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A drought & flood resilience strategy for Berat

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Introduction

The Berat Island study centers around on a group of temporal islands (i.e. sand bars; sediment deposits) in the Osum River which are left bare during summer, when the river's base flow is limited. During the driest periods, only a small stream is flowing through Berat section, leaving most of the riverbed exposed. Apart from a bottleneck located on the west of the city, the river sections around Berat are relatively wide. This leaves the city with an unused wasteland, covered by temporal vegetation. Due to the flood hazard during winter, these river islands are left relatively untouched. Yet, the opportunity the islands provide for the city, might be seized given that there are either limited, or no interferences at all in the existing river sections.

The proposed approach attempts to seize that opportunity by introducing a development strategy for the islands that is both drought and flood resilient, but most importantly connects the dry riverbed with the city. The approach might not only be feasible for Berat, but might also provide a generic strategy for many of the other cities in Albania facing similar problems.

Resiliency / From fashion to guiding principle to cope with an uncertain future

'Resiliency' has replaced 'sustainability' as the next buzzword for many projects. Yet, the concept of resiliency has a solid body of scientific work in ecology and engineering (e.g. Holling, 1973; Hollnagel et al, 2007). The basic notion of resiliency is how a system copes and recovers, when it is experiencing conditions beyond its initial design criteria. This makes it especially fit for conditions that are clouded by future uncertainties: instead of being optimized to operate within a predetermined range of conditions, the system is designed to cope with a relatively wide range of different conditions. This can be achieved by making the system robust (i.e. making it able to withstand extreme conditions), or by making the system flexible (i.e. ensuring that it can be adapted in the future to cope with changing conditions).

Main challenges / Developing a robust river for all seasons

The seasonal variability in discharge of the Osum river is large: during summer the river's base flow barely sustains a small stream while in spring the steep river basin can cause peak discharge levels that almost mimic those of flash floods. Thus, coping with such extremes requires a design that can accommodate periods of drought, as well as abundance of water while ensuring value and use to the city of Berat. These observations change the focus: the issue is not only how to make Berat's islands and river bank more resilient to high discharge levels and subsequent floods, but maybe even more importantly, how to maintain the river during summer and early autumn, when water levels barely sustain a stream and the riverbed is dominated by sandbanks covered with low quality vegetation and deposited litter.

