Still Water Revival – Restoring and conserving still water ecosystems of Mediterranean karst mountains

Guidelines for pond and well restoration using traditional methods

12-2023

The project benefits from the support of the Donors Initiative For Mediterranean Freshwater Ecosystems.

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INTRODUCTION

GUIDELINES

These restoration guidelines, created as part of the Still Water Revival (SWR) project, are primarily intended for public institutions which manage protected areas, but also serve as a starting point for all other parties which need to or wish to restore a pond or a well (local self-government units, Hrvatske šume ("Croatian Forests", a state-run enterprise), hunting and hiking associations, private individuals...).
The guidelines comprise general experiences and instructions for restoration, and are not intended as a comprehensive manual for contractors conducting specific works on ponds and wells.

PONDS AND WELLS

Traditional ponds and wells are included in the unique abbreviation "SFEU" which stands for "small freshwater ecosystem unit(s)". Ponds are shallower objects featuring open, wider water surfaces and at least partially shelving shores, while wells are deeper objects featuring smaller water surfaces, vertically constructed walls, and occasionally a covering as well.

TRADITIONAL CONSTRUCTION METHODS

Traditional construction and agriculture is also referred to as vernacular or folk, something that has undergone a long development by having been passed down from generation to generation in the past. Builders from rural areas, much like their methods of construction which relied on their hands and hand-held tools, without heavy machienery, were out of necessity connected to agricultural processes, ways of living off the land and karst, and materials directly available in nature.

Modernity arises in opposition, or rather parallel to tradition, tied to industrialization, urbanization, occupational professionalization, and new materials. Accelerated socio-economic changes and processes during the 20th century has caused the traditional way of life in rural areas to fade into the background.

Traditional techniques are re-evaluated once again as the former basis for survival in karst landscapes, not only for historical or ethnological reasons, but primarily because of their contribution to biodiversity and nature protection.

POND AND WELL SIGNIFICANCE AND POSSIBLE FUNCTIONS

Before making any decisions on restoration, it is important to be aware of and to investigate the significance and functions of an object, which are not always apparent, particularly if it has been disused or neglected over a long period of time.

1. Biodiversity

- Ponds and their immediate surroundings are the habitat of many types of organisms, often rare and protected.
- In karst areas, they are often the only aquatic habitat present, thereby contributing to overall biodiversity by enabling the survival of species tied to aquatic and wet habitats, such as amphibians.
- Providing drinking water for wild animals and birds is one of the most important functions of these objects.

2. Water for livestock

- Drinking water for livestock, once one of the most important economic functions of ponds and wells, is today a key factor in extensive livestock farming, primarily in places far away from human settlements and water supply networks.

3. Irrigation and use for agricultural processes.

4. Drinking water for humans

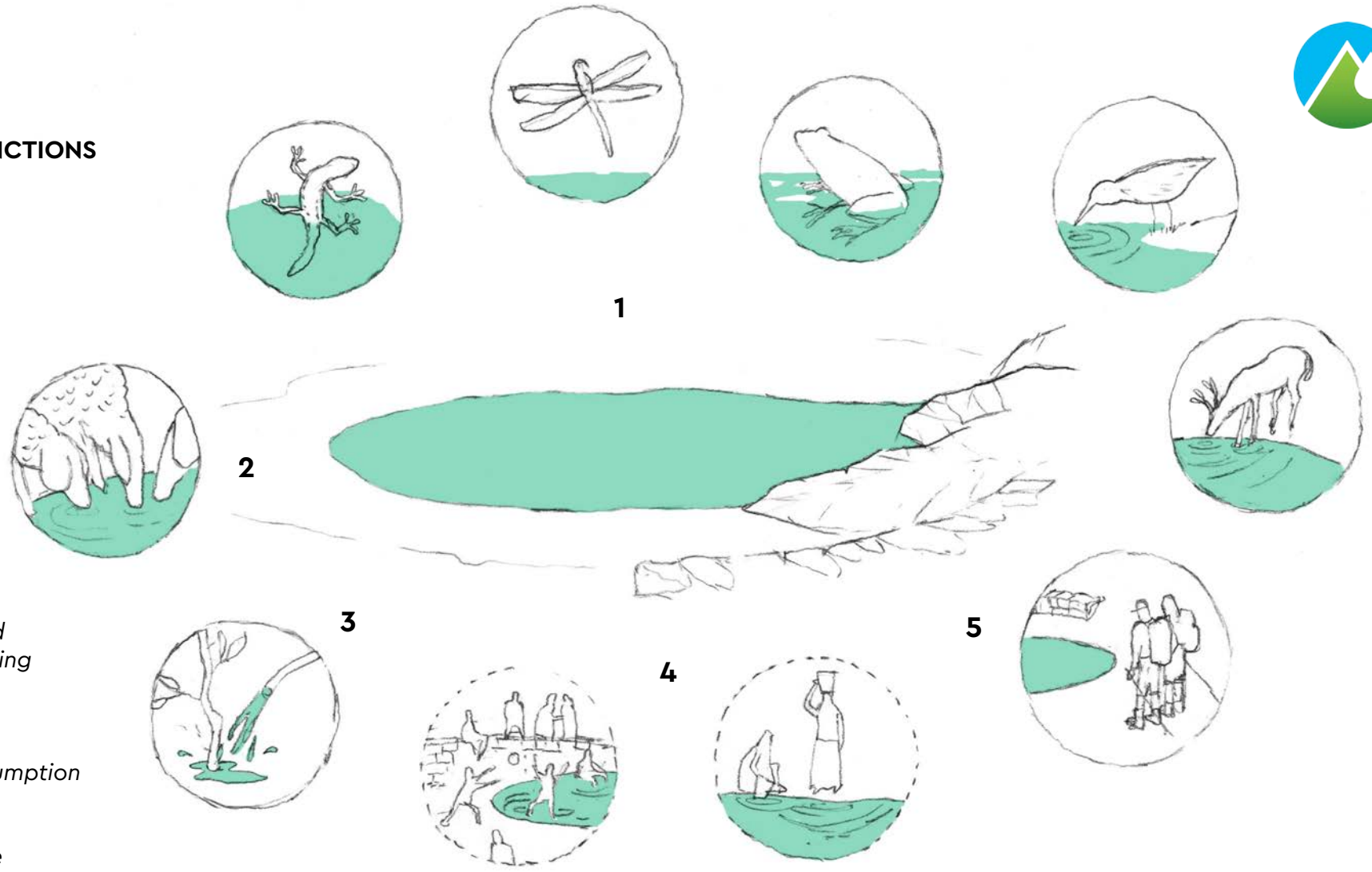
- In the past, ponds and wells were crucial and often the only source of drinking water for people living in rural karstic areas.
- For this reason, they also often served as the site of frequent gatherings and the social life of a community.
- Today these objects, if maintenance is provided, are possible sources of drinking water for humans on distant transversal hiking trails and hard-to-reach protected parts of nature.

5. Landscape and architectural heritage attraction

- A constituent part of traditional landscape, cultural heritage, and a precondition for life on karstic land.
- Ponds and wells can serve as points of interest on themed, educational and interpretation paths, routes and trails.

Note: the order of the functions (1-5) reflects their actual prevalence today. The prevalence of their original functions was somewhat different. For instance, in the past these objects served as drinking water sources for humans much more frequently, while recognition of their importance for biodiversity is a recent development.

SIGNIFICANCE AND POSSIBLE FUNCTIONS OF PONDS AND WELLS



*pond and well **functions**:*

1) biodiversity - a habitat for rare and protected species, amphibians, drinking water for birds and wild animals
2) water for livestock
3) irrigation, agricultural processes
4) in the past: water for human consumption and a site of social life
5) potential for education; natural, landscape and architectural heritage attraction

NATURAL WATER RETENTION ON KARST;

PRECONDITIONS FOR POND AND WELL FORMATION

A:
The main feature of karst is an overall lack of water on its surface: despite the abundant precipitation, water is rarely retained there, and watercourses hardly ever form.

