

Flash flood risk in Mediterranean catchments

# FLASH FLOODS



LET'S PREPARE TOGETHER, BEFORE THE WATERS GATHER



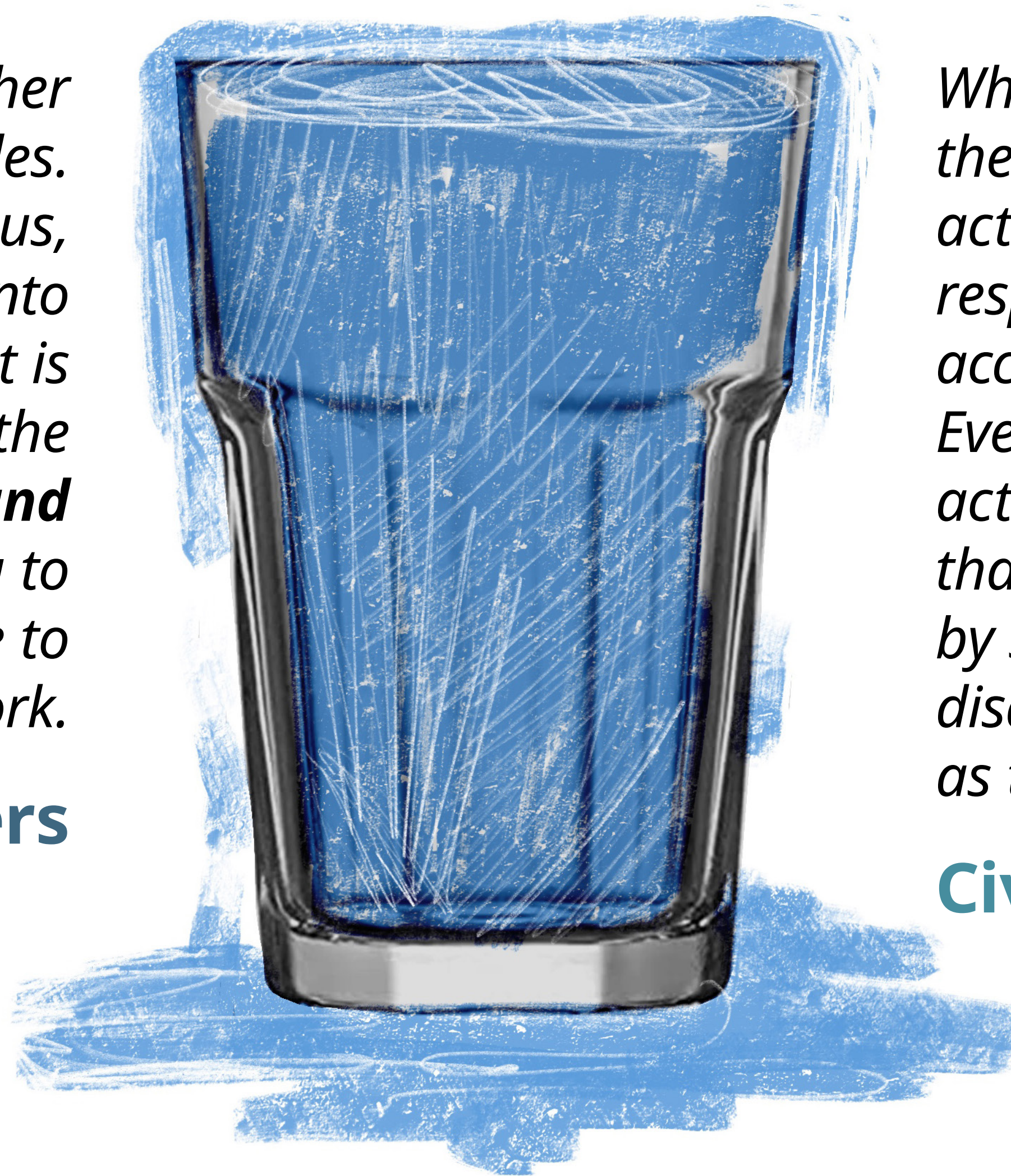
*At school, we learned that the weather doesn't always play by the rules. Sometimes a storm breaks right above us, and within minutes the streets turn into rivers. We've come to recognise that it is not only about how hard and intense the rain falls but **how well we understand the land beneath it**. By learning to read the landscape we have come to understand how ecosystems work.*

### Students and Teachers



*When an **early warning alert** is issued, there's no time for hesitation. We activate emergency protocols, mobilize response teams, close dangerous access points, and alert the public. Every minute counts. But behind every action lies experience: we've learned that knowing the territory, working side by side with people, and acting before disaster strikes are just as important as the emergency response itself.*

