations and, on the other, on the degree of awareness of the public visiting these places.

**GOOD PRACTICE 14** MEASURES FOR PREVENTING THE COLONISATION OF INVASIVE SPECIES



Figure 117. Río Foix (Cubelles, Barcelona), with different non-native species on its banks.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Maintain the natural biodiversity of the stream and its surroundings.</li> <li>• Facilitate sediment mobility.</li> </ul>
ACTIONS	<ul style="list-style-type: none"> <li>• Protection of autochthonous species.</li> <li>• Maintenance of the sediment seed banks in the ephemeral stream.</li> <li>• Limit the introduction of invasive species to the watercourses by the local or visiting population.</li> <li>• Environmental education to raise awareness about the most common invasive species and warn of the dangers of the introduction of invasive species.</li> </ul>
AGENT	Conservation associations have an important role to play in informing the public about the most dangerous species and the negative effects of their introduction.
CONDITIONING FACTORS	It is necessary to implement different synergistic actions, such as those indicated, to achieve the objective, so it is essential to have a well-defined action plan in the medium term.
TIME, TREND, PROGNOSIS	The alteration of the natural environmental conditions of these streams facilitates the settlement of many invasive species, whose management is especially complicated due to the cryptic and stochastic nature of the invasion process. Only by maintaining the good condition of these channels will it be possible to minimise the impact caused by these species.

**GOOD PRACTICE 15****CREATION OF HABITATS**

Figure 118. Río Huecha (Bulbunte, Zaragoza)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Maintain the natural biodiversity of the ephemeral channel and its surroundings.</li> <li>• Maintain the natural hydrodynamics of the stream.</li> <li>• Activate the different biogeochemical processes.</li> </ul>
ACTIONS	<p>All actions aimed at the maintenance and conservation of native natural vegetation, as well as all processes that facilitate natural hydromorphological dynamics, are key in the genesis of habitats for organisms.</p> <p>In extreme cases of degradation, it is necessary to create new habitats, which favour the reinstallation of processes and forms, soil formation and colonisation.</p>
AGENT	<p>Passive restoration can be adopted, in which the ephemeral stream performs the work of habitat generation. But sometimes, the damage is so severe that it is necessary to carry out an active process of creation. It would correspond, in principle, to the Hydrographic Confederations, where a works management team with competence in river geomorphology is fundamental.</p>
CONDITIONING FACTORS	<p>The creation of habitats depends almost exclusively on maintaining the natural conditions of the channel; that is, freedom for the water and solid load to move, which is deposited creating bars and other morphosedimentary units of varied texture, on which basic organic matter accumulates for the colonisation of different plant and animal species. Having natural floods is a guarantee of success.</p>
TIME, TREND, PROGNOSIS	<p>The amount and diversity of biogeochemical processes (e.g. the decomposition of organic matter, release of nutrients, nitrogen control, etc.), which characterise the ephemeral channels, occur over the different habitats generated. Thus, the creation and diversification of habitats is a guarantee of the proper functioning of these streams.</p>

## GOOD PRACTICE 16

## REVEGETATION



**Figure 119.** Bad practice of revegetation in a dry channel reach of the Arba de Luesia (Rivas, Zaragoza) altered by recovery work of the drainage cross-section. The aligned stakes narrow the channel.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Recreate the autochthonous vegetation of the place as much as possible.</li> <li>• Increase biodiversity.</li> <li>• Control sediment movements and generate sand bars and other bedforms in the channels.</li> <li>• Generate new habitats for species.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Let the seed banks act, the one which exists in the bed sediment, and the one transported by the flood waters (passive revegetation).</li> <li>• Use of plant cuttings or planting in exceptional cases to speed up the processes (active revegetation).</li> </ul>
AGENT	Hydrographic Confederations in the Hydraulic Public Domain, both allowing the watercourse to work and taking action if necessary.



CONDITIONING FACTORS	Excessive grazing and activities such as trekking, moto-cross or off-road vehicles, and even hiking, can delay the revegetation process.
TIME, TREND, PROGNOSIS	Ecological succession in passive revegetation processes is not usually slow, but depends on the entry of seeds through floods or the amount and diversity of the seeds accumulated in the bed sediments. Passive revegetation is the best guarantee to recover autochthonous vegetation.