The seasonal variability in river discharge

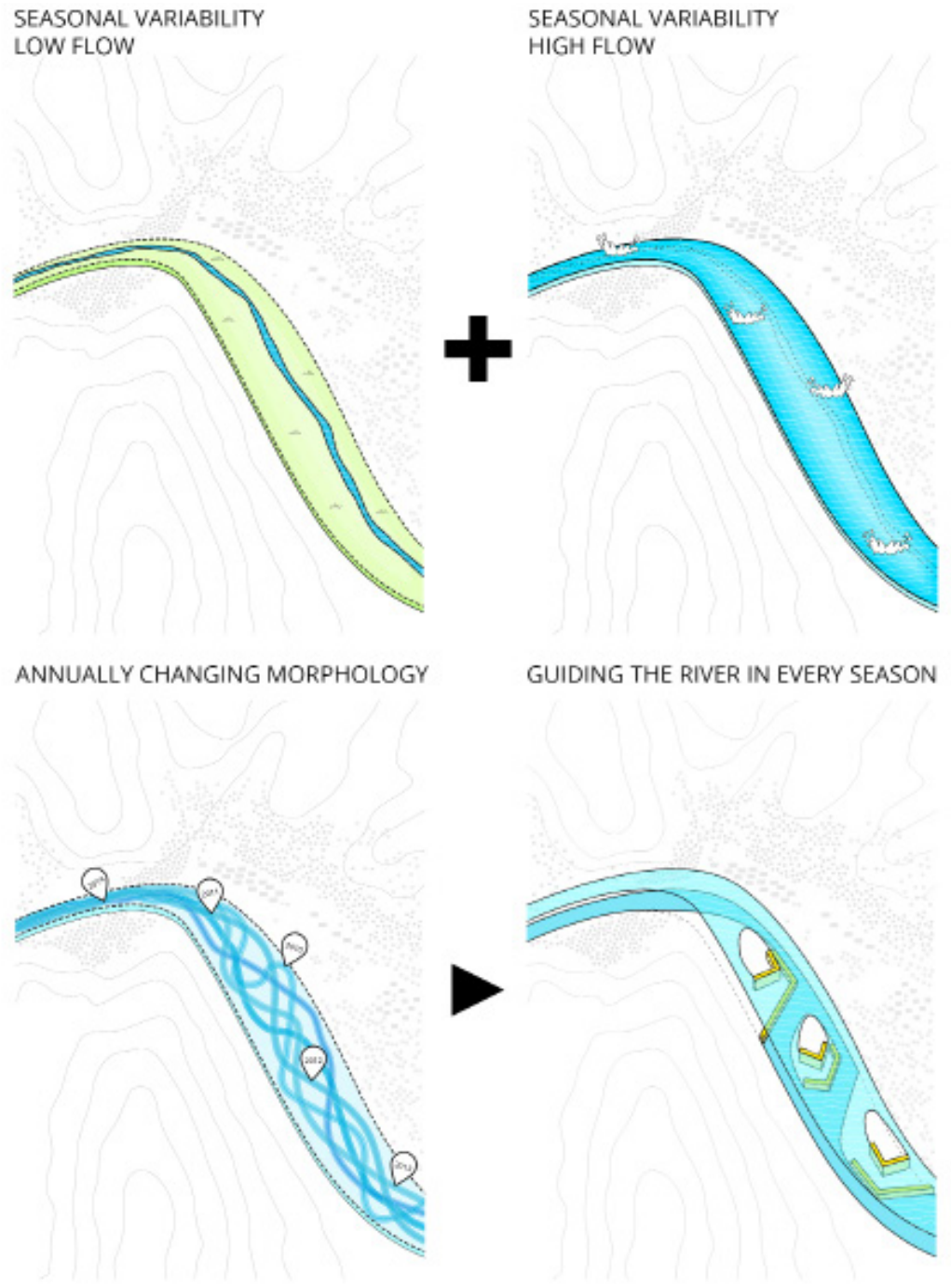


Fig 1 / Large variability of the river, better guidance of the river flows
source / Felixx Landscape Architects & Planners; Seasonal Isles

creates also another characteristic feature of the islands: the islands' morphology is continually changing. Compared to for instance many of the large river basins in the rest of Europe, the Osum river is relatively steep which causes high flow velocities. This results in high erosion levels and (partly due to the soil composition) a large sediment load during winter and spring. The erratic hydrodynamic behavior of the Osum River causes the sandbanks in the broad sections of the river to continually shift. While these dynamics might be regarded as a characteristic feature of the Berat river, they also limit, or even prevent actual use of the islands and hence their role as an active component of Berat city.

The hydrology of the Osum river defines to a large extent Berat's problematic position: Located on elevated and steep river banks the city is well prepared to cope with high water levels; flood hazard is limited to adjacent villages and towns located within the floodplains. Yet, during periods of low flow, the city is unable to profit from the river. The marginal stream-flow, the emerging sandbanks and the resulting amphibious river landscape only create an underused, low quality environment that does serve the characteristic of this UNESCO-protected city.

The outcome is therefore to develop Berat's river islands as resilient systems able to cope with the hydrologic conditions