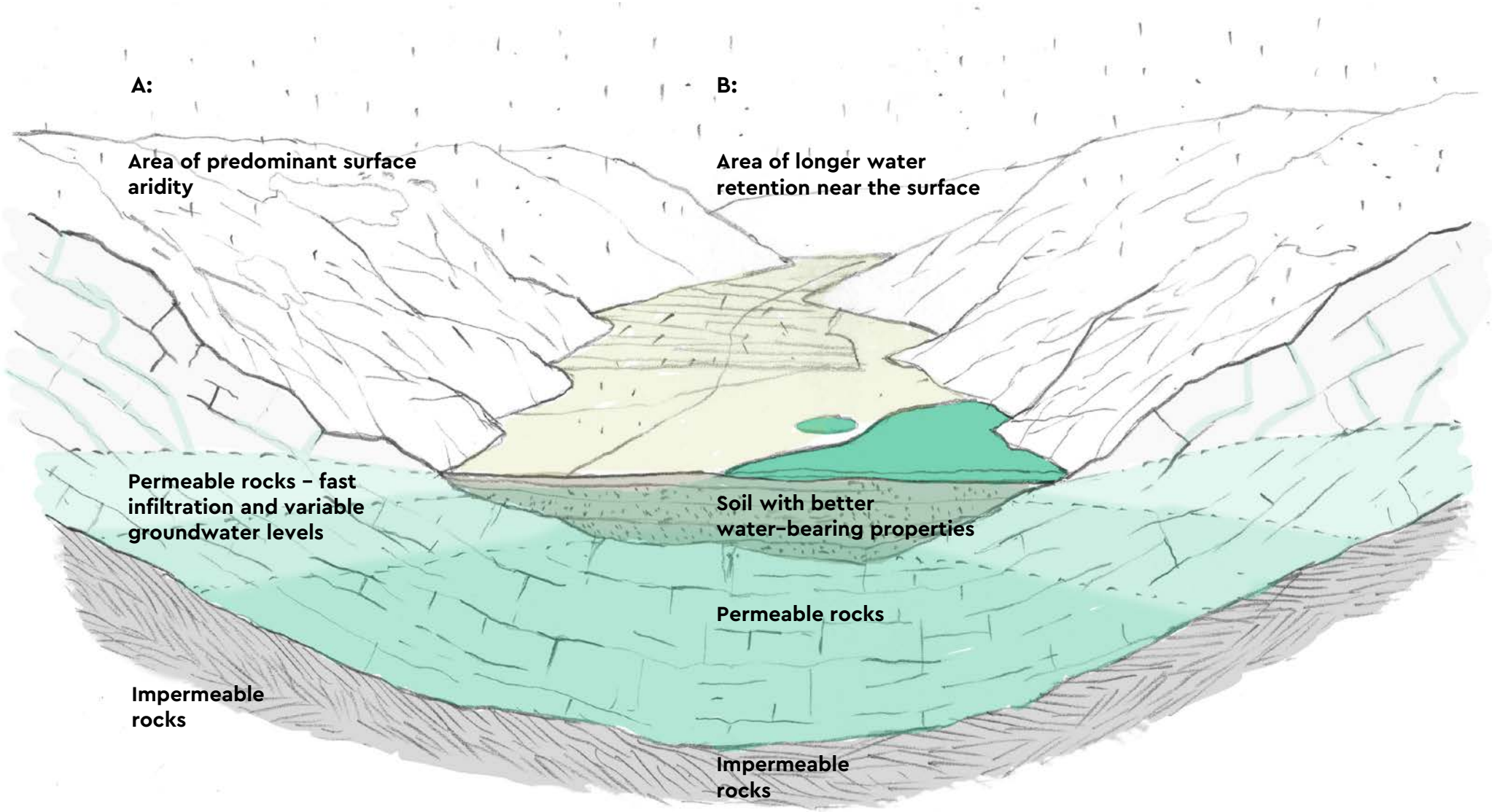
The impossibility of surface water retention on karst is due to numerous small and large cracks inside carbonate rocks, primarily limestone and dolomite in our area. These cracks were already created when this type of rock was formed, as interlayer cracks and intergranular porosity (so-called primary porosity), then due to the effects of tectonic movements (so-called secondary porosity), and lastly due to the chemical dissolution of rocks, corrosion (so-called tertiary/karst porosity).
Karst (tertiary) porosity is highly specific to our karst landscape. In addition to its impact on the creation of specific karst landforms (above and below ground), it also affects the further expansion and merger of subterranean cracks, i.e., the increase in both rock porosity and permeability.

Consequently, water on karst easily drains into the underground, becoming inaccessible to humans, animals and plants.

B:
In some areas, nonetheless, water manages to remain near the surface longer.

A favorable combination of terrain morphology and ground and/or rock type contributes to this, namely the combination of karst hollows/depressions (sinkholes, karst valleys and karstic fields) and impermeable soil (e.g., terra rossa) and/or impermeable rocks (e.g., dolomite, flysch). Given that karst depressions are geological contours which are lower than the surrounding landscape, precipitation water seeking its path to the lowest possible point often accumulates in them. Water retention occurs in places where a waterproof layer of soil or rock is located on the bottom of karst hollows.
Contacts – transitions from permeable rocks to ones impermeable to water – are also places where underground water resurfaces and forms springs.

This is precisely where humans in search of water in the rugged karst landscape create ponds and wells – water accumulation and usage objects.


A:
Area of predominant surface aridity
B:
Area of longer water retention near the surface
Permeable rocks – fast infiltration and variable groundwater levels
Soil with better water-bearing properties
Permeable rocks
Impermeable rocks
Impermeable rocks