**GOOD PRACTICE 17** ELIMINATION OF RUBBISH AND DUMPING IN CHANNELS AND BANKS



Figure 120. Garbage and waste in the Ruisseau des Lavandières in Caunes-Minervois (France)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Eliminate anthropogenic elements of the ephemeral fluvial system, contributing to their naturalisation.</li> <li>• Improve habitats and increase biodiversity.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Frequent periodic campaigns to clean the entire ephemeral stream network of rubbish, waste and dumping.</li> </ul>

	<ul style="list-style-type: none"> <li>• Awareness campaigns to try to educate the population about the inappropriateness and negative consequences of using the channels as garbage dumps and landfills.</li> </ul>
AGENT	Hydrographic Confederations and volunteers from associations and educational centres.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Social inertia from a deeply rooted ancestral contempt for these dry courses.</li> <li>• Absence of cataloguing and legal recognition of many of these channels.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice can have an important and immediate social impact, so that campaigns can be quickly organized at a local level promoted by associations and educational centres. The benefits can be immediate.

### 4.3. A proposal for good practices in managing the fluvial territory

Fluvial management, including restoration measures, implies and requires the existence of a territory. The fluvial system has a spatial component, it occupies a place on the earth's surface, which must be respected and which is the setting where it functions and recovers. Land management is a work in progress marked by conflicts, interests, lack of coordination, irresponsibility, breaches, inertia and complex economic and environmental dynamics throughout the geographical space; made even more complicated in rivers and further still in ephemeral streams.

The good practices of this block, which are very difficult to apply, could achieve a new scenario for the area occupied by fluvial zones. With more natural basins and channels, it is possible for ephemeral streams to establish themselves in their space and adjacent land uses can be managed for the maintenance of that space and to guarantee natural fluvial function.

**GOOD PRACTICE 18** | **NATURALISATION OF THE BASIN**



**Figure 121.** The Rambla Celumbres (Cinctorres, Castelló)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Make the fluvial system more natural.</li> <li>• Recover erosion, transport and sedimentation processes.</li> <li>• Increase biodiversity in the basin and channels.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Reduce land uses that involve water and sediment consumption.</li> <li>• Reduce uses that make the zone more impermeable, such as urbanisation processes and the consumption of space.</li> <li>• Increase the surface area of protected natural spaces to guarantee natural sources of water, sediment and species.</li> </ul>
AGENT	<p>All bodies and institutions involved in land management and environmental protection. It is also necessary for the collaboration of environmental organizations and citizens in general, to take the lead in changes in consumption habits.</p>
CONDITIONING FACTORS	<p>It is a very complex process integrated into land management and adequate and sustainable land use planning. The difficulty and slowness of many planning and legal processes and the obstacles established by the economic powers, interested in maintaining the current situation of overconsumption, are widespread conditions that are very difficult to overcome.</p>

TIME, TREND, PROGNOSIS	It is essential to start these types of actions at the basin scale now in order to achieve long-term results. It will take several decades for changes to become effective and results meaningful.
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<b>GOOD PRACTICE 19</b>	<b>RETURNING THE WATERCOURSE ITS NATURAL SPACE AND GENERATING A FLUVIAL TERRITORY</b>
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Figure 122. The Rambla Cervera (Sant Mateu, Castelló), with internal protective ripraps that cut through and restrict the channel active space.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Achieving continuous erodible, floodable, wide and non-developable river spaces (which do not have to be public spaces, they must only maintain some conditions such as the prohibition of extraction or building).</li> <li>• Geomorphological freedom and regeneration processes, increasing the mobilisation and transport of solid discharge, as well as activity on erodible banks.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Recovery of the functionality of riparian corridors and floodplains, allowing overflow and managing to naturalise the function of the watercourse.</li> <li>• Lamination of flood waters in a natural way, cushioning the peak flows by the overflow itself within the fluvial territory. In this way, downstream risk can be reduced by avoiding and limiting the installation of defense structures.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Removal of longitudinal dikes (levees) or setback of embankments, to achieve the mobility of the channel and the free dynamics of fluvial processes.</li> <li>• Widen the river territory upstream and near population centers to reduce the frequency of overflows.</li> <li>• Establish expropriations, acquisitions, barter or compensatory measures for territories and private plots within the river territory, offering the possibility of maintaining their activities, but respecting flood processes.</li> <li>• Promote changes in land use, prioritising its adaptation to river functioning.</li> <li>• Provide the fluvial space achieved with a nominal and legal consideration as a Fluvial Territory in accordance with National Strategy for River Restoration.</li> </ul>
AGENT	Hydrographic Confederations and regional councils for spatial planning and land management, through coordinated plans and programs that are implemented in reference fluvial reaches.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Ownership conflicts.</li> <li>• River spaces occupied by crops, buildings, communication links by road and rails or other infrastructure.</li> <li>• Heterogeneity in ownership arrangements and the circumstances of each section.</li> <li>• Applicability in extensive ephemeral streams with flood plains, and much less feasible and effective in others with a very small width.</li> <li>• Need for budgets for this type of action, which can be important if expropriations or purchases are the chosen action option.</li> </ul>
TIME TREND, PROGNOSIS	This action will achieve its medium-term objectives and must be linked to the correct land use planning in the flood-prone area. The fluvial territory must be seen as a solution based on nature in the face of existing environmental problems, protecting the dynamics of the ephemeral stream and minimising risks, and thus recovering part of its territory.