### Civil Protection and Police







## What are floods and how do they form?

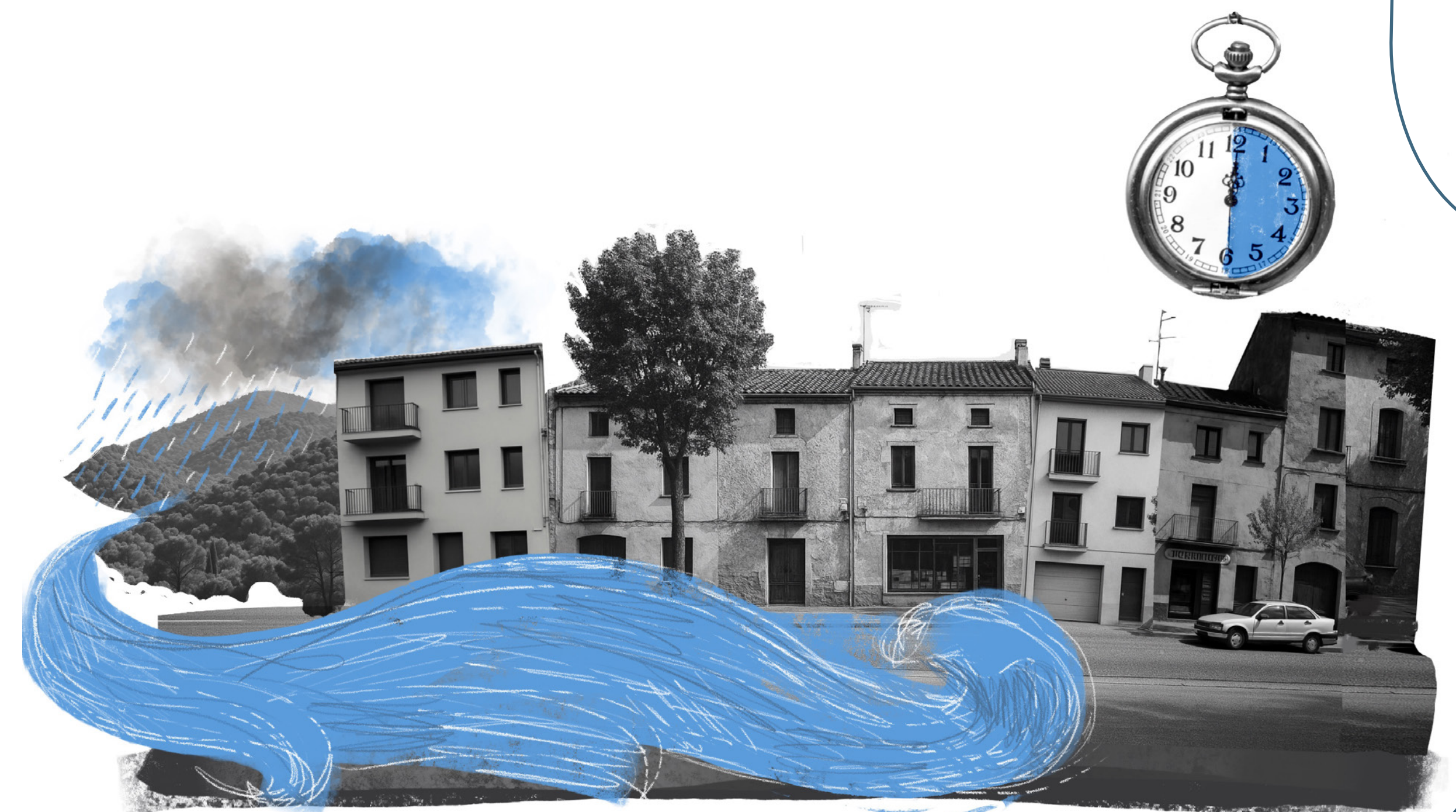
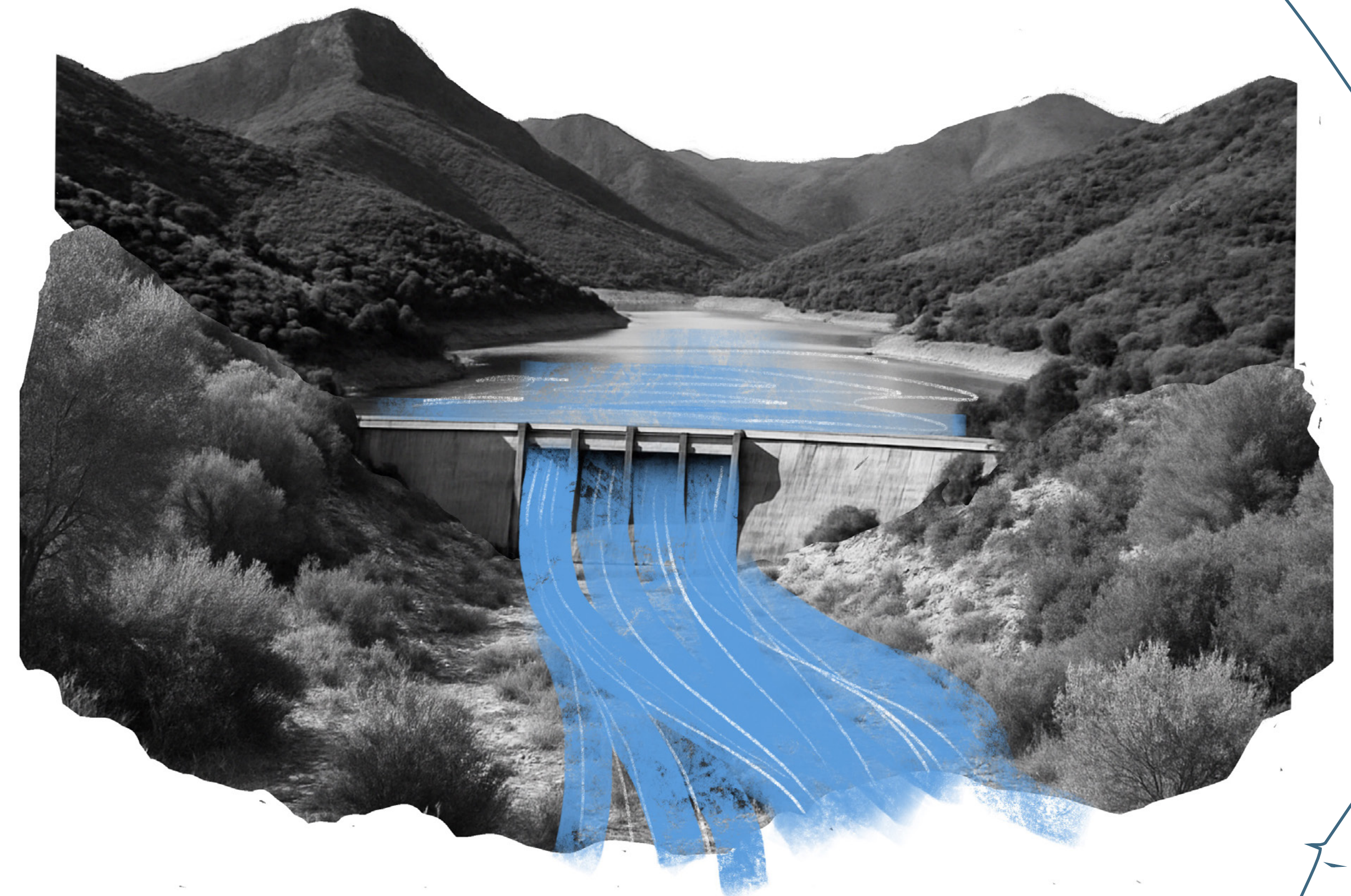
Floods are **natural phenomena** that occur in many parts of the world, sometimes bringing renewal by **enriching the soil with water and nutrients**.

They happen when water rushes into places that are usually dry - often because too much **arrives too quickly for the ground to absorb or drain away**. This leads to development of what is called **surface runoff**. With **climate change**, floods are striking more often, and with greater force.

Sometimes floods may result from **prolonged rainfall** which overwhelms natural or built drainage systems or **by failures in infrastructure**. When **heavy rain falls suddenly and intensely**, we experience **flash floods**. In the Mediterranean region, these tend to occur during winter and autumn.



Do you remember any flash flood events?