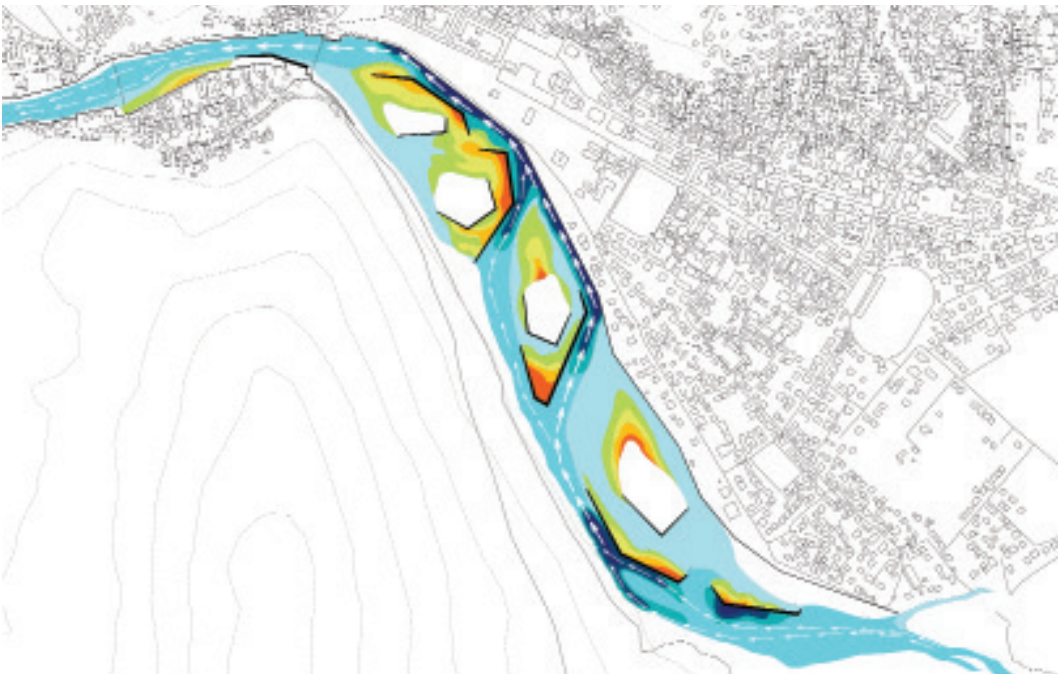


Fig2 / Position of structures in relation to streams of the water; sedimentation and excavation source / Felixx Landscape Architects & Planners; Seasonal Isles

associated to all seasons; to make the Berat islands both flood resilient and drought resilient; to be able to cope and recover from extremes, but most of all to develop an active use of the river (fig1).

Operational resilience / Building by nature, preparing for nature

Making interventions in the river bed does not necessarily imply the introduction of large scale structural measures; e.g. the introduction of quays, dams or other barriers that while ensuring a controlled steady flow during dry periods, create inflexible obstacles that limit the Osum River's discharge capacity during peaks in the wet seasons. Instead, it is possible to create a better 'guidance' of the river's hydrology by combining small interventions with the potential building capacity provided by the river's hydrodynamic: a controlled erosion and deposition of river sediment to create a relatively stable development of sandbanks and channels. Thus, by using the river flow and the resulting flood patterns due to the introduction of small obstacles (e.g. boulders, poles, etc.), we can shape the landscape, which during dry periods will constitute the sandbanks or 'islands'.

'Building with Nature'- Such an approach is not new: in various projects the hydrodynamic properties of water systems are used to change the morphology or flow patterns. For instance in the so-called Sand Engine project, beach and dune nourishment is achieved by using the tidal flows along the coast south of The Hague, Netherlands. The sand of a man-made peninsula, is distributed along the coast to maintain the beaches and dunes that protect the country against storm surges. In a similar fashion, boulders are used in many rivers surrounding Bergen, Norway to adjust the stream flows without the need for large, civil engineering-based structural interventions.

Currently, enough scientific knowledge in the field of fluvial geomorphology has been developed to create computer and/ or physical models that mimic the effects of small interventions (e.g. deflectors) in streams and rivers (e.g. Knighton, 1996). Depending on an initial classification (e.g. Rosgen, 1994) and the collection of adequate data describing the hydrological features of the river in combination with the river geology (including an analysis of the sediment), a precise model can be constructed to determine which places are likely for sediment deposition based on the location, shape and size of non-movable elements in the river bed. Likewise the resulting channel(s) that are sustained by higher flow velocities can be determined and located to where they provide the highest value to the city of Berat in terms of usability. Additionally, depending on the sediment size, small ridges can be constructed resulting in alternating riffles and pools of deeper water to ensure a minimal water level in the river section adjacent to Berat (fig2).

Especially in smaller streams, boulders (i.e. rocks), or tree trunks are often used to influence flow patterns and the stream morphology. For larger, more engineered