## GOOD PRACTICE 20

## RETURNING PUBLIC PROPERTY TO THE FLUVIAL TERRITORY



Figure 123. Andarax River (Santa Fe de Mondújar, Almería)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Recover the Hydraulic Public Domain in channels affected by private occupations.</li> <li>• Recover naturalness in the fluvial function according to the lines indicated by the objectives of the previous good practice (n° 18).</li> <li>• Minimize risks associated with flooding and erosion by reducing exposure and vulnerability.</li> <li>• Improve the planning of land use in the fluvial space and control over it.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Cadastral reviews throughout the ephemeral stream network.</li> <li>• Delimit and demarcate the Hydraulic Public Domain (HPD), defined by the Water Law and regulated by Royal Decree 9/2008, throughout the ephemeral stream network.</li> <li>• In the reaches where it is possible, consolidate the continuous band of the fluvial territory.</li> <li>• Expropriate land within the Hydraulic Public Domain, and remove defences and channeling works that restrict its function.</li> <li>• Raise awareness and educate about the importance of the figures of the HPD and the Fluvial Territory, not only to improve the hydrogeomorphological and ecological naturalness of the river system, but also as instruments that provide effective and adaptable land planning and management in order to control activities in this space, with the consequent reduction in risks.</li> </ul>

AGENT	The State through the Hydrographic Confederations and with the support of the judiciary making existing laws effective.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Ownership conflicts.</li> <li>• Pressure from companies, individuals and owners of the affected territories within the HPD and the Fluvial Territory.</li> <li>• Lack of knowledge and lack of social awareness about the HPD and the Fluvial Territory.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice would have to be immediately implemented, although expropriation processes are complex and lengthy, so their positive effects could take time to be noticed.

**GOOD PRACTICE 21** FLUVIAL TERRITORY IN URBAN REACHES: GREATER WIDTH, DEURBANISATION, CHANGING LAND USES



Figure 124. Barranco Valera in Herce (La Rioja)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Recover the functionality and fluvial naturalness also in urban areas, freeing up spaces for the watercourse, removing obstacles and making the channel and the floodplain permeable.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Reduce urban exposure and vulnerability to flood hazards.</li> <li>• Reduce and prevent “bottleneck” situations generated in many channels by their passage through an urban space and with its negative effects on the affected specific reach and other reaches involved.</li> <li>• Raise awareness among the urban population about the values and functioning of ephemeral streams regardless of their specific dimensions and previous local perception.</li> </ul>
ACTIONS	<ul style="list-style-type: none"> <li>• Recover land to free up the fluvial zone by generating an erodible and flood-prone space as wide and continuous as possible.</li> <li>• Plan the urban space adapting the urban regulations to the fluvial space and make land gains along the course non-developable.</li> <li>• Change uses and structures so that in the urban space there is a wide and continuous lateral zone which expands the channel.</li> <li>• Eliminate landfills and dumping in the fluvial territory, which is very frequent in urban and peri-urban areas.</li> <li>• Promote and execute the deurbanisation (decanalisation of the channel, removal of constructions and roads, distancing and diversion of infrastructure, etc.) of surfaces of the fluvial territory for its better adaptation to fluvial function.</li> <li>• Replace urban uses and structures with open spaces such as orchards and naturalised parks.</li> <li>• Encourage citizen movements that work along these lines.</li> </ul>
AGENT	All the competent administrations in matters of land management and urban planning. It should be supported by a large-scale state plan that would coordinate and guide action at every local level.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Urban areas are considered to be well-established both socially and legally, which makes it very difficult and expensive to take action on them. Many situations are inherited and irreversible and urban planning regulations themselves prevent their modification.</li> <li>• Conflicts with owners and with urban managers that protect regulated public use.</li> <li>• Fluvial spaces occupied by buildings, communication links or other infrastructure.</li> <li>• Perception and social consideration of urban structures as a positive and inevitable progress and a broad rejection of deurbanization initiatives</li> <li>• Insufficient budgets for this type of action.</li> </ul>