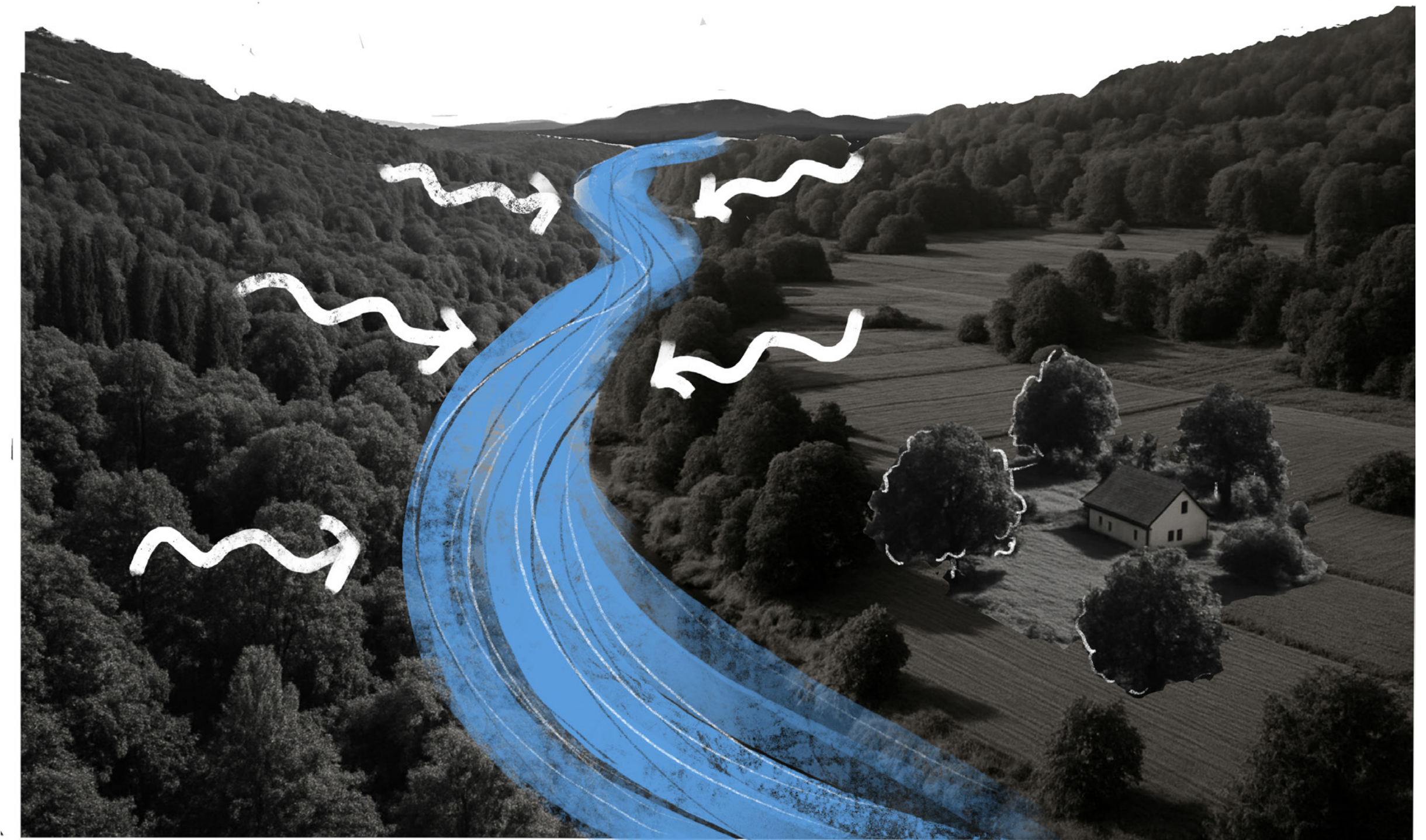






To understand floods, it's essential to understand the concept of a **water catchment** - the area of land where rainwater collects and drains toward a common outlet, usually the sea.

**The catchment's shape, size, slope and land cover all influence how water moves through the landscape.** In elevated catchments, water flows quickly and has little time to infiltrate the soil, which increases the risk of flooding downstream. Human activities, such as urban and industrial expansion in flood-prone zones, further increase flood risk, as they reduce the soil's ability to absorb water.



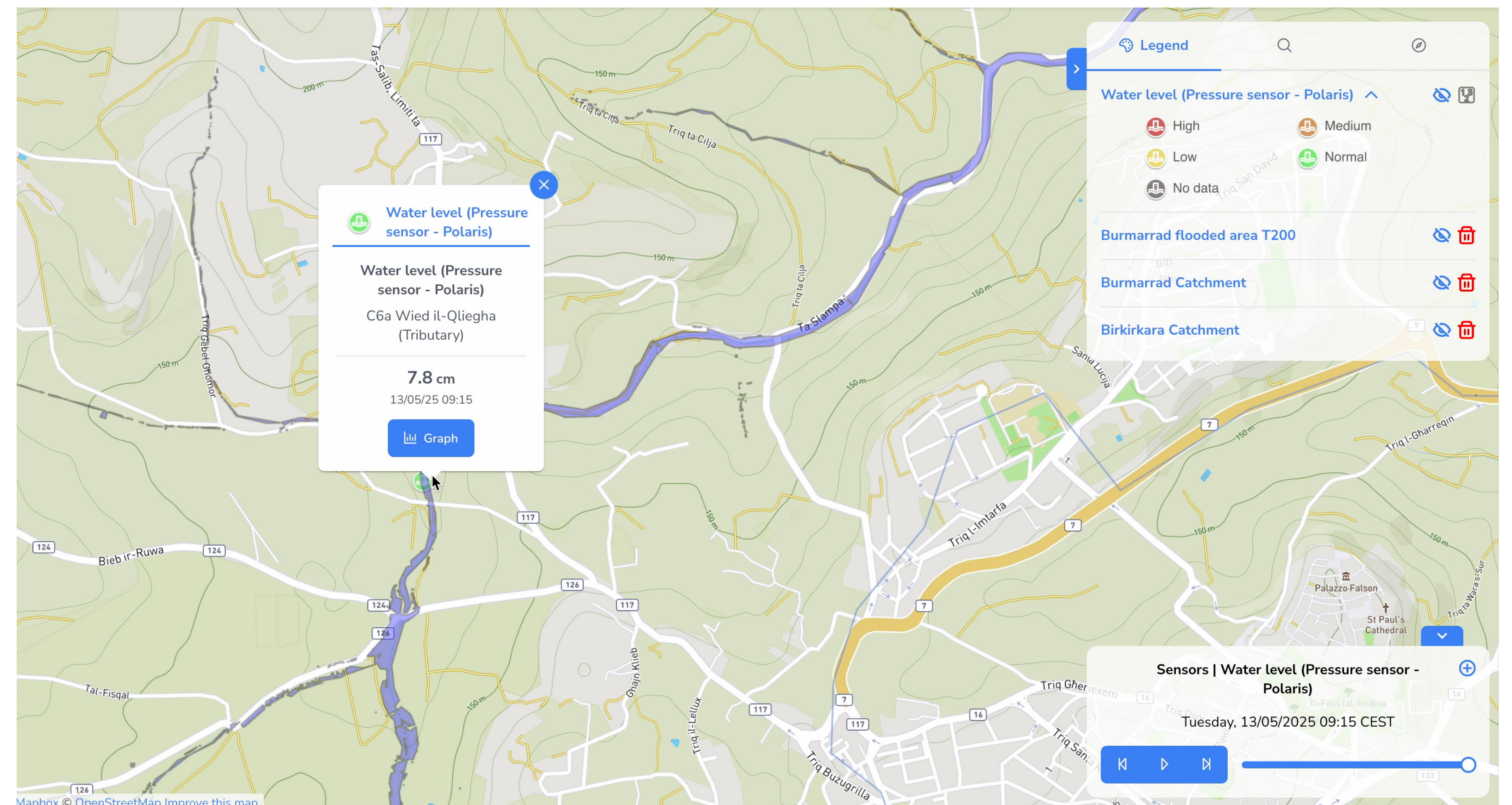




## What is an early warning system?

Flash floods are difficult to observe and predict because they develop rapidly and often in very localized areas. Traditional water-flow monitoring networks rarely provide sufficient advance warning to capture such events accurately. That is why new monitoring systems and models are needed **designed specifically for these fast-moving phenomena, to improve the accuracy, speed of alerts, and make flood risk management more efficient during emergencies.**

**Bringing flash flood prediction into local risk management is crucial.** The European Environment Agency highlights early warning systems (EWS) as one of the best tools reduce impacts and adapt to climate change – giving alerts when floods are about to strike. Such systems, however, are often unavailable for small catchments, since their size makes prediction less precise.