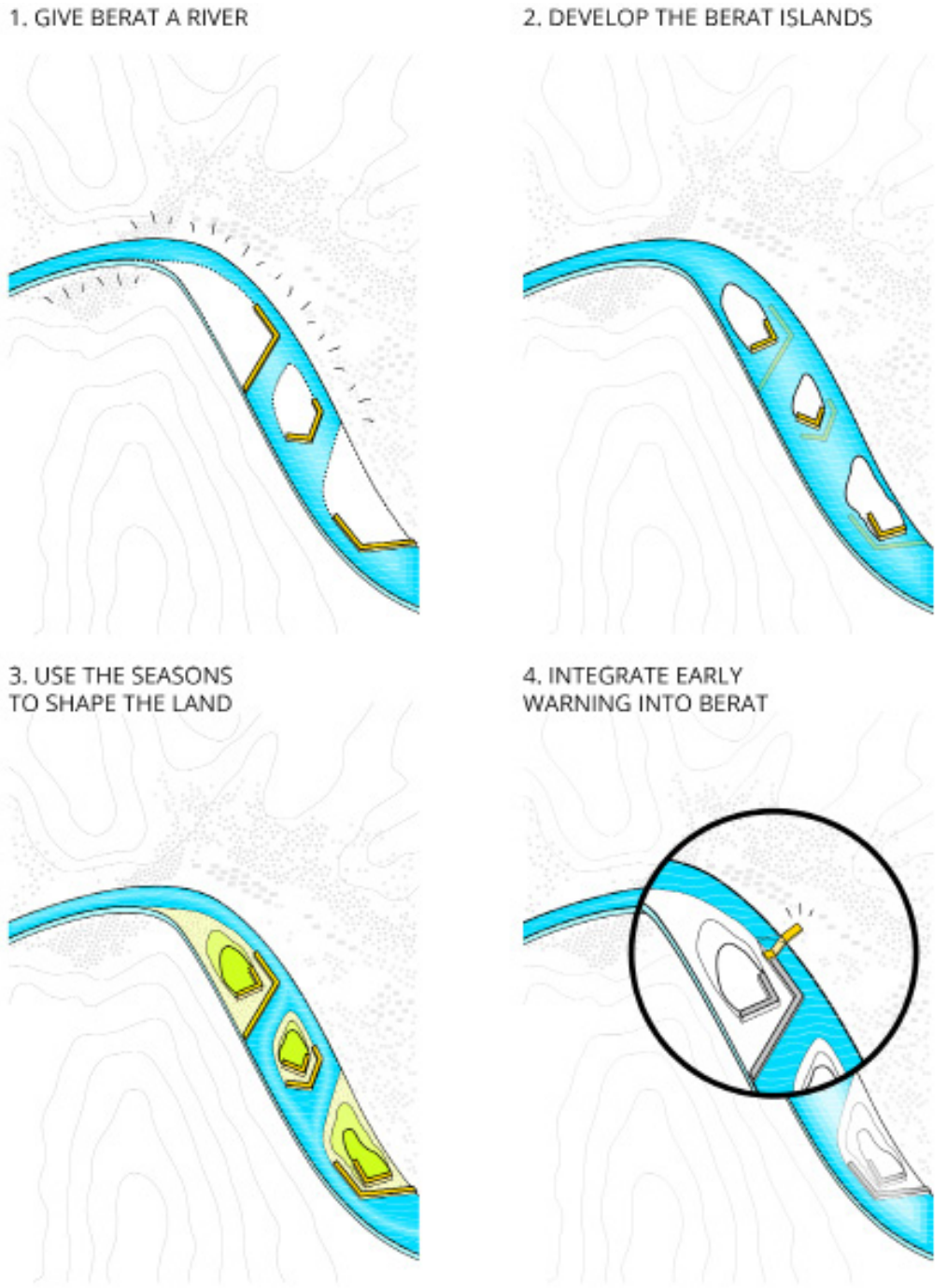


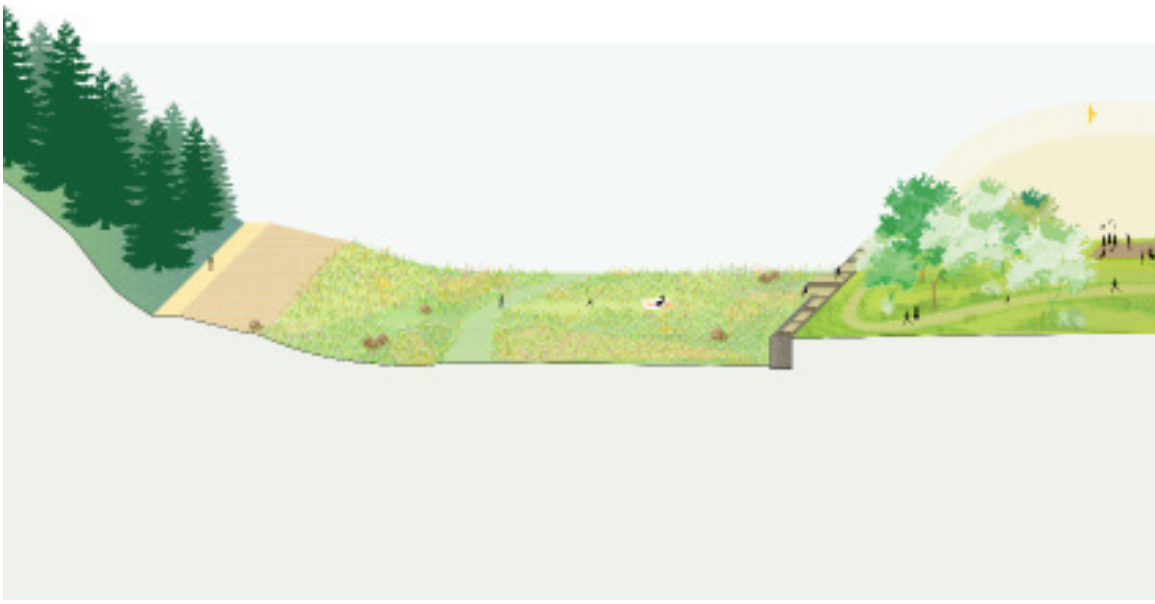
Fig3 / Controlled dynamics: design strategies
source / Felixx Landscape Architects & Planners; Seasonal Isles