<p>TIME, TREND, PROGNOSIS</p>	<p>This good practice is complex in its implementation and will probably require action in phases, especially in large population centres. The expected effects will also be progressive. It has to be linked to the correct land use planning in the flood plain. The fluvial territory should be seen as a solution based on nature, effective risk management, social acceptance and a priority in municipal management.</p>
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**4.4. A proposal for good practices in hydrological, environmental and risk management**

This block focuses on management and is above all a call to administrations to accept responsibility for considering and valuing the ephemeral fluvial network, for monitoring its correct hydrological functioning, for its permanent environmental evaluation and for the legal and effective protection of these watercourses. For all this, sensitivity, awareness and willingness to act are all necessary.

**GOOD PRACTICE 22**      **CATALOGUING AND FORMALIZING ALL OF THE EPHEMERAL CHANNELS IN THE FLUVIAL NETWORK**



Figure 125. Barranco del Cilluelo (Fuendejalón, Zaragoza)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Identify the different ephemeral fluvial systems to be able to manage them and find specific and effective solutions.</li> <li>• Assess the importance and representativeness of the ephemeral fluvial network in the context of the overall drainage network.</li> </ul>
ACTIONS	<ul style="list-style-type: none"> <li>• Integrate the entire ephemeral stream network as bodies of water into the management mechanisms of hydrographical districts.</li> <li>• Have a complete and updated cartography of the ephemeral fluvial network.</li> </ul>
AGENT	The State through Hydrographic Confederations.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Sometimes there are difficulties of definition due to variations in flow regime and diversity in channel geometry and planform.</li> <li>• There are streams with only a few ephemeral reaches, which makes it difficult to catalogue them.</li> <li>• It is necessary to overcome inertia due to ignorance and underappreciation both in society and in government administrations.</li> </ul>
TIME, TREND, PROGNOSIS	<p>This good practice is an indispensable starting point. To reverse the current situation it is necessary to improve knowledge, and that knowledge starts with identification as a first step, of both specific cases and the whole ephemeral drainage network. It is a simple action, which can be carried out through a research project, but will then require a willingness to make it effective and will lay the foundations for other measures.</p>

**GOOD PRACTICE 23** INCREASING THE GAUGING STATIONS AND CONTROL POINTS OF THE AHIS SYSTEM IN THE EPHEMERAL FLUVIAL NETWORK



**Figure 126.** One of the very few gauging stations in the ephemeral network of the Ebro basin, that of the Seco River in Oliete (Teruel), built after the flash flood of 2013, which caused a fatality.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Improve the knowledge of ephemeral streams and give them greater visibility.</li> <li>• Detection, quantification and classification of peak discharges and floods in ephemeral streams.</li> <li>• Improve the prediction of extreme events and reduce risk.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Creation, updating and improvement of a georeferenced database of all ephemeral streams.</li> <li>• Provide AHIS network stations to all ephemeral streams where it is possible.</li> </ul>

AGENT	The State through Hydrographic Confederations. It could be subject to funding from European funds.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Lack of budgets for this type of action.</li> <li>• Large dimensions of the ephemeral fluvial network.</li> </ul>
TIME, TREND, PROGNOSIS	It is a fundamental and good practice, but it involves a considerable cost and will have to be considered as we move forward gradually over time. It would be of great interest to have this infrastructure throughout southern Europe.