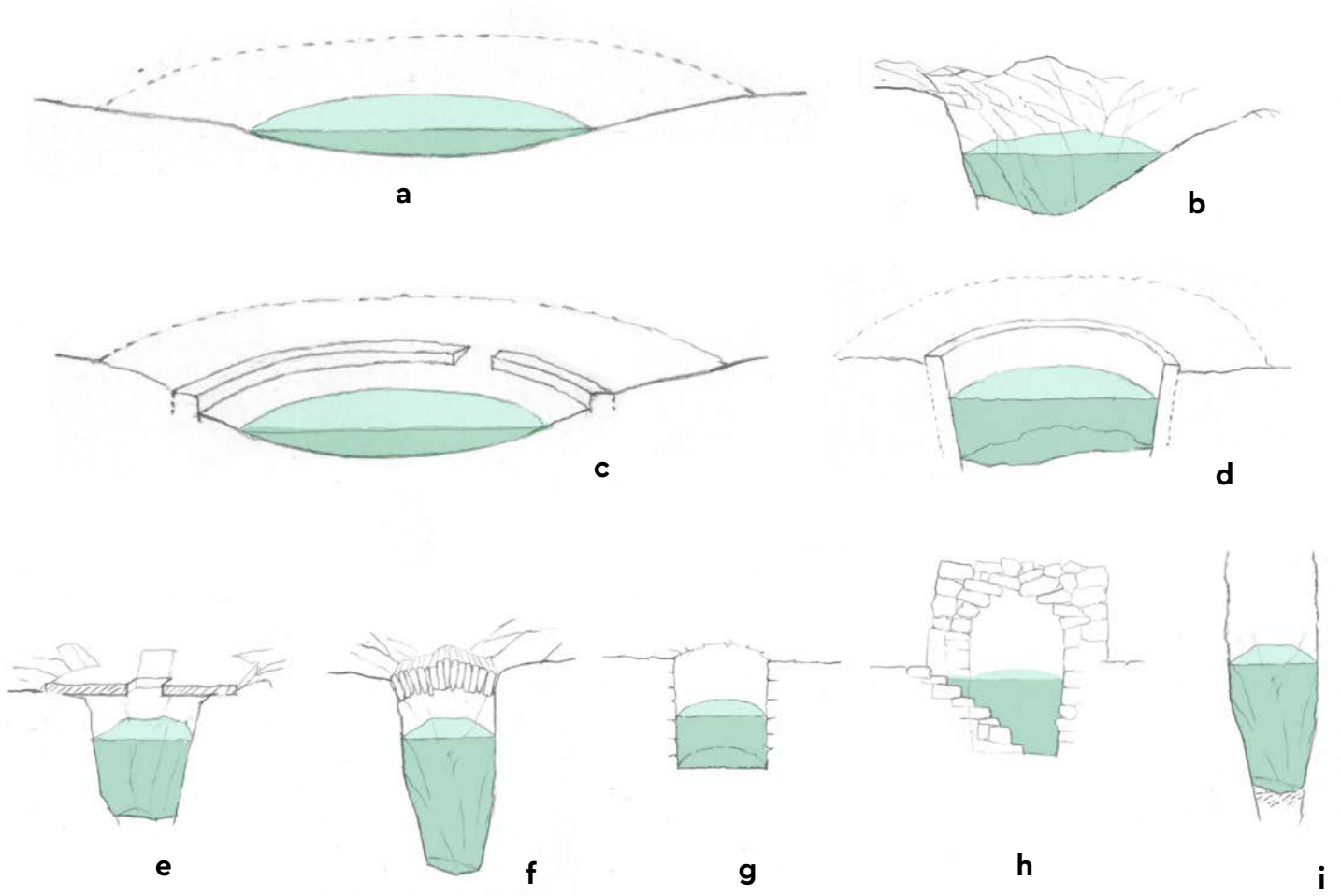
FORMS OF SMALL FRESHWATER ECOSYSTEM UNITS

• **Ponds** are fairly wide, shallow recesses with at least partially shelving shores. Humans and animals can directly access these water surfaces.

• **Wells** are deeper and narrower, structurally reinforced, i.e., walled excavations with vertical walls, and vessels or pumps are used to retrieve water for use from them. To provide animals with drinking water in a controlled manner, it is poured into solution pans or troughs in close proximity. Wells are sometimes covered or vaulted.

• **Cisterns**, water tanks also known as *šterne*, *gustirne*, and *čatrnje* are hollows, cavities between irregularly shaped natural rocks which humans have built upon by sealing cracks with lime or other binding compounds to make them waterproof, and which were sometimes covered, i.e., enclosed. Water is retrieved from them, much like it is from wells.

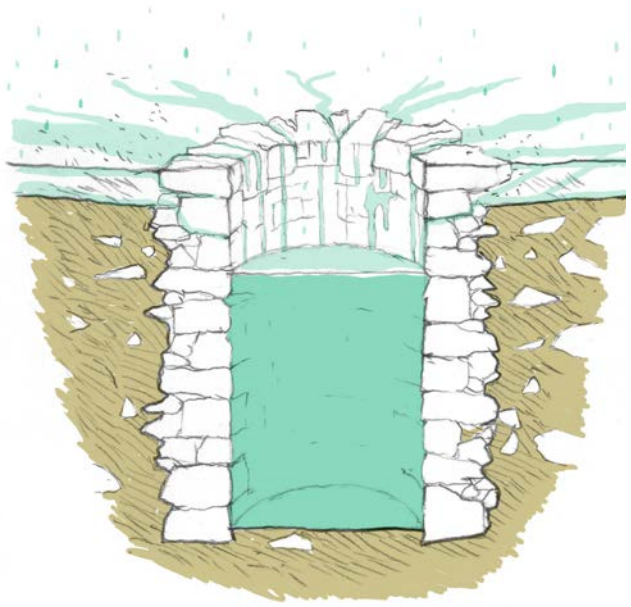
• **Karren wells** are completely natural karst formations – hollows with vertical or steep walls where the bottom has become waterproof via a natural process of material deposition, enabling water accumulation.



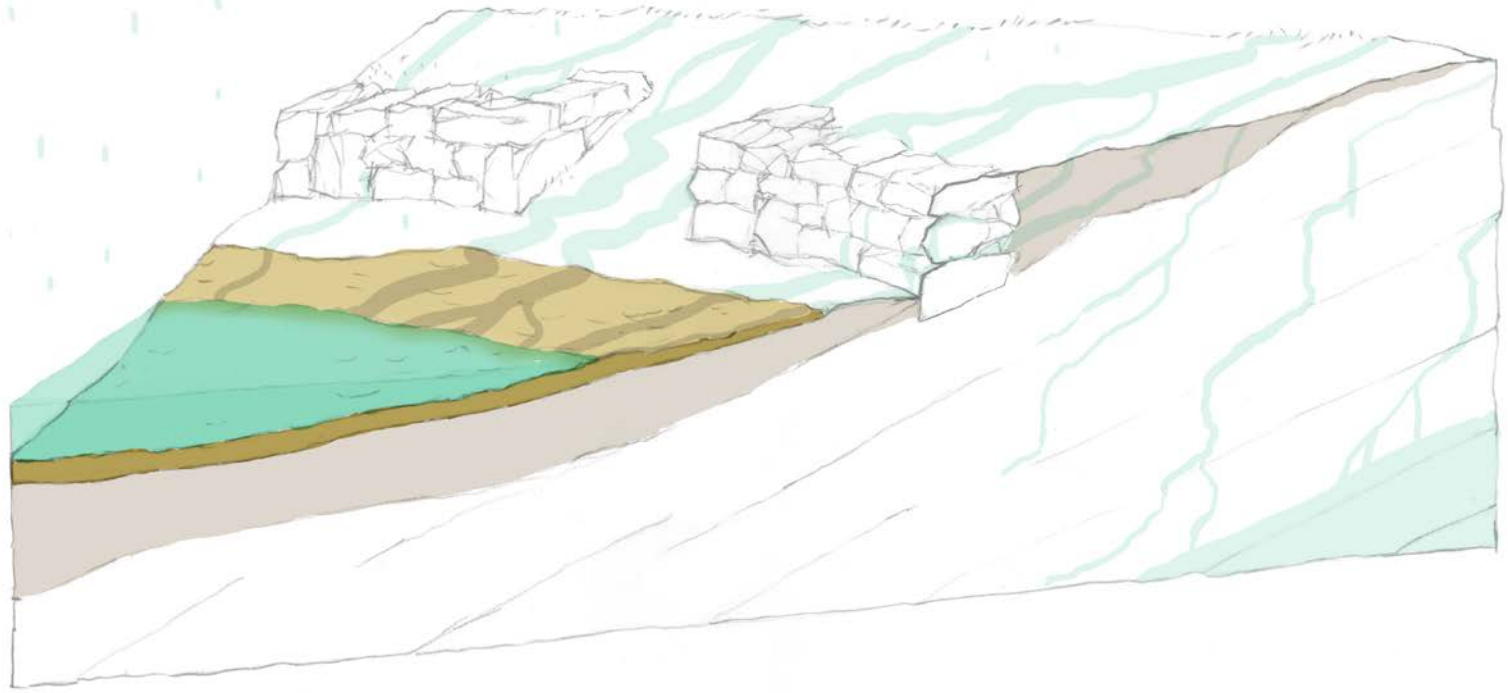
a) pond with shelving shores and no encircling wall, b) pond partially embedded between stone blocks of bedrock, c) pond with a shorter dry stone retaining wall, d) pond with a taller dry stone retaining wall, e) cistern embedded between stone blocks and covered with a concrete slab, f) cistern embedded between stone blocks and vaulted with stone, g) open well, h) corbel-vaulted well, i) karren well

WATER RETENTION IN OBJECTS WITH AN IMPERMEABLE BOTTOM AND WALLS

In the surface layer of the ground, where conditions for longer water retention are already present, humans create shallow and broad impermeable clay pond bottoms, or partially walled cisterns dug into natural rock, sometimes connected to stone water run-off slopes (*kameni naplovi*) / rainwater drainage objects (*pjoveri*) / water catchment structures (*vodovati*), and lastly, deeper, walled wells.
Objects with impermeable bottoms and walls directly depend on precipitation falling on water surface and streaming down in a torrential flow across the surface of the ground in the immediate vicinity. They fill up during the rainy season, and often completely dry up during or near the end of the dry season due to use and evaporation.