solutions, the use of gabion baskets is often preferred. These are relatively cheap, flexible and have been extensively tested by reinforcing embankments in order to limit erosion as well as deflectors for the alteration of flow patterns.

Design strategies
Controlled dynamics

Manipulating the river flow patterns by a 'building with nature'-approach provides the tools to develop a design strategy that is not only resilient to both droughts and floods, but also enhances the usability of the islands by providing a more robust basis for use. The strategy consists of 4 main pillars (fig3):

1. Give Berat a river: ensure a minimal, steady stream-flow during dry periods along a steady trajectory (i.e. channel). The river is guided by a first system of low curbs.
2. Develop the Berat islands: by partially protecting the crests of the existing sandbanks, the contours of the islands are to a certain extent stabilized. The islands therefore become more robust and better equipped for vegetation and hosting activities. The river is guided by a second system of higher curbs.
3. Use the seasons to shape the land: by carefully adjusting to the different water levels associated to the seasonal variability in river discharge, a design can



be developed, in which the islands shrink and grow, reaching a minimal footprint during winter and early spring, when water levels are highest, and a maximal extent during summer, when only a steady stream-flow is reached.
4. Integrate early warning into Berat: extreme peak flows during winter and early spring could provide a possible flood hazard for Berat. Climate change will only exacerbate those extremes in the coming decades. It is therefore essential to not only develop an early warning system for floods, but also to manifest the warning in the city of Berat to ensure awareness among Berat's citizens and to restore the relation to the river by creating visible signposts. The bridge, used to make the islands accessible, could be opened when flash floods are coming. As such the opened bridge prevents the accessibility of the islands, and functions as a striking mark to warn the inhabitants of Berat for the high water.

These main focus points provide the basic framework from which the design is developed. Instead of focusing on objects or functions, the proposal is approached from the different seasons and the associated river characteristics.

Low water isles: summer & autumn
During the summer, Berat becomes alive. The city is vibrant and tourism flourishes, which means that the riverfront should add to the city's scenery.

By introducing a low curb into the riverbed, the modest base flow is directed into a single stream predominantly adjacent to the Northern quay. The curb is widened to create a walking path along the canal; a second quay that provides a new routing through and along the 'summer version' of the Osum River. The new quay is connected to the city by a new bridge. Apart from providing a pedestrian walkway along the river, the curb-quays act as the perimeter of the largest set of islands: the first terrace level that becomes available when the sandbanks dry out during summer. Although providing the largest area, these flower gardens exist only for a few months annually; on average from mid-July until late September.

That requires a vegetation that can flourish within only a few months, but can be sustained when (partially) submerged when the water level raises (see Winter and Spring). This flower plane is criss-crossed with mown trails. The 'tail' of the islands, which unlike the 'head' is not protected by a curb, is dynamic and moves depending on the seasonal deposition of sediments during winter and spring.

A second higher curb system, providing the perimeter for a second terrace layer, covers a set of smaller islands when stream-flows are somewhat more substantial. Due to this protecting curb, this terrace level emerges during a longer period, which means that the vegetation options are wider. Grasslands with bushes and trees create a park-like environment that adds to the public realm of Berat. It offers a place for residents to stay, and festivities to be organized.