Water level sensor — data collected by the Argos platform (HYDS, S.L.), which forms part of an EWS.





## How does an EWS work?

It is a multifunctional, integrated tool that combines data from multiple sources — some collected in real time — to analyze and detect imminent risks. The type of data that can be collected by EWS, includes:

### Hydrometeorological information

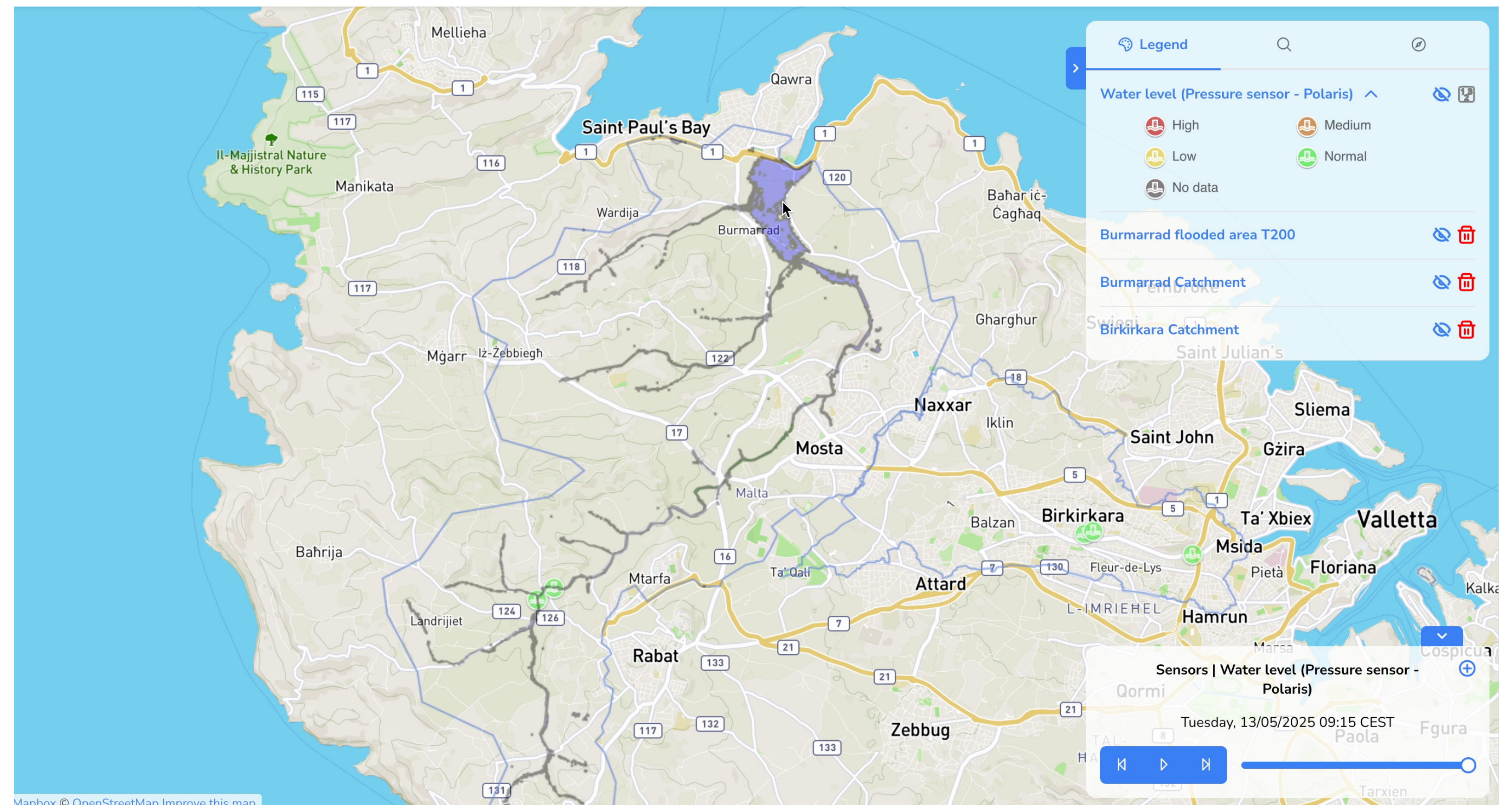
- 🌊 **Sensors:** rain gauges, flow velocity and level sensors, radar data, satellite data, etc.
- 🌊 **Models:** weather forecasts, hydrological and hydraulic models, etc.
- 🌊 **Official alerts:** warnings issued by competent authorities.

### Real-time data

- 🌊 **Traffic information:** cameras, road conditions, etc.
- 🌊 **Emergency calls:** direct reports from citizens and responders.
- 🌊 **Cross-referenced data:** integrated from multiple agencies and institutions.

### Additional data

- 🌊 Thematic maps on flood-prone areas, critical infrastructure, vulnerable points, and more.
- 🌊 Complementary data sources to support decision-making.



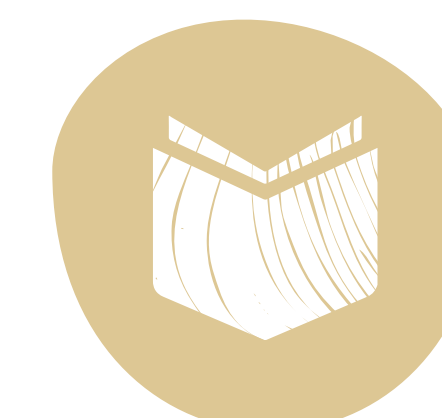
Rainfall water level sensors — data collected by the Argos platform (HYDS, S.L.), which forms part of an EWS.



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*When we unfold a risk map, we see more than colours and lines - we see how the land itself behaves. These tools help us identify where water might accumulate, which areas are vulnerable, and how a flood could evolve. With this knowledge, we plan, act, and comply with the **European Floods Directive**. Above all, it's how we safeguard people and the land itself.*

**Water management authorities**







## How is flood risk managed in Europe?

The **European Floods Directive (2007/60/EC)** sets a common framework **for identifying, assessing, and reducing flood risk** and aiming to minimize impacts on the receptors at risk namely human health, the environment, cultural heritage, the economy, and infrastructure.