<b>GOOD PRACTICE 24</b>	<b>HYDROLOGICAL NATURALISATION, GEOMORPHIC AND FUNCTIONAL DISCHARGES</b>
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**Figure 127.** Ephemeral channel reach of the Isuela River (Huesca) with denatured discharge due to hydrological regime regulation from the Arguis reservoir.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Deregulate these streams, since the intense regulation is a cause of environmental degradation and completely modifies the natural discharge regime.</li> <li>• Recover the processes of erosion, transport and sedimentation of ephemeral fluvial systems.</li> </ul>
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	<ul style="list-style-type: none"> <li>• If regulation is maintained, recover the frequency of floods in order to activate the functional processes of the fluvial system.</li> <li>• Control populations of living beings.</li> <li>• Cleaning and decontamination of the channel.</li> </ul>
ACTIONS	<ul style="list-style-type: none"> <li>• Elimination or regulation of anthropogenic detractions and derivations of the discharge.</li> <li>• In reservoirs, consider the possibility of releasing water to generate geomorphic and functional floods when it is recommended.</li> <li>• Naturalise by controlling spills from Wastewater Treatment Plants (WWTPs).</li> <li>• Control irrigation collectors and other external spills, which make the discharge less natural. If possible, divert them to perennial streams or rivers.</li> </ul>
AGENT	Hydrological Confederations and users of regulation and exploitation systems.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Conflict over water uses.</li> <li>• Ownership conflicts.</li> <li>• Low capacity of reservoirs in ephemeral streams.</li> <li>• Difficulties in having water when it is needed.</li> </ul>
TIME, TREND, PROGNOSIS	Hydrological naturalisation can be achieved in the medium and long term if agreements are reached about water use. Situations are often very complex and local constraints prevent global action. The generation of geomorphic and functional discharge, which is very necessary in most fluvial systems, is of little effectiveness in ephemeral streams, which are already naturally subjected to a limited number of hydrogeomorphic events. It can only be considered in exceptional cases in streams affected by the construction of reservoirs.

## GOOD PRACTICE 25

## ASSESSING THE ECOLOGICAL STATUS OF THE ENTIRE EPHEMERAL STREAM NETWORK



Figure 128. The Rambla Huechaseca (Pozuelo, Zaragoza)

OBJECTIVES	<ul style="list-style-type: none"> <li>• Improve knowledge of ephemeral streams.</li> <li>• Improve the state of ephemeral streams.</li> <li>• Raise awareness about the environmental status of ephemeral streams and make this type of fluvial systems known to the population.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Integrate ephemeral streams into the bodies of water assessed with the aim of achieving a good ecological status (Directive 2000/60/EC).</li> <li>• Amend the ecological status assessment procedure of Directive 2000/60/EC for bodies of water from ephemeral streams, basing it mainly on hydromorphological indicators.</li> </ul>
AGENT	<ul style="list-style-type: none"> <li>• Hydrographic Confederations.</li> <li>• Volunteers.</li> <li>• The private sector can also participate.</li> <li>• Working groups of the European Commission, which should insist on the need to evaluate ephemeral streams.</li> </ul>

<p>CONDITIONING FACTORS</p>	<ul style="list-style-type: none"> <li>• Lack of budgets for this type of action.</li> <li>• Large dimensions of the ephemeral fluvial network in the Mediterranean area.</li> <li>• Need for geomorphological and ecological training for the people who develop the evaluation.</li> </ul>
<p>TIME, TREND, PROGNOSIS</p>	<p>It is a good practice of great interest, which should be implemented urgently taking into account the state of many ephemeral streams. Diagnosis is the first step to solve the problems and be able to proceed to the environmental recovery of these courses.</p>

**GOOD PRACTICE 26**      **CONTROLLING AND CLOSING OF GROUNDWATER ABSTRACTION POINTS IN EPHEMERAL CHANNELS**



**Figure 129.** “The Pozuelo Geyser”. This artesian well was drilled in the 1970s on the bed of the Rambla Huechaseca (Pozuelo, Zaragoza) and causes the water to outflow with a constant discharge and temperature.

OBJECTIVES	<ul style="list-style-type: none"> <li>• Protect ephemeral streams and their environmental quality.</li> <li>• Maintain or recover natural hydrological functioning and the volumes of water in the channel and in the phreatic zone.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Compile a complete record of wells and their location in the context of the ephemeral stream network and their associated aquifers.</li> <li>• Restrict well construction.</li> <li>• Sanctions and rules in favour of the closure of groundwater abstraction points near these ephemeral fluvial systems.</li> </ul>
AGENT	Hydrographic Confederations.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Existence of many illegal wells and clandestine water extraction.</li> <li>• Associated economic activities and private interests in water.</li> <li>• Deficiencies in hydrological planning.</li> <li>• Absence of sanctions and widespread systematic judicial non-compliance.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice will be very complex to bring in, requiring a long time. The effects on the fluvial dynamics will not be immediate, but will take time. It should be considered in the long term and associated with changes in land use, consumption habits and the process of adaptation to climate change.