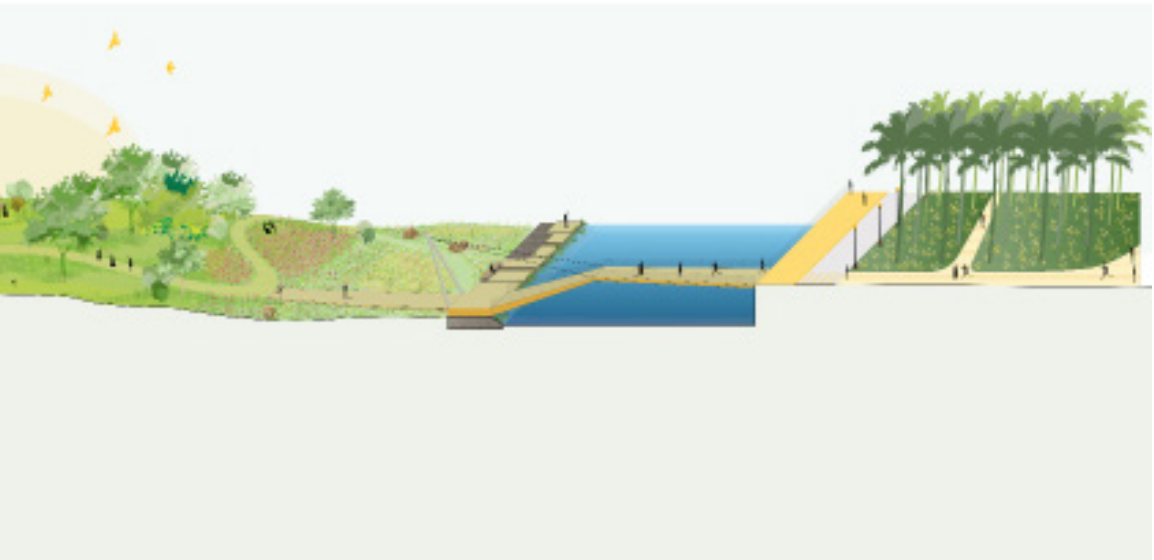


Fig4 / River section, low water level
source / Felixx Landscape Architects & Planners; Seasonal Isles

The curbs are covered with wooden boardwalks. The low and higher curbs are connected with these boardwalks through the first terrace level, preserving a smooth connection through the entire islands in every season (fig4).

Low to high water isles: winter & spring

During winter and spring the discharge levels of the Osum River increase. The lowest curb level (and terrace) is overflown at certain spots, which effectively means that the 'summer version' of the Osum River is widened. The summer gardens are now gradually submerged and transforming into seasonal wetlands. The flowering zones are overflown by small streams and ponds, the former mown reed paths transform into full-grown reed beds.

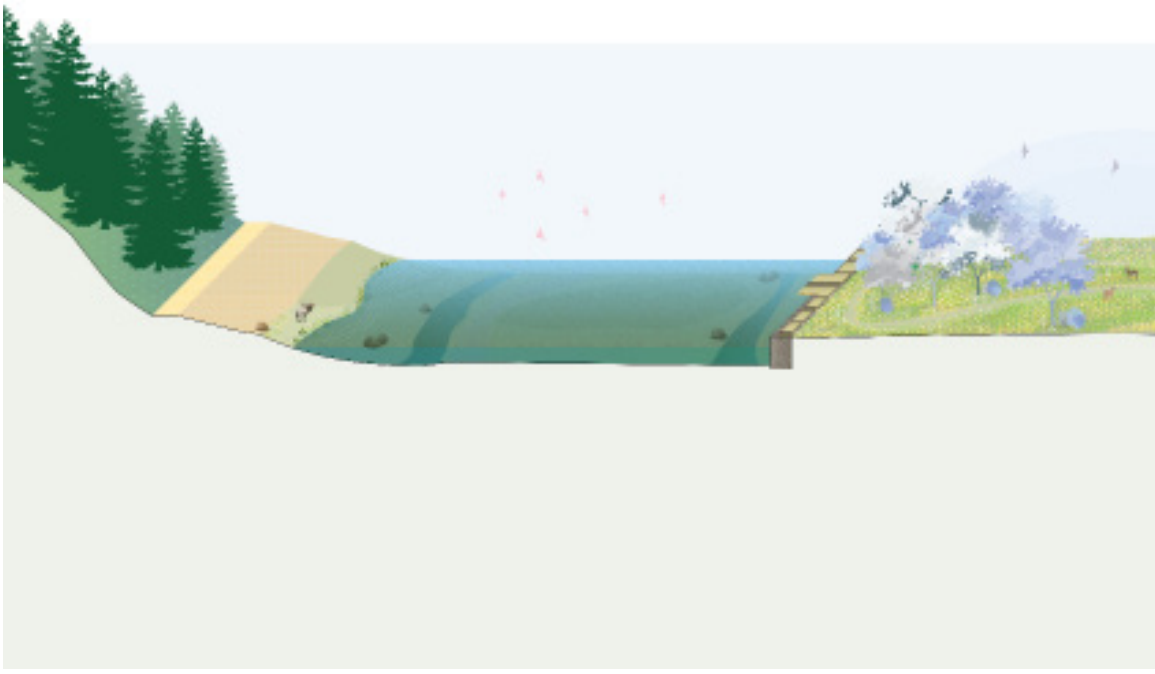
Small boulders (i.e. rocks) or tree trunks are used to steer the flow of the streams. The level of inundation depends on the flow rate of the river, and varies constantly through the season, creating an everyday changing landscape.