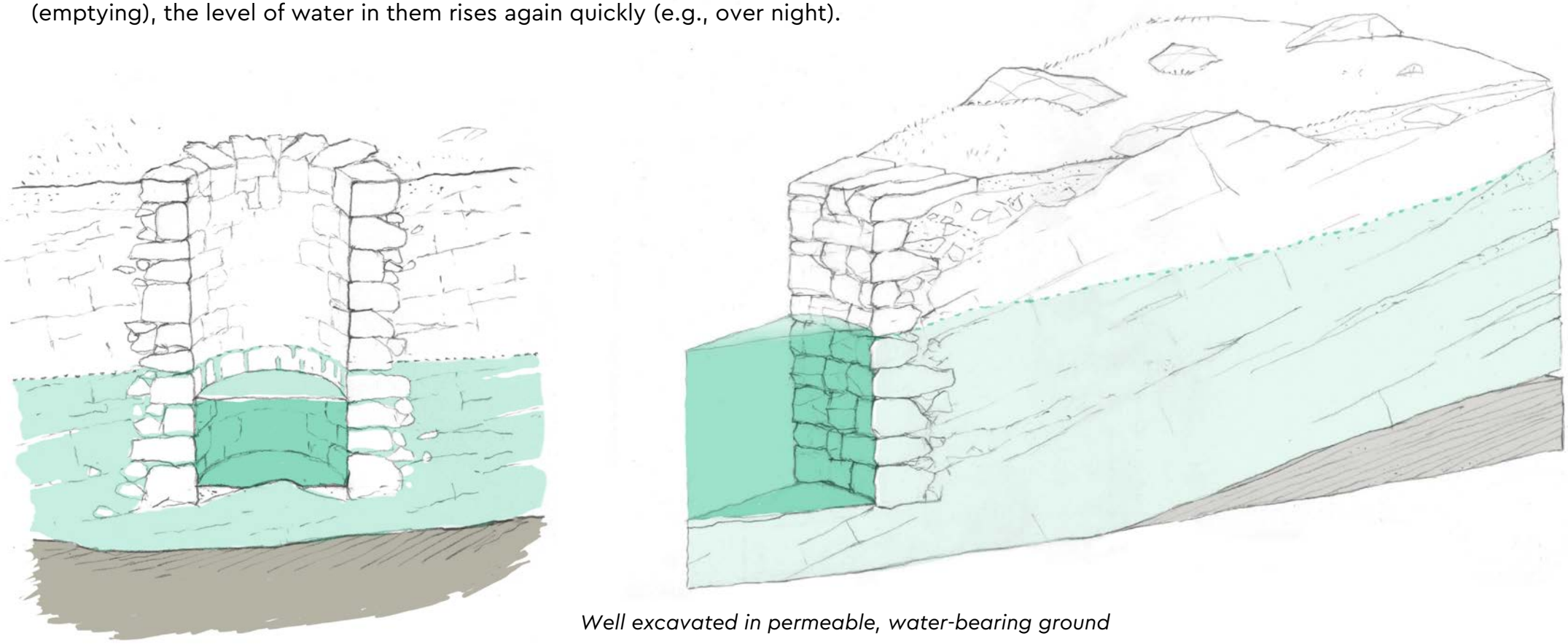
Well excavated in clayey, impermeable ground



Pond with a clayey, impermeable bottom

WATER RETENTION IN OBJECTS WITH A PERMEABLE BOTTOM AND WALLS

In places where conditions for and indications of water flow and/or retention below ground are present, excavations are undertaken to reach the water-bearing layer of the ground. The permeable masonry walls of such wells and ponds are used for the supply / percolation of water from the surrounding ground structure into the well. Permeable objects are connected to a broader subterranean layer of water-bearing ground. Water levels inside them primarily depend on precipitation amounts in the greater area and during a longer period of time. This is why locals state that these objects rarely go dry, even during the dry season. After use (emptying), the level of water in them rises again quickly (e.g., over night).



Well excavated in permeable, water-bearing ground

PROTECTIVE ELEMENTS AND DETAILS OF WELLS

The provision of drinking water is the principal function of wells. Wells are often open, but builders have covered water surfaces whenever possible to slow evaporation, prevent the intrusion of any kinds of impurities into the well, and to prevent humans and animals from falling in.

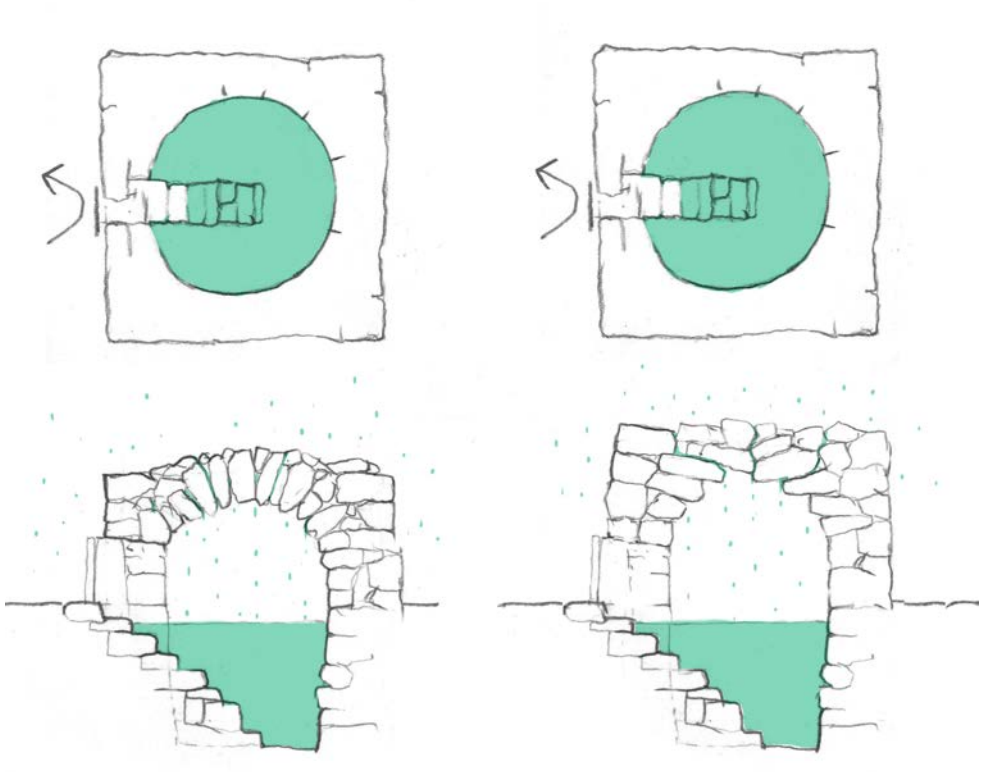
Covering can be performed via a simple wooden or metal lid, sometimes a concrete slab with a lid, but also with a stone vault structure.

Vaulting can be performed in the classical way, as an arch / dome, but it can also be corbell-vaulted. The well vault is constructed in a way that lets precipitation leak through.