**GOOD PRACTICE 27** | **PROTECTING EPHEMERAL STREAMS OF A HIGH ENVIRONMENTAL VALUE AND QUALITY**



**Figure 130.** One of the headwaters of the Rambla Barrachina in la Muela de Teruel (Teruel).

OBJECTIVES	<ul style="list-style-type: none"> <li>• Maintain and improve the hydrogeomorphological and ecological status of these ephemeral streams.</li> <li>• Use the media to promote and disseminate environmental information related to ephemeral streams.</li> <li>• Complete networks of protected fluvial spaces with all existing ephemeral channel typologies.</li> <li>• Enhance the value of the ephemeral streams as a whole as well as their unique reaches of greatest value and quality.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Create and implement specific protection figures for ephemeral streams.</li> <li>• Multiply the number of ephemeral streams protected as fluvial nature reserves.</li> <li>• Provide to protected watercourses management plans and environmental education proposals.</li> </ul>
AGENT	Ministry of Ecological Transition

<p>CONDITIONING FACTORS</p>	<ul style="list-style-type: none"> <li>• Lack of budgets for this type of action.</li> <li>• Low social interest for these streams.</li> </ul>
<p>TIME, TREND, PROGNOSIS</p>	<p>This good practice, in addition to involving a figure of protection for the reach in question, would be fundamental for improving the promotion of these types of channels among the local population, and could even energize the territory. It is urgent that we protect ephemeral streams because this will produce positive environmental and social effects and will function as an example so we can go on developing initiatives in all basins.</p>

**GOOD PRACTICE 28** FLUVIAL AGENTS FOR CONTROLLING, MONITORING AND PROTECTION



Figure 131. Hydrographic Confederation of the Júcar River.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Protect ephemeral channels by preventing impacts from taking place.</li> <li>• Monitor compliance with the rules and check the result of the good practices that are being executed in the fluvial systems.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Report to the authorities and sanction bad environmental practices in ephemeral streams.</li> <li>• Create the green jobs that are necessary and compatible with the change of environmental mentality that must be implemented in society.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Creation of the figure of “Fluvial Agent”.</li> <li>• Enact a statewide prohibition law that includes sanctioning procedures for the main impacts on ephemeral streams.</li> <li>• Associate the work of fluvial agents with the implementation of good conservation and monitoring practices.</li> </ul>
AGENT	The Ministry of Ecological Transition through Basin Organisations and Water Agencies.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• A significant permanent budget allocation is needed in view of the size of the fluvial network and the need for a large group of agents.</li> <li>• Possible negative social perception if it is considered as a new environmental measure in conflict with certain economic interests.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice should be a priority in the framework of post-pandemic recovery funds and in the context of environmental change and adaptation to climate change. It would be a starting point that could guarantee the effectiveness of the remaining good practices and also help bring about the necessary change in social mentality about ephemeral streams.

**GOOD PRACTICE 29** | **IMPROVING BUILDING CONDITIONS IN FLOOD ZONES**



Figure 132. Barranco de Gran Tarajal (Fuerteventura).

OBJECTIVES	<ul style="list-style-type: none"> <li>• Reduce vulnerability and thus risk in ephemeral streams, in cases in which exposure cannot be reduced (deurbanisation).</li> <li>• Educate the population about risk and raise awareness about the need to change consumption habits and location.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Close basement floors in flood zones.</li> <li>• Permeabilise the floors at ground level to facilitate the passage of water and raise all equipment</li> <li>• Raise homes, shops and services to non-floodable floors, preferably in pilot-supported structures.</li> <li>• Have temporary barriers and portable containment and retention elements, as well as floodgates and watertight doors.</li> <li>• Transfer of public services and common buildings to non-flood prone areas.</li> <li>• Prohibit new construction in flood zones.</li> <li>• Establish emergency systems and evacuation plans for each urban centre.</li> </ul>
AGENT	This action should be the subject of a state plan led by the ministries of housing and ecological transition.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Need for large budgets.</li> <li>• Social inertia and a false sense of security in the riverside population.</li> </ul>
TIME, TREND, PROGNOSIS	This good practice should be subject to a legal procedure that allows it to be carried out rapidly. Its effectiveness will be immediate and will make it possible to considerably reduce vulnerability. The problem is widespread, since many population centres are crossed by, or directly built, on ephemeral streams.