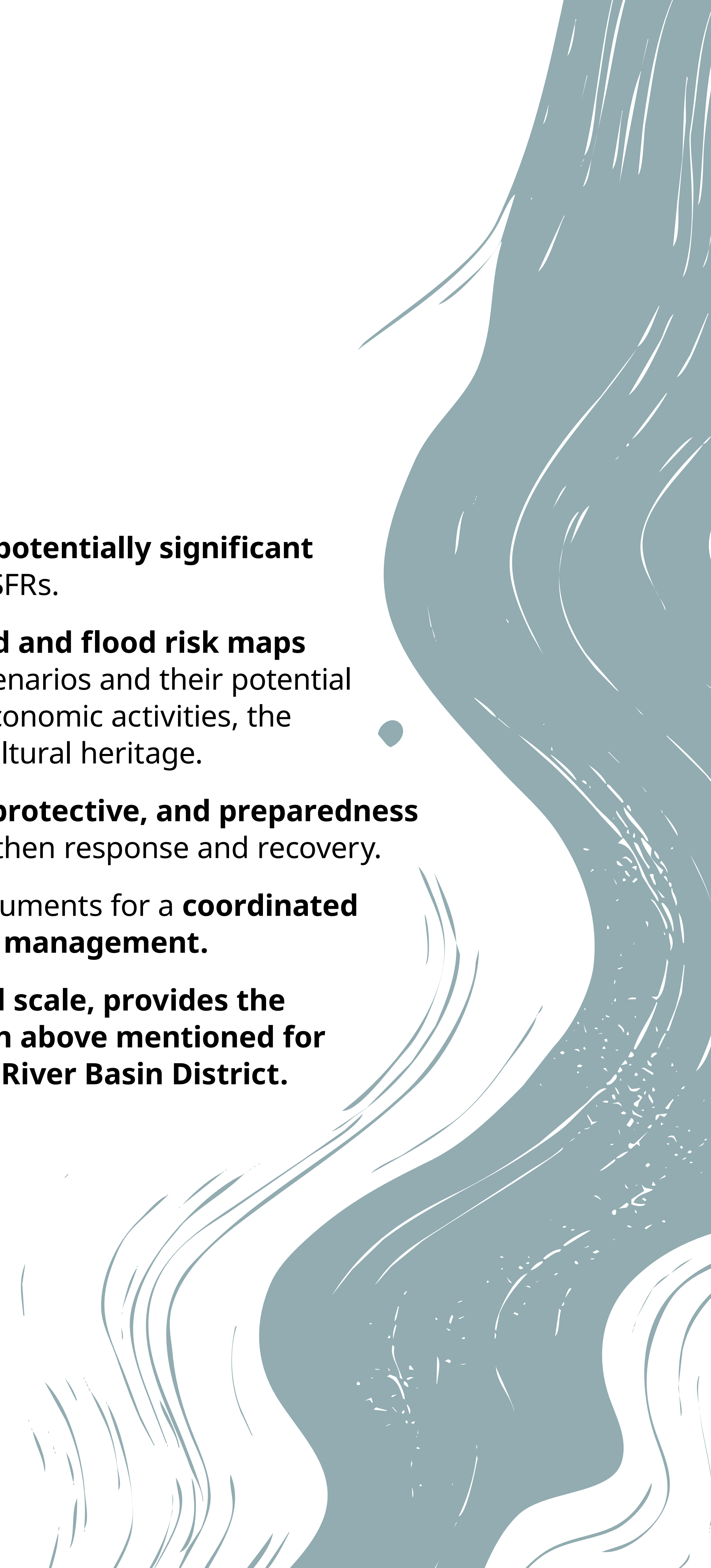
Each EU member state adapts the Directive to its own context. For each **river basin district**, authorities prepare a **Flood Risk Management Plan (FRMP)** which is a living document, updated every six years.

Overall, each FRMP:

- ◆ Identify **areas with potentially significant flood risk** called APSFRs.
- ◆ Include **flood hazard and flood risk maps** that outline flood scenarios and their potential impact on people, economic activities, the environment, and cultural heritage.
- ◆ Define **preventive, protective, and preparedness measures** to strengthen response and recovery.

FRMP are the key instruments for a **coordinated and preventive flood management**.

**The FRMP, at national scale, provides the full set of information above mentioned for Malta's one and only River Basin District.**







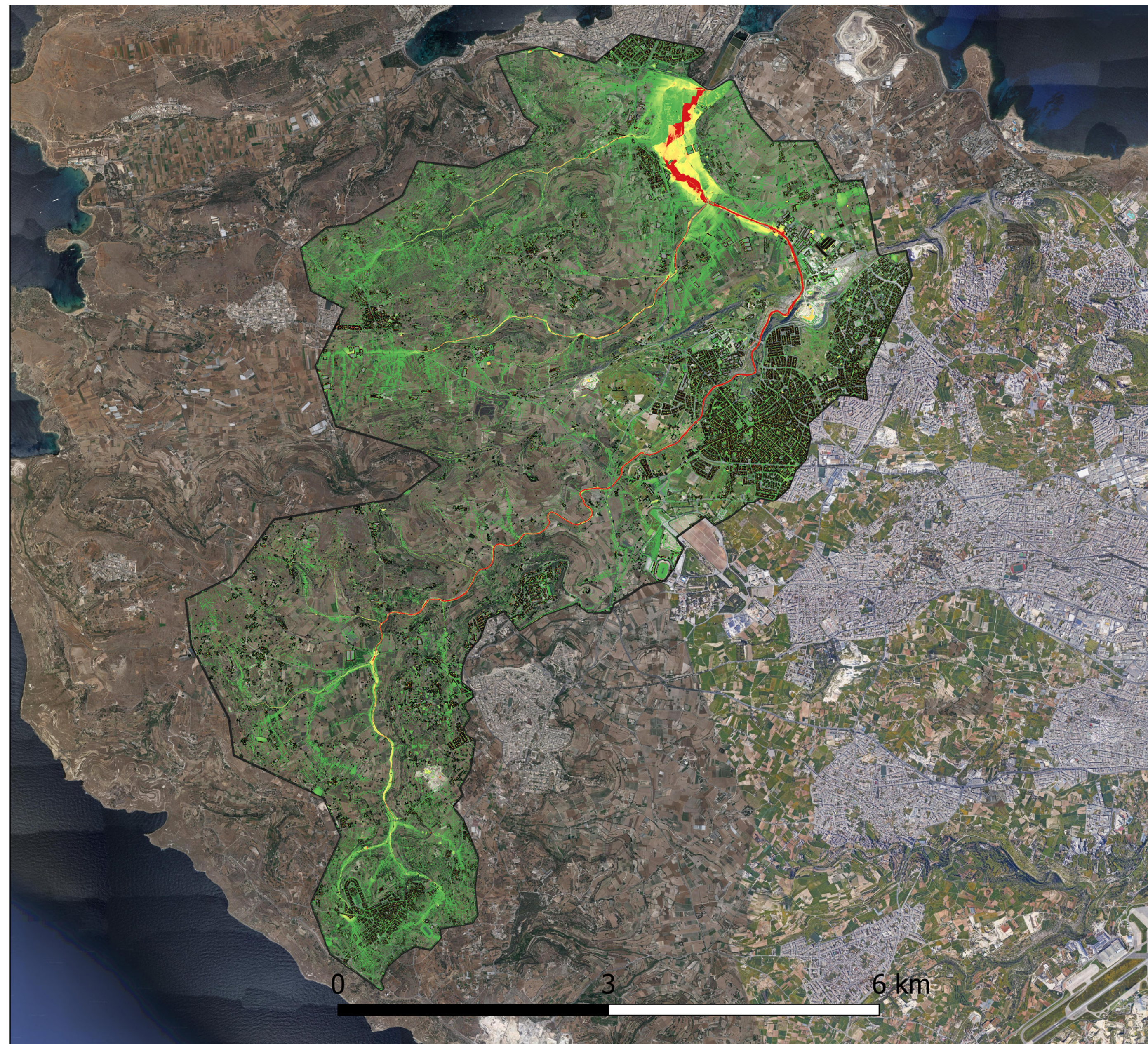
## Flood hazard map of Malta for a 50-year return period (T50)

The return period (T) represents the statistical probability of a flood occurring once every 5, 50, or 200 years. It's important to note that these are probabilities — not certainties.