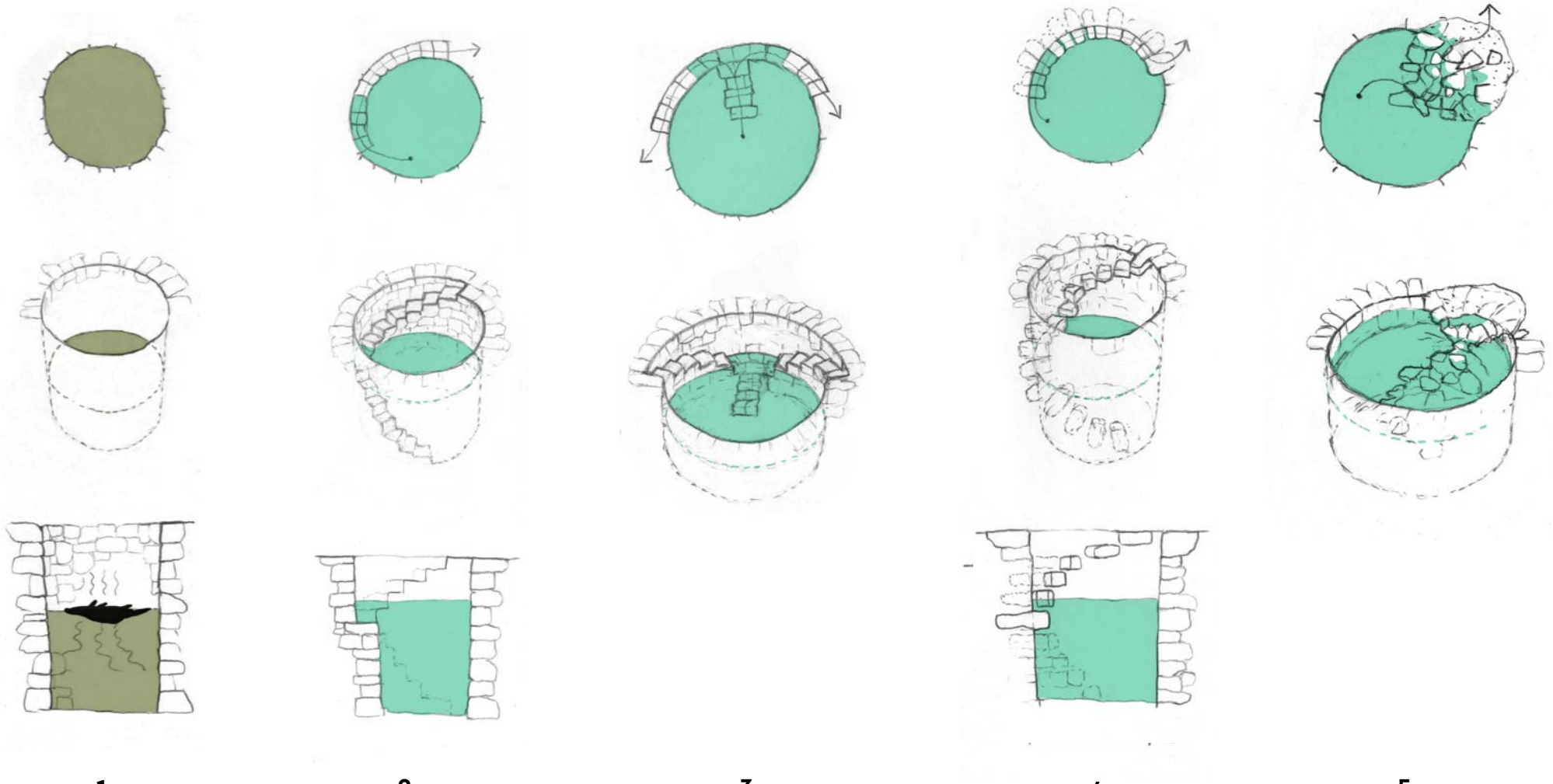
Steps – stairs have a dual function:

1. To enable safe access to the water surface whose level changes throughout the year.
2. To prevent drowning, i.e., to enable safe exit in case of falls into the water. If, for instance, an animal drowns in the well and stays there for a longer period of time, its decomposition causes prolonged water pollution.

A caved-in part of the wall can be used instead of stairs.
A ramp in combination with one or two steps can be used for gentler slopes. In any case, planning and construction should be performed so that drowning is prevented.



well covering with a stone vault
1) vaulted well 2) corbel-vaulted well
In both cases, the water surface is accessed by a stone staircase, while animal access is restricted by a wooden gate.

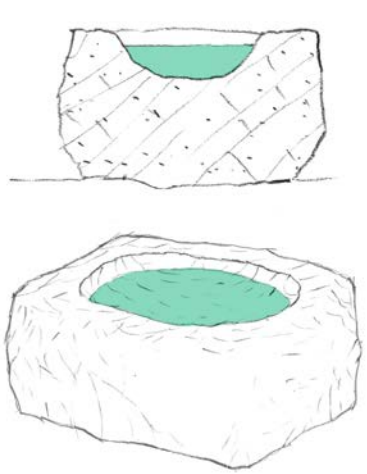


1 2 3 4 5

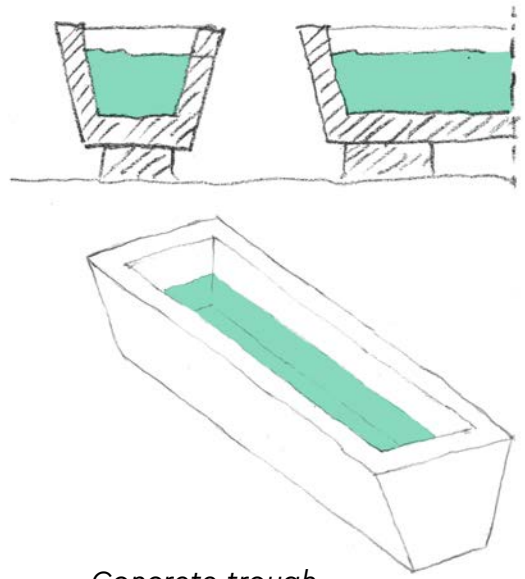
Steps for water surface access *– 1) an open well with no access point – a drowning hazard, 2) and 3) steps built on top of a protruding wall plane, 4) cantilever stairs, 5) an improvised approach: in this case, collapsed material on site is used as a functioning access to the water surface*

SOLUTION PANS – WATERING HOLES

Solution pans – watering holes are an important accompanying feature of wells used as a source of drinking water for livestock. Water is retrieved from the well and poured into an adjacent solution pan to make it available to animals. Solution pans were often carved in stone, but for simplicity's sake, today they are constructed more pragmatically, using various materials at hand, plastic etc., which are not always the best choice. It is acceptable to construct a concrete trough next to a well.



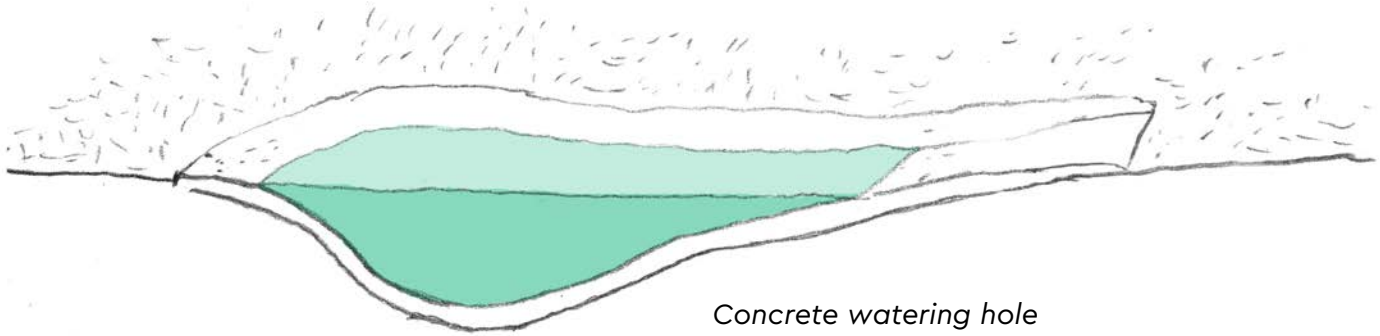
Solution pan carved in stone



Concrete trough

INTRODUCTION OF CONCRETE

- Concrete is a convenient material, but it must be used rationally and with restraint.
- As previously mentioned, concrete slabs are occasionally used to close wells.
- Watering holes / troughs adjacent to wells can be made of concrete.
- Concrete watering holes / ponds directly accessible to animals have been constructed on the land in recent times, featuring a concrete access ramp doubling as a water accumulation slope.
- It is undesirable to coat the bottoms of already existing natural or traditional ponds with concrete, nor to use concrete as a binder in existing stone wells.