The higher islands stay protected from the stream, as they are covered by the higher curbs. The grasslands are managed less intensively during this timeframe, creating a safe haven for birds and animals. The first terrace levels stays accessible through the boardwalks, preserving as well the connection from the city to the islands (fig5).

High to peak water isles: designing for exceedance

During certain periods in winter and spring, the water level in the Osum River reaches the highest stages. While the first terrace level, including the curbs that mark the perimeters, are overflown by water, a small set of islands remains, the winter islands. This last set of plateaus is no longer accessible for pedestrians, providing a last resort for animals and birds within a now formidable river that almost covers the complete cross section. Peak discharge levels, occurring with return periods of 10 years or more will overflow all river islands, including the winter islands with relatively high elevations. To accommodate such discharge levels, it is essential that the interventions within the river bed do not create significant narrowing of the river section, which could increase the flood hazard for Berat. It is crucial that the level of the winter islands never transcends the height level of the quay of the city, to enable the submersion the islands, to accommodate the required discharge level within the river basin. During these particular floods, the first and second curb system secure the terrace levels, so they are not washed away.

It is essential that high and especially peak water levels (and the associated flood hazard) are communicated to Berat. After all, the level of the quays, the street levels and elevation of the built-up areas are historically based on observed peak river levels. These levels provided safety for the inhabitants and ensured sustainable occupation. To re-inspire the century old relation to the Osum River, the rivers stages should become part of the city again. This is done by using the pedestrian bridge, which in case of high



river discharge (i.e. flood hazard) is turned upwards. Depending on the lead time, and the flood warning system, the bridges can be turned upwards hours prior to the peak levels are reached. This symbolic act can become a signpost for inhabitants, visitors to increase awareness and flood preparedness. This might be especially prudent in the coming decades, when climate change induced rainfall (possibly combined with snow melt) might boost river levels to unprecedented heights (fig6).

Creating multiple values / Increasing usability, identity and livability in Berat

The main aim of the project is to activate the islands both as new places for the local community and as emerging entities, able to take a role in guiding the flow of the water and therefore in turning a potential crisis (the flooding) into a collection of diverse opportunities. Essentially, the intervention deals with the allowing of a next step of human actions towards the river: starting from the riverbed and the historical creation of a community and the foundation of the city, to the contemporary involvement in the transformation and maintenance of the city's identity.