Where is your home or workplace?

Burmarrad



Birkirkara



Source: Energy & Water Agency (EWA)

LEGEND No hazard Low Moderate Significant Extreme



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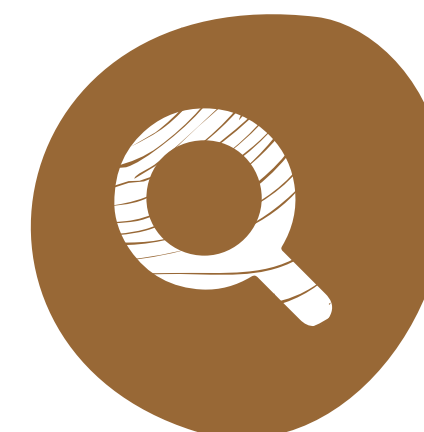
Some days start out calm, until the sky shifts and everything changes. In just minutes, an intense storm can turn into an emergency. That's why we stay alert and ready to move. The real danger lies in thinking it won't happen to us — when, in fact, the **highest-risk places** are often the ones we call home or where we work each day. The first step toward safety is knowing we'd be at risk during a flash flood.

Firefighters



We've prepared together and know **what to do when a flash flood strikes** — we've identified safe points, learned to follow emergency instructions, understood how to help, and how to avoid unnecessary risks. When everyone knows their role, everything works better. It's in these moments that community truly matters — we protect one another.

Neighborhood associations





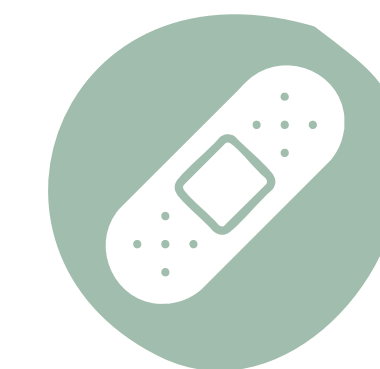


## What do we mean by “risk”?

Modern society faces a wide range of risks — both natural and human-made — that require effective management. **Risk** is the result of the interaction between four key components: **hazard, vulnerability, exposure, and response**.



**Hazard** refers to the inherent potential of a phenomenon to cause harm. It becomes a risk only when vulnerable elements are exposed to it.



**Vulnerability** is the tendency of a system to suffer damage, influenced by physical conditions as well as social, economic, or political factors.



**Exposure** is the presence of people, infrastructure, or assets in hazardous areas — a key factor in determining overall risk.



**Responses** encompasses prevention, mitigation, emergency, and recovery strategies designed to reduce both vulnerability and exposure, and therefore lowering the overall risk.

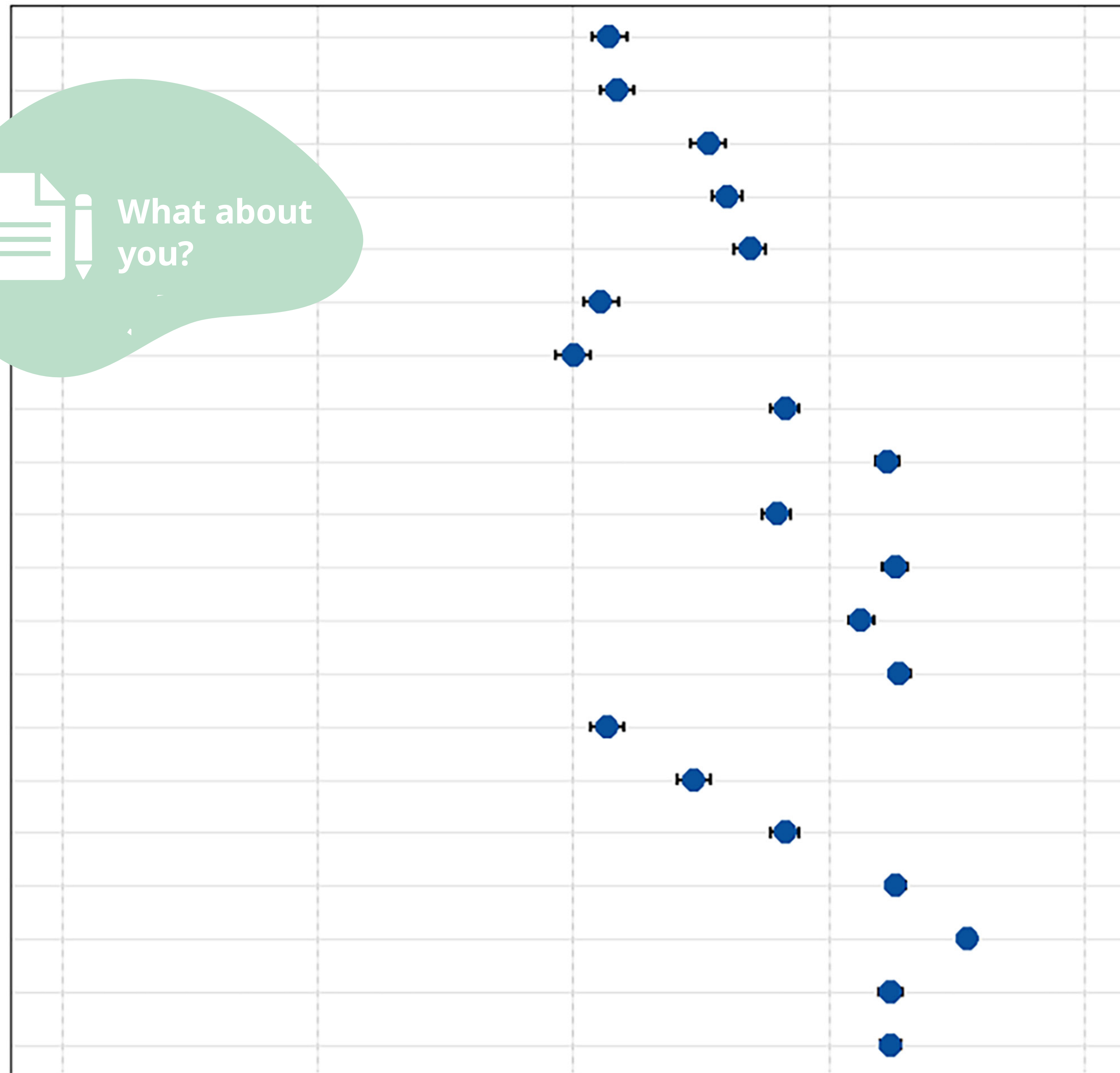
Effectively managing risk requires understanding how these four components interact and how these can be integrated into strategies that reduce impacts and build more resilient communities.