Concrete watering hole with animal access ramp

POND DEGRADATION PROCESSES

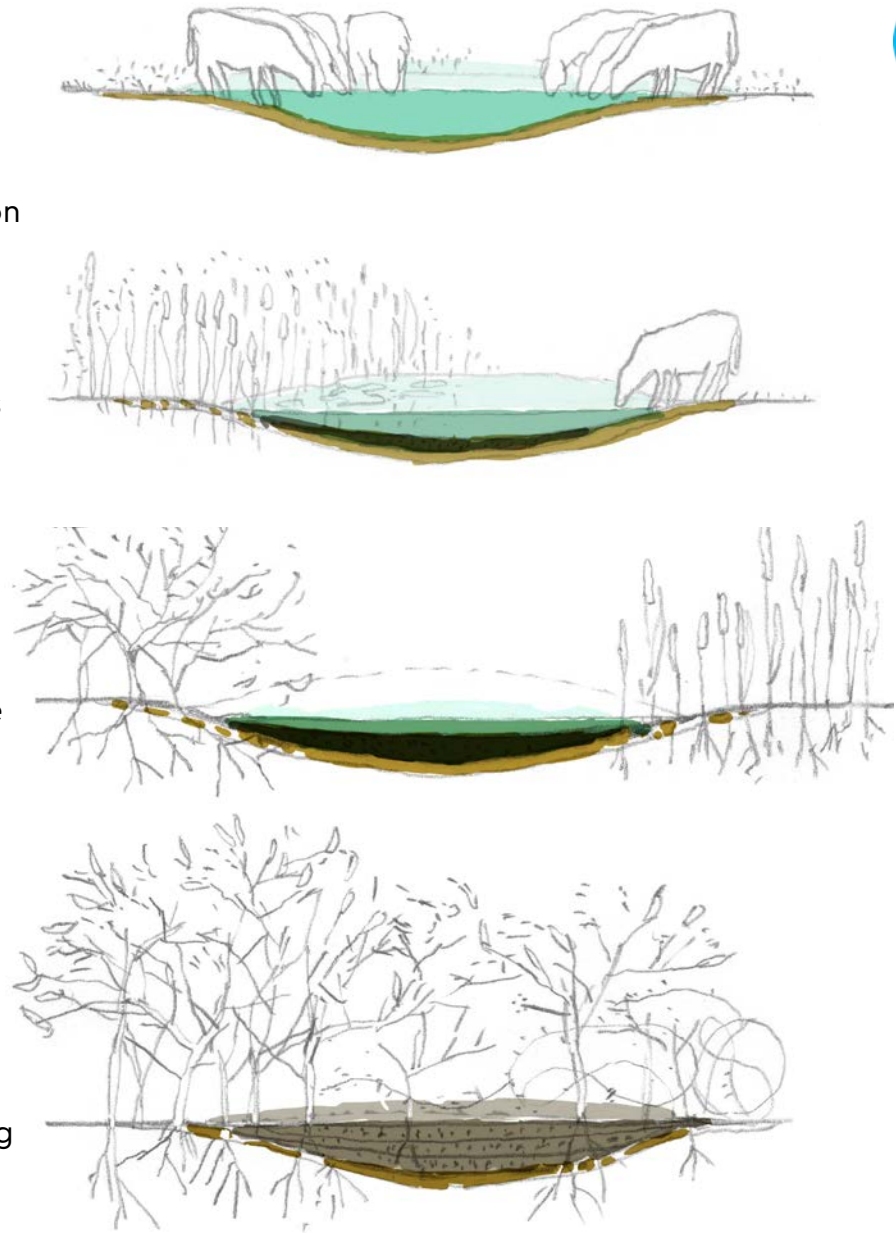
• When ponds are not maintained, natural processes become rampant, leading to eutrophication, succession, and overgrowth. Ponds begin to resemble swamps, ultimately becoming completely overgrown and drying out.

• The deposition of organic material of plant and animal origin causes eutrophication and raises bottom level, thereby reducing the pond's water holding capacity.

• The presence of fish in the pond also accelerates the pond degradation process due to the large amount of biomass produced by fish, and their domination over other species present in the pond. Humans used to release fish in ponds for various reasons – from efforts to counter the development of mosquito larvae as the transmitters of malaria, through fishing, and the occasional release of ornamental goldfish. In any case, fish are undesirable in ponds as small ecosystems.

• Gradual erosion of surrounding land into the pond due to torrential run-off increases the amount of sediment and decreases pond capacity.

• With time, the waterproof layer degrades. In the absence of livestock which once compressed it, preventing it from becoming overgrown, its edge is gradually destroyed by undergrowth, reeds, and tree roots. The waterproof layer can also erode and be washed down to the lowest point of the bottom.



WELL DEGRADATION PROCESSES

• A well bottom is less likely to become overgrown due to its depth, but faces a higher risk of collapse – becoming buried under stones and soil due to the exertion of lateral forces, often stemming from the roots of nearby woody vegetation.

• If the well has not been covered, organic material falls in and accumulates, leading to eutrophication.

PREPARING FOR RESTORATION

BASIC RESTORATION CRITERIA

Pond and well revitalization is becoming more and more frequent, but several fundamental questions must be raised before their restoration begins:

• **Identifying target functions and features** – why undertake a restoration, what are the priorities, significance and possible functions of the object?

• **Microlocation analysis** – why here specifically? What was the original builders' intent, and what were the object's original functions? (More on specific information gathering methods, both archival and on-site, in the following paragraphs)

example 1: having checked the map and having talked to local residents, we have discovered that the pond in this particular spot was primarily constructed for drinking water harvesting. However, a water supply network is available today, but a special species of dragonfly lives in this pond which gives us a reason to take care of it.

• **Long-term maintenance and use plan** – are there any actual beneficiaries who will profit from the restoration, and who will carry out maintenance on the pond after the restoration?

example 1: if the pond / well is located in an area of, for instance, extensive sheep farming, the restoration will have a long-term positive effect, and there will be beneficiaries to maintain the object.

• **Access ways** – has access to the location been provided for restoration and subsequent use?

• **Water surface access** – is access to water already possible?

• **Proximity of other similar objects or waters** (flowing and still water, springs, the sea...) – is there any point in restoring a pond close to an already functional water source?

• **Potential threats** (traffic, landfill, construction works, waste water...) – is there any point in restoring a pond threatened by negative factors from its surroundings?

example 1: if the pond is near a major road, its restoration will increase the frequency of animal deaths because automobile traffic will jeopardize frogs and larger animals which come to the pond at night to drink.

example 2: if the pond / well is near a landfill or waste water outlet, there is no point in restoring it (at least not until the harmful factors are removed) because the development of life in it will be threatened, and the water will not be safe to drink.

• **Has basic consent been acquired, or are there obstacles** to construction / restoration when it comes to ownership relations or competent authority permits?

example 1: if the pond / well is located on privately owned land, and the owner is unavailable or did not agree to the restoration, there is no point in planning for it.

DOCUMENTATION ANALYSIS AND OBTAINING PERMITS

Before any construction work is done, documentation and information available online must be checked, and the necessary permits obtained. It may take a while to obtain the permits, so sufficient time must be allocated to this stage of the preparation.

• **Flora and fauna, habitat, protection:** bioportal.hr, arkod.hr verification of protection status and target protected species. Ponds are legally protected based on biological factors. It is important to register so-called target species residing on the pond area and, accordingly, to hire biology experts for research and oversight.

• The Ministry of Economy and Sustainable Development of the Republic of Croatia (the Nature Protection Administration) must be contacted in order to obtain a permit for construction works on ponds and wells. If the pond or well is located in a protected natural area, the permit must be obtained from the public institution in charge of its management (a national or nature park public institution, or an equivalent county level institution).

• **The previous existence** of a pond or well on a given location is ascertained via field research and cartographic material analysis. In addition to local informants in the field, the best sources are topographic maps - TK 25, HOK (Croatian basic map) which record a large number of ponds and wells.

• **Ownership** katastar ownership verification. Ponds and wells were often located on common land, are often not even charted in the land register, but are located on a larger plot owned by Hrvatske šume ("Croatian Forests"). Permission from the owner of the pond / well must be obtained, whether the object is privately owned or within state jurisdiction (e.g. by Hrvatske šume or Hrvatske vode ("Croatian Waters")).

• **Cultural heritage protection** registar.kulturnadobra.hr The competent conservation department must be contacted if the pond / well is entered in the protected cultural property register or located within a protected cultural landscape.

INITIAL ON-SITE VISIT

• determine the level of neglect of the pond / well

• register the presence of invasive plant and animal species in and around the pond / well

• try to obtain additional information on the history of the pond / well from locals – how it was used, when it dries out, are there any users at the moment etc.