#### 4.5. A proposal for good practices for evaluation, knowledge and awareness

This block proposes good practices which are fundamental for the achievement of all the previous ones, and especially those concerned with management. The involvement of society is sought here and is to be based on education and awareness, which must encourage both the continuous denunciation of bad practices and collective work on the definition, implementation and monitoring of good actions.

**GOOD PRACTICE 30** GLOBAL ENVIRONMENTAL EDUCATION, A CHANGE OF MENTALITY AND AWARENESS CAMPAIGNS ABOUT EPHEMERAL STREAMS



**Figure 133.** School environmental awareness activities.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Improve knowledge about ephemeral streams and their geomorphological function and fluvial ecology.</li> <li>• Inform and raise awareness about the impacts and problems of ephemeral streams and their environmental value.</li> <li>• Contribute to a profound change of mentality in relation to the territory and the environment, as a fundamental basis to be able to address river recovery and in the context of adaptation to climate change.</li> <li>• Change societal habits by moving towards processes of productive degrowth and sustainability.</li> </ul>
<p>ACTION</p>	<ul style="list-style-type: none"> <li>• Develop information and awareness campaigns and activities about fluvial functioning in educational centres and for broad sectors of society.</li> <li>• Develop a specific and urgent awareness campaign about ephemeral streams.</li> </ul>

	<ul style="list-style-type: none"> <li>• Establish social awareness and specific environmental education programs, including content in the school's curriculum.</li> <li>• Promote the creation of associations that are working for the necessary change of mentality.</li> <li>• Finance initiatives that change consumption habits and favour degrowth and sustainability.</li> <li>• Awareness-raising actions aimed especially at the riverside populations which are potentially vulnerable to floods in these types of streams.</li> </ul>
AGENT	Initiatives must be led by civil society and formal education and financed by the ministries of education and universities and ecological transition.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Widespread ignorance of the population that has a negative impact on rivers.</li> <li>• Lack of respect and social and administrative attention towards ephemeral streams.</li> <li>• Limited traditional participation in the initiatives that are undertaken along these lines.</li> <li>• Economic, social and political inertia that hinders changes in mentality and in forms of consumption.</li> <li>• Need for budgets to implement the proposed actions.</li> </ul>
TIME, TREND, PROGNOSIS	Decades ago, society changed its mentality towards issues such as adaptation of the environment and the unsustainable consumption of fluvial resources. Now we have to go the opposite way, which could also take decades. This good practice should be constantly publicised and made permanent over time, as it forms the basis for any fluvial recovery project. A specific awareness campaign on ephemeral streams is needed very urgently, in the short term, in order to lay the foundations for the implementation of all the other good practices.