## Discover how residents of Malta perceive the flood risk where they live or work.

What about you?



Strongly Disagree    Disagree    Neutral    Agree    Strongly Agree

1. I am informed about the flood risk in this area.
2. I know what actions to take in case of an emergency.
3. A flood will occur in this area in the coming years.
4. I am concerned that a flood might occur here.
5. If a flood happens, I believe it will affect me.
6. I trust the public administration to manage it effectively.
7. Communication from public authorities is clear and effective.
8. Educating the population is the key action to reduce impacts.
9. Poor urban planning negatively affects people's safety.
10. During a flood event, vehicles should be moved to safe locations.
11. The drainage system in this area should be improved.
12. More green spaces and trees are needed to reduce flood risk.
13. Forests and vegetation should be restored to lower the risk.
14. The river has great natural value.
15. A dam should be built to reduce flood risk.
16. Restoring (renaturalizing) the river helps reduce flood risk.
17. Channeling the river reduces flood risk.
18. Clearing vegetation from the river is very important to lower the risk.
19. Widening the river channel reduces flood risk.
20. Risk-reduction measures should also improve the ecological health of the river.

Survey questions (LocAll4Flood Project, Autumn 2024)





# What to do and what to avoid before, during, and after a flood?

## Before a flash flood



### Know the risk zones

Identify areas prone to flooding (rivers, streams, low-lying areas).



### Plan evacuation routes

Know which routes are available, especially if you live in a risk area.



### Do not ignore flood warnings or evacuation advice

Follow weather alerts and official recommendations.

## During a flash flood



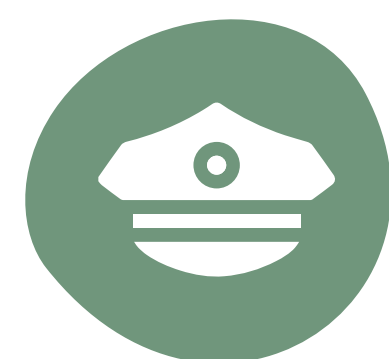
### If possible, move to higher floors

If not, leave the building and go to a safe shelter, away from flood-prone zones.



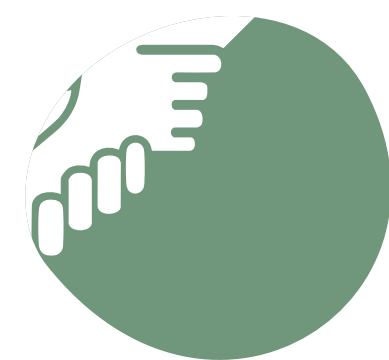
### Get ready

Turn off the main electricity switch and close doors and windows.



### Follow official instructions

Listen to Civil Protection and emergency services via radio, mobile alerts (e.g., EU\_ALERT), or loudspeakers.



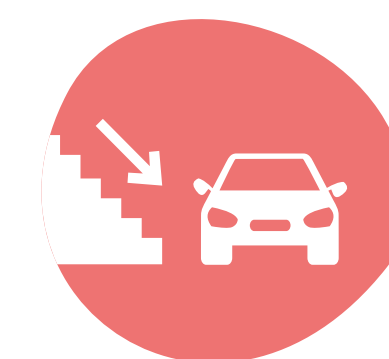
### Warn and help others

Assist vulnerable people, but always prioritize your own safety.



### Do not cross rivers, streams, or underpasses

Whether on foot or by car: never underestimate the power of water.



### Do not try to save belongings

Avoid retrieving objects from basements or garages.



### Do not use your vehicle

Leave it and move to higher, safer ground. Avoid crossing flooded roads or bridges.



### Do not overload emergency lines

Use the phone responsibly.





### After a flash flood



**Do not return home until  
authorities give permission**

Wait until it is officially declared safe.



**Do not enter your  
home without checking  
for damage**

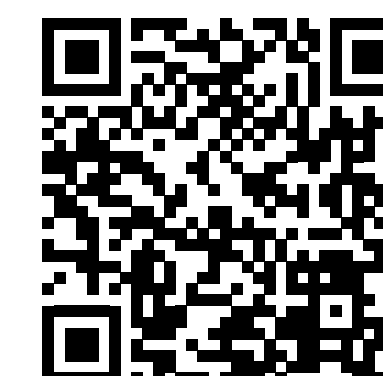
Inspect the structure and watch  
out for fallen electrical cables.

## In case of emergency, call 112.

For more information,  
visit the website of the Civil  
Protection Department (CPD)



Want to know  
if it is raining in  
your location?





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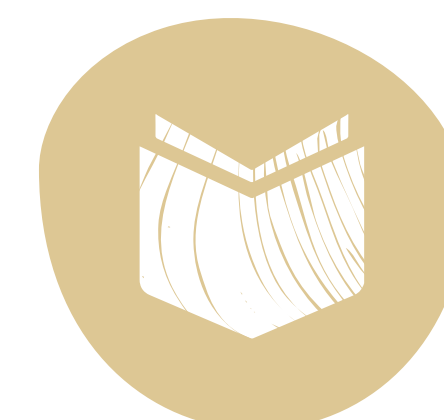
Every urban decision leaves a mark on the land. That's why **planning also means thinking about safety** - reinforcing high-risk areas, improving drainage, and preparing for a future shaped by heavier and more frequent rains. It's more than infrastructure - it's a responsibility we owe to future generations, those who will inherit what we build today.

## Municipal Government



When we talk about **nature-based solutions**, we're talking about more than plants and landscapes. We're talking about giving space back to the nature — reclaiming urban areas and allowing nature to do part of the work. As we study how ecosystems absorb and slow down water, we also discover how they enrich our lives. Protecting ourselves from floods can simply mean learning to live in harmony with our environment.