RESTORATION MODALITIES

• Funding can be acquired via various national and county-level tenders, the preparations for which also need to be initiated in advance.

• **More demanding restoration** may include: machine works, excavation, working at a height in the case of taller encircling walls and deeper wells, total bottom reconstructions, complex biological surveillance. Hiring competent contractors for individual works is recommended.

• **Less demanding restoration** may include: waste removal, mowing, reconstruction of less demanding encircling walls and rings. This kind of restoration can be carried out trough organized volunteer activities.

RESTORATION – WORKS

HABITAT RESTORATION, BIOCONSERVATION

Important: the restoration of bodies of water and their surroundings as entire habitats is often the main goal, particularly in the case of protected and Natura 2000 areas. As stated earlier, preparing for restoration must include an analysis of protected species as one of its first steps, which then determines the subsequent course of the restoration. All hydrological and construction works, as well as cleaning and maintenance, **must be performed in accordance with the prescribed conservation measures**.

• Each pond or well has its own particular features and differences from others, and that is how the works must be approached, namely, each object should be analyzed separately.

• Experts (individuals, organizations, sole traders...) in the fields of biology, ecology, and bioconservation must be hired to draw up appraisal reports, conduct monitoring and prescribe conservation measures. Habitat preservation and restoration is a long, often experimental process requiring continuous engagement, unlike works on restoring waterproof layers and encircling walls which can be carried out as a single act and in a relatively short period of time.

A couple of general guidelines which must be adapted to each case:

• **Cleaning** – The first stage always includes removing refuse, waste and pollution of any kind from the pond or well.

• **Invasive and non-invasive plants** growing over the pond or well must be removed by mowing. Supplying drinking water to livestock on these objects meant that the environment was always kept tidy by grazing and compressing the ground. This is not always the case today, and a mowing plan must be made if there is not enough livestock.

• **Woody plant species** which regenerate from roots (such as blackthorn, *Prunus spinosa*) must be removed by plucking out as much of their roots as possible, because the penetration of roots through the bottom of the pond or wall of the well is one of the main causes of structural degradation.

• **Tree crowns** above ponds cause organic material (dry branches, leaves) to be deposited on the bottom, but a partial **shading** of the pond is desirable nonetheless. Where possible, if the roots of a plant do not pose a structural threat to the object, its crown should be left to provide shade.

• **Aquatic plants** – need not be fully removed.

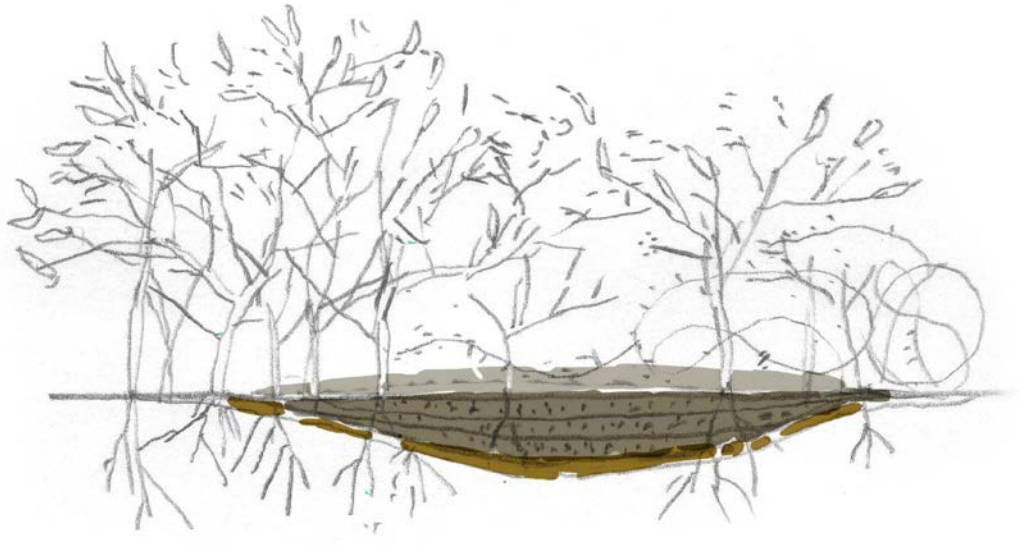
• **Fish** – of any species, if present, must be relocated to other bodies of water such as small lakes or fish ponds because their presence in ponds / wells causes excessive organic sediment accumulation.

• **Removing sediment** excessively accumulated due to erosion from the surrounding area.

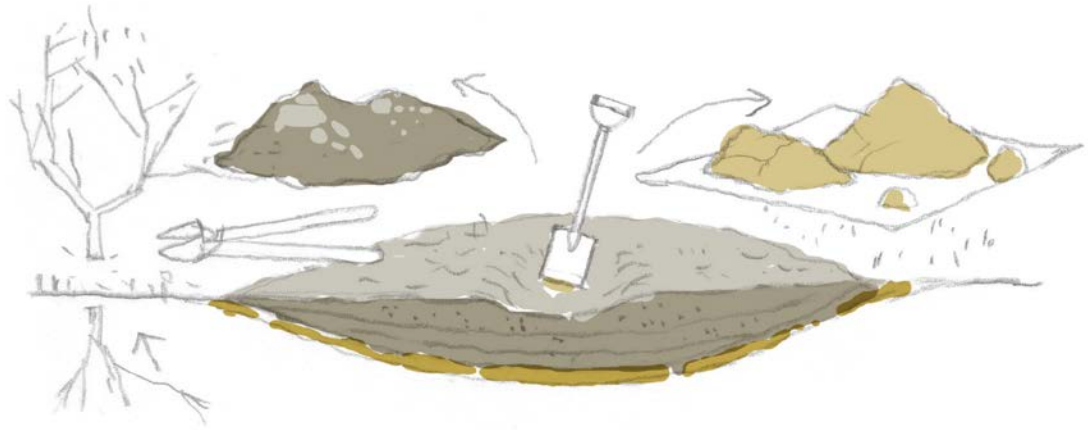
IMPERMEABLE POND BOTTOM RESTORATION

Important: A complete pond bottom restoration is a delicate process which requires hiring contractors / craftspeople with bottom restoration experience.

• Ponds undergoing succession are overgrown and buried under shallower or deeper sediment. There is always a certain amount of sediment, but so-called 'desludging' is performed when a certain threshold is crossed where water capacity becomes reduced, negatively affecting the ecosystem.
• Sediment created by organic material deposition – anaerobic humus – is dark, nearly black.
• Sediment may come in other colours as well when it originates from the surrounding soil which intrudes into the pond due to erosion in times of heavy rain, and buries it, which often happens at ponds located on sloped terrain.
• Restoration is performed at the end of summer when ponds are drying out or when water levels are at their lowest, and the life cycles of animal species which breed in the ponds have been completed (usually in September, but possible earlier if the pond has dried out ahead of time). Ponds which have permanently dried out can be restored at any time.
• Removal of the dark layer of sediment must be performed carefully to avoid damage to the clay layer. This is often inevitable, which is why the clay layer is separated from sludge after excavation and preserved for reuse, with the addition of more clay from other sources if needed.
• Soil and sediment removed from ponds must be disposed of at a safe distance to ensure it is not quickly washed down into the pond again by rainfall.