**GOOD PRACTICE 31**    **STUDYING AND DENUNCIATION OF NEGATIVE ACTIONS**



**Figure 134.** Ford built in a particularly active channel reach on the Rambla de Valdelentisco, next to Isla Plana (Cartagena). During the floods, a large bedload (sand and gravel) passes through this road-stream crossing, with the consequent danger that it represents for vehicle access.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Prevent the proliferation of bad practices, negative action and false restoration in ephemeral channels.</li> <li>• Better understand the dynamics of ephemeral streams and their response to certain human interventions.</li> <li>• Raise awareness among the population about bad and good practices in ephemeral streams.</li> <li>• Modify the generalized negative social perception of ephemeral streams and the generalized positive social perception of many negative actions.</li> <li>• Recover from negative actions present in the ephemeral channels.</li> </ul>
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ACTION	<ul style="list-style-type: none"> <li>• Identify and locate all possible bad practices and negative actions throughout the ephemeral fluvial network.</li> <li>• Officially report through legal procedures and through public communication all these bad practices, including false restorations.</li> <li>• Continuously insist through the media on the values and natural functioning of ephemeral streams and constantly and forcefully warn about bad practices that harm them.</li> <li>• Creation of green employment with figures such as “fluvial agents”, who can facilitate control and protection of these types of watercourses and has the main role in making formal complaints to the authorities of bad actions.</li> <li>• Awareness and sensitization campaigns in order to teach how to detect negative actions in ephemeral streams.</li> <li>• Creation of a simple portal for complaints, so that anyone can quickly report negative actions, and that the competent administration can detect and expedite hypothetical restorations.</li> </ul>
AGENT	<p>Groups and management bodies, such as the Iberian Centre for River Restoration (CIREF), the environment agencies or departments of the different public administrations and environmental associations. It can also be developed from individual scientific-technical voluntary work.</p>
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Need for budgets for this type of action.</li> <li>• Ignorance and lack of awareness about these types of fluvial systems, both socially and in the judicial field itself, which causes abandonment and neglect and proliferation of negative actions.</li> <li>• The often enormous extent of the ephemeral stream network, which make it very difficult to reach all of it in order to identify and report bad practices.</li> </ul>
TIME, TREND, PROGNOSIS	<p>Many restoration actions and good practices that are efficiently applied will have started from the identification and official reporting to the authorities of anthropogenic impacts, so this previous work is necessary and urgent and should be extended in the territory covering the entire ephemeral network.</p>



**GOOD PRACTICE 32** PARTICIPATION AND VOLUNTEERING



Figura 135. Field campaign with fluvial geomorphology students.

<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <li>• Involve the population in the defence and recovery of fluvial systems and natural spaces.</li> <li>• Awareness-raising and environmental education about ephemeral channels.</li> <li>• Speeding up the execution of stream restoration actions and good practices.</li> <li>• Detection of environmental problems, conflicts and difficulties that may arise in restoration processes.</li> </ul>
<p>ACTIONS</p>	<ul style="list-style-type: none"> <li>• Creation of local campaigns to reverse negative actions.</li> <li>• Development of scientific studies and promotional publications to inform and prevent new actions and / or negative impacts.</li> <li>• Courses and technical meetings to encourage participation and environmental volunteering in fluvial issues and to train participants.</li> <li>• Design a participation and volunteering protocol for each action and good practice.</li> </ul>

AGENT	It can be managed and coordinated from the hydrographic confederations with support in educational, scientific and social centres.
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Generally low social appreciation of ephemeral streams.</li> <li>• Limited experience and extension of these types of environmental practices in the territory.</li> <li>• Insufficient budgets to finance these actions.</li> <li>• Complexity of ephemeral streams and many of the recovery initiatives and good practices that can be carried out.</li> </ul>
TIME, TREND, PROGNOSIS	Participation and voluntary actions must be present in all phases of fluvial recovery, starting with the approach, debate about and prior planning of the measures and including the follow-up after the actions.

**GOOD PRACTICE 33****MONITORING AND FOLLOW-UP**

Figures 136 and 137. The Rambla de Cariñena (Zaragoza) and Río Seco de Sarsamarcuello (Huesca).

OBJECTIVES	<ul style="list-style-type: none"> <li>• Recognize over time the processes and effects derived from the recovery actions implemented in ephemeral streams, checking their effectiveness and proceeding, if necessary, to changes of action within the framework of adaptive management.</li> <li>• Have a scientific network of information and studies on ephemeral streams.</li> </ul>
ACTION	<ul style="list-style-type: none"> <li>• Process monitoring at observation and sampling points to check changes.</li> </ul>

	<ul style="list-style-type: none"> <li>• Application of geomorphological and ecological monitoring protocols for the recovery and function processes of the fluvial system.</li> <li>• Periodical applications of diagnostic indices.</li> <li>• Implementation and maintenance of multidisciplinary scientific-technical teams that carry out monitoring and follow-up, and technical training to develop these practices.</li> <li>• Possibility of involving volunteers in some actions.</li> </ul>
AGENT	Hydrographic confederations, universities and research centres
CONDITIONING FACTORS	<ul style="list-style-type: none"> <li>• Insufficient budgets for this type of action.</li> <li>• Complexity of ephemeral streams and recovery initiatives, so there is a need for different monitoring and follow-up programs adapted to specific conditions.</li> </ul>
TIME, TREND, PROGNOSIS	It is an essential and good practice, which guarantees all the others and contributes to the success of all of them. It must be carried out before any other action is taken and last for at least five years.