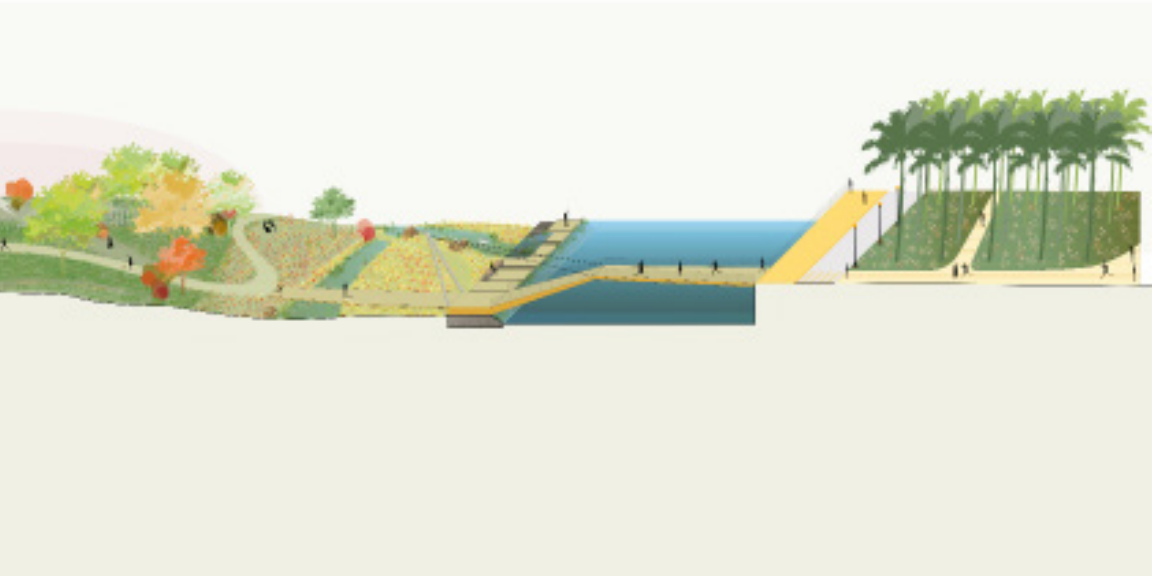


Fig5 / River section, high water level
source / Felixx Landscape Architects & Planners; Seasonal Isles

Fig6 / River section, peak water level
source / Felixx Landscape Architects & Planners; Seasonal Isles

Therefore the riverbed is regarded as the focus of the proposal. This position can be seen as an inversion of the common attitude. Rather than insisting on the river's borders, the center of the proposed actions is the riverbed, which is considered as the starting point to finally reach the urban environment. A trend is inversed: the city and the river, which are normally regarded as a dichotomy and therefore, as separated, opposites and antagonists, become coupled, aimed to give rise to a collaborative relationship between the natural and the artificial environment.

The history of many Albanian and Mediterranean cities is exactly the story of this coupling. As such, we would regard the project, as the attempt to establish a tandem, where the islands, the borders, the city and the local communities cooperate in the creation of multiple values and reciprocal benefits. The word tandem, which essentially refers to the ability of conducting and arranging things together, is activated through a series of landscape actions. Rather than focusing exclusively on the aesthetical side of the transformation, these actions attach flood risks through a landscape approach to new cultural possibilities. By reinforcing and making the islands a permanent part of the city environment, the flooding crisis

Fig7a / Illustrative plan drawing Berat, regional scale
source / Felixx Landscape Architects & Planners; Seasonal Isles

Fig7b / Illustrative plan drawing Berat, local scale
source / Felixx Landscape Architects & Planners; Seasonal Isles

can be treated integrally. The project involves new relations in terms of cultural usability. The three islands allow for compatible activities. The Northern island could have a recreational function and festivities, linked to the historical center. The Southern islands hosts functions, which are related to the ambient of the residential areas. The central islands might not be accessible, focusing on ecological enhancement (fig7a).

Increasing the uses on the islands involves a new possibility for the local community. Citizens (it might be for the first time) can watch the city from the riverbed, and through this get a better understanding of the values, arising from the relationships between the river and city, whereas each identity reinforces the other one. Along with activities like picnic, walking in the nature, sport etc., the fundamental activity of knowing the ecology of the places where someone lives, becomes more relevant. To specify the use and programming of the islands, the project seeks to generate several layers of citizen's involvement. This could result in a wide range of possibilities: from proposing the island as a kind of reservoir for the incrementing of local biodiversity, up to the organization of various activities and functions.

Additionally, Berat is an important heritage site, resulting in substantial inflow of visitors. The islands offer space to accommodate new leisure and sport activities, avoiding the undesirable transformation of the historical heritage of Berat to facilitate these functions. Moreover these functions could establish a meaningful interconnection between the historical and ecological values of Berat city. Avoiding a position towards only aiming at pure conservation, or on the opposite side the total transformability of important cultural heritage, the project creates a gentle negotiation between natural values, habits, needs and ecological crises, preferring more the way of compromise than that one of forcing. This attitude derives from the decision to handle the problem of water related stresses at the roots, suggesting an intervention, which is regarded as a new alliance between nature and human activities, as to allow the ground snatched from the waters of triggering a cycle of life where human activity is excluded. It is definitely an intervention, which works in terms of viability, as both the city and the river, through a renewed co-existence could create a new layer of Berat identity (fig7b).

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