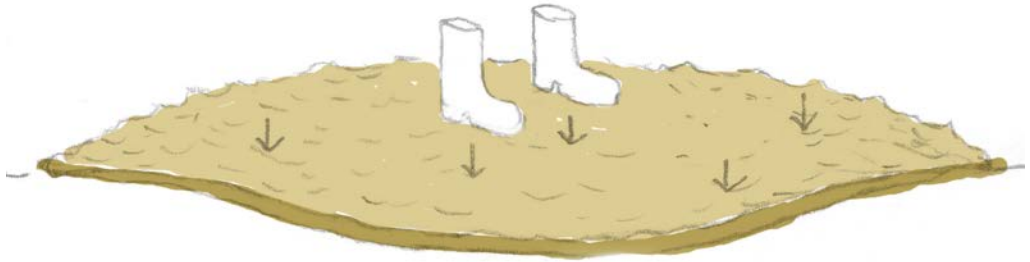


A pond undergoing succession – overgrown and buried under sediment

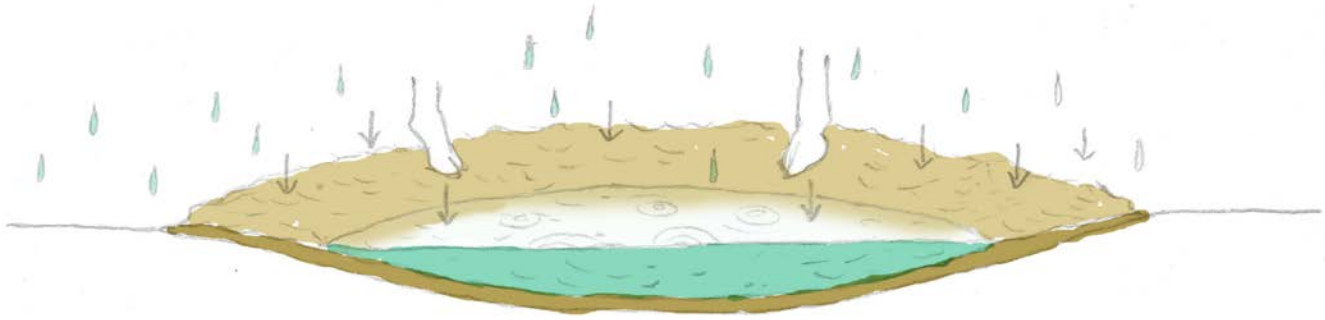


Cleaning the surroundings and extracting superfluous sediment, separating sediment from clay

• The waterproof clayey layer is lighter and yellow-green or grey in colour, depending on the composition of the bedrock soil.
• When applying a new layer of clay, it must be well-distributed, the lumps of clay formed into a continuous plane and compressed tight.
• Compression is performed by stamping the ground in boots, and will later be carried out by animals accessing the watering hole and walking on the clay bottom, occasionally rolling on it as well.
• The slope of the pond bottom must be gentle, otherwise clay will tend to erode downhill towards the center, thereby reducing the pond capacity.
• When the clay layer is evenly distributed – once water has already entered the pond – it helps to intentionally mix it with water and let it settle evenly. The "clouding" process is encouraged by stomping around in the pond in boots until it becomes very clouded, when the particles must be left to slowly precipitate.



Compression – stamping in boots as the first stage



Compression – the bottom is later additionally stamped and compressed by animals accessing the pond

RESTORATION OF DRY STONE POND RINGS

Decisions on restoring dry stone walls or retaining walls must be based on the function prioritized.

example 1: a fairly tall dry stone retaining wall has collapsed, which has reduced water capacity and made access unsafe, and there is a danger of further collapse. In this case the encircling wall must be restored.

example 2: a lower dry stone ring encircling the pond was once used to restrict livestock access to the pond, but no cattle is being farmed in this area today. In this case dry stone restoration need not be prioritized.

Walls encircling ponds are restored according to standard dry stone technique rules.

- The collapsed part must be additionally broken down to reach the structurally sane part of the wall.
- Care must be given to the wall plane during reconstruction.
- The top panel of each embedded stone must be flat or gently sloping towards the inside of the wall.
- With taller retaining walls, stones roughly shaped with a hammer should be used to make the binding more precise.

FUNCTIONS OF DRY STONE POND RINGS

Ponds often (but not necessarily) feature a dry stone ring, sometimes several. The steeper the slope of the surrounding terrain, and the more recessed the pond, the greater the threat of erosion, and thereby the need for retaining walls and cascades. If the pond is located on gently sloping terrain, there is no need for protection from erosion nor wall construction.

- Dry stone rings are often constructed as **retaining walls**, with one plane facing downhill towards the pond, and another dug into the ground. The retaining wall bridges the height difference between the pond and its surroundings.

- The role of the retaining wall is, as usual, to contain the erosion of surrounding soil into the pond.

- The retaining wall also cleanses torrents streaming into the pond from debris, sludge, and impurities, much like a stone "sieve".

- Sometimes dry stone rings are constructed as **barriers** – relatively low walls with two planes which can be used to control and restrict animal access to the pond, especially when walls are combined with wicker, branches and bramble distributed on their tops.

RESTORATION OF DRY STONE WELL WALLS

Wells are deeper pits requiring a structural wall to prevent them from caving in on themselves.

• The retaining wall, i.e. the well wall, is typically vertical and in line with the wall of the pit.

• The wall is laid out as a circle. Circular layouts, forming vertical cylinder, are more structurally stable and more resistant to lateral forces and erosion than layouts featuring flat planes.

• Stones have usually been roughly shaped with a hammer to make them more regular, to ensure higher quality bonds and wall stability.

• Construction using more regular, roughly shaped stones aids water collection as well – in the case of waterproof wells, the background layer and grouts are easier to fill with clay, and in the case of permeable wells, less impurities and sediment will be released into the well because the grouts are narrower.

• The foundations are constructed on bedrock or a hard surface.

• The crown, the top row of stone on the well must be solid to ensure that walking on the edge during use (while extracting water) does not lead to collapse. Larger, plate-shaped, regular and more stable stones are used for the top row of the well.

• With open wells which surface water streams into, if the top ring is above ground, it needs to be permeable, set on a layer of gravel, or it must feature openings through which water can flow.

SAFETY CHALLENGES POSED BY WELL RESTORATION WORKS

• Wells are vertical holes, often several meters deep.

• Working inside wells comes with the risk of caving in, falls from a height, and inhalation of harmful gases, meaning that these construction works must be carried out cautiously, applying the necessary protection measures.

• Suitable equipment must be provided (climbing, speleological, height protection – helmets, rope, gloves).

• Experts experienced in working at a height, speleological activities etc. must be hired.

• It is sometimes necessary to use temporary building scaffolds.

CONCLUSION – SUMMARY

Ponds and wells are common karst landscape features in our coastal and mountainous areas, with scarce surface water. They were extraordinarily important for local communities which needed water supply for both people and livestock. Although water supply is no longer an issue today, and livestock numbers are decreasing, ponds and wells remain highly important for karst areas and communities living there. These guidelines, created as part of the "Still Water Revival" project, therefore educate users on the most common forms of ponds and wells in our area, their principal functions and processes, and the basic steps of traditional restoration.

Pond and well restoration is a complex, long process consisting of several stages:

- **Preparing for restoration** (investigating the current state, gathering documentation and funding, creating appraisal reports if necessary, hiring experts, obtaining permits, creating usage plans)
- **Structural works** (cleaning, waterproof layer restoration, retaining wall restoration...)
- **Usage, maintenance, surveillance** (anything to do with long-term use and maintenance of the object after restoration)

"Still Water Revival – Restoring and conserving still water ecosystems of Mediterranean karst mountains" is a project co-funded by Donors' Initiative For Mediterranean Freshwater Ecosystems (DIMFE).
The project partners include the BIOM Association, the 4 Grada Dragodid Association, the Biokovo Nature Park Public Institution, the Sjeverni Velebit National Park Public Institution, the Učka Nature Park Public Institution and Hrvatske šume (Croatian forests). The project duration is three years – from April 2022 to the end of March 2025.

The Still Water Revival project tackles the challenges of restoring small freshwater ecosystems and brings solutions through a strategic approach, an assessment of the current state of these ecosystems, the development of a methodology for determining priorities, and finally through restoration of ponds and wells determined to be of the highest priority .
National parks and nature parks, as well as Croatian forests as different land management systems, provide perspectives on different land management practices and rules that must be obeyed in protected areas, all in collaboration with the local community. The Dragodid Association ensures that all aspects of cultural heritage preservation are taken into account during the restoration of dry stone walls and provides expertise in the collection of spatial data. The Biom Association provides ecological and biological expertise, as well as expertise in wildlife and habitat management and management plans. The *Caretaker* program developed within the project encourages active involvement of local stakeholders in the care of water bodies in their area to ensure long-term sustainability of the restored water bodies.

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