## Research Groups



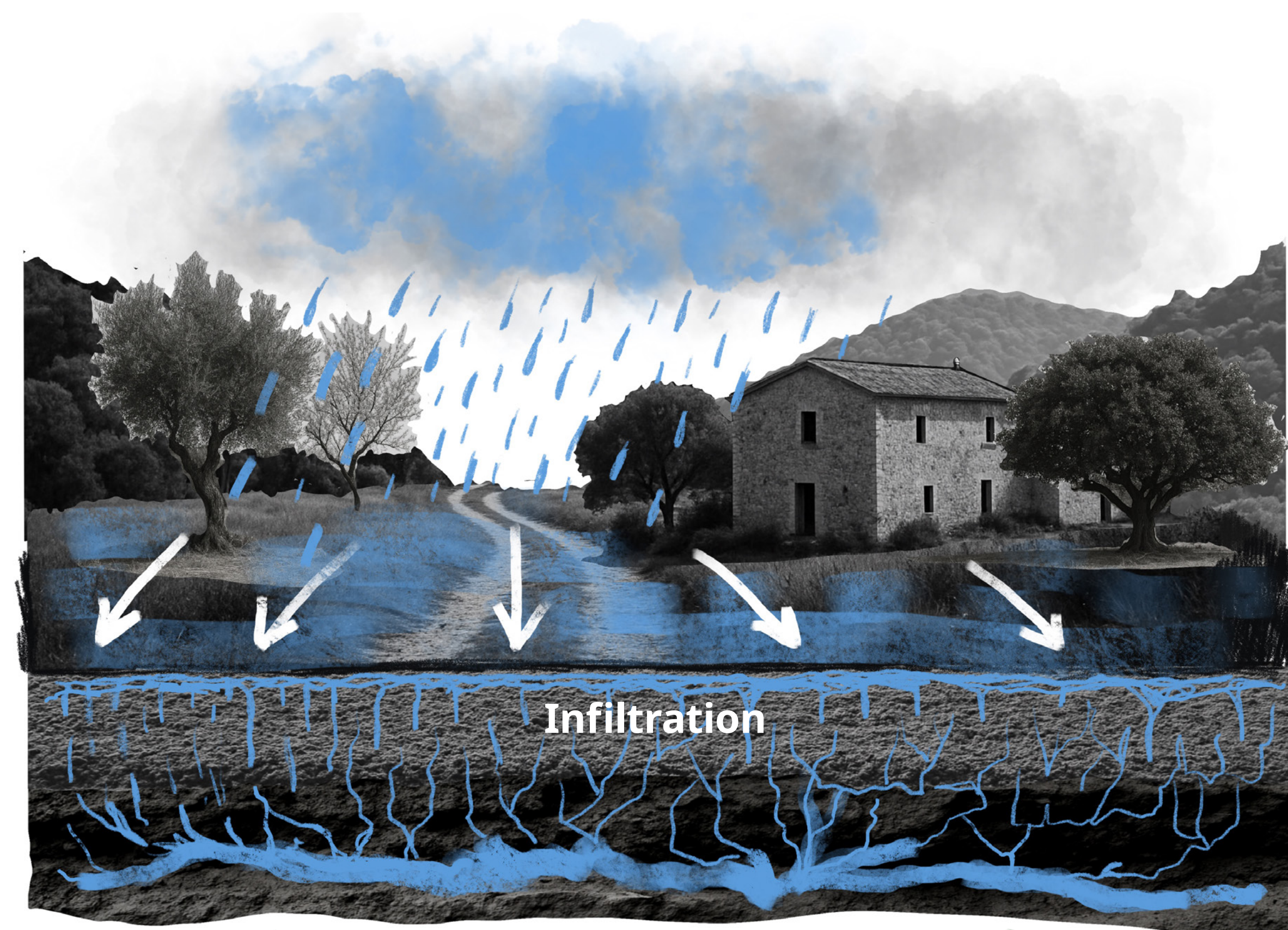




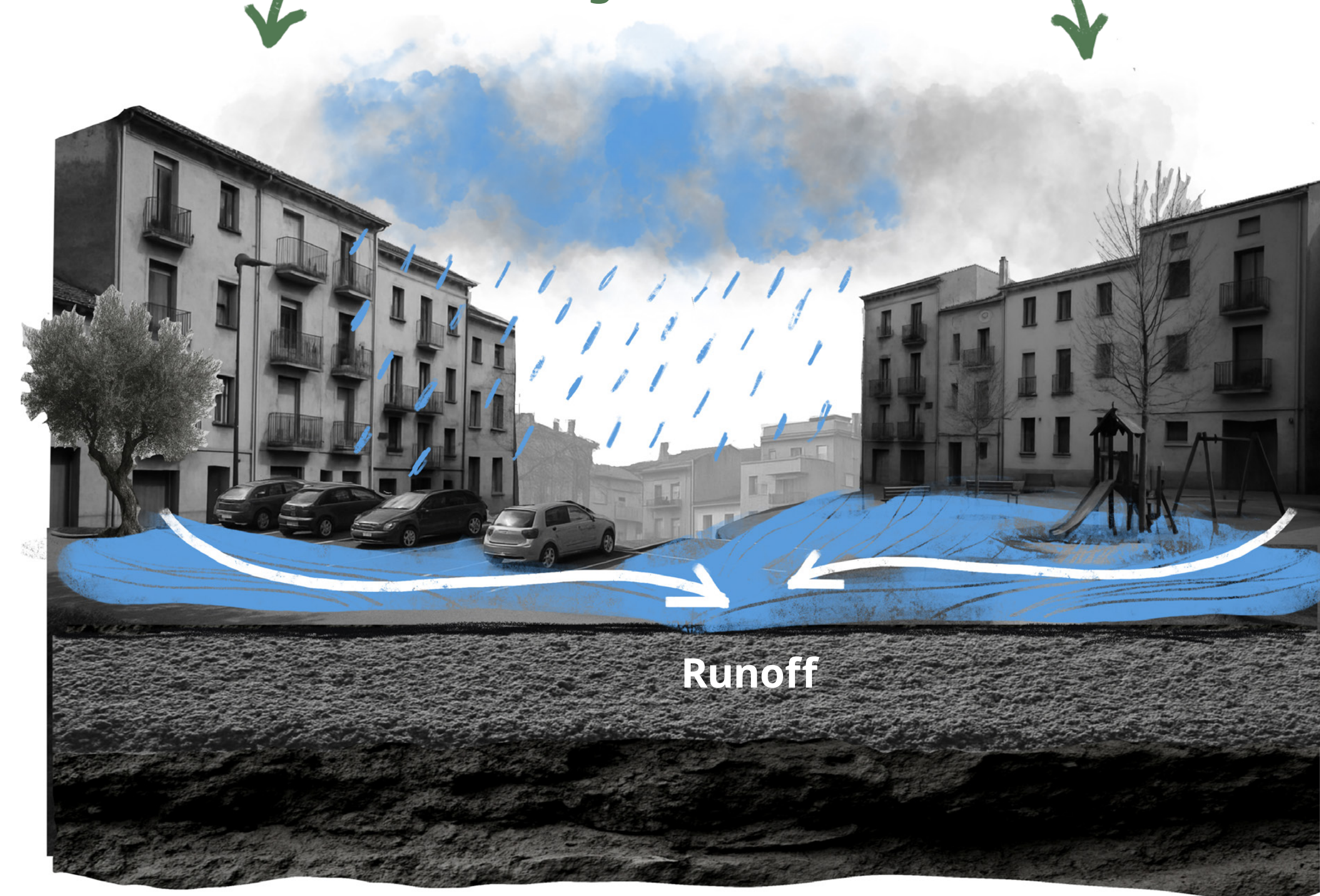
## How does urbanization affect flood risk?

**Urbanisation and changes in land use** have increased the risk of flash floods because they have altered the way land interacts with water. When natural surfaces such as agricultural areas are replaced with urban infrastructure, the ground loses its ability to absorb rainwater.

The **soil's reduced permeability** leads to more surface runoff. During intense rainfall, water flows more quickly toward catchment areas or drainage systems which can fail when receiving water at an overwhelming rate. Moreover, building in floodplains or near watercourses can obstruct the river's natural flow, amplifying the impacts of flash floods.



Changes in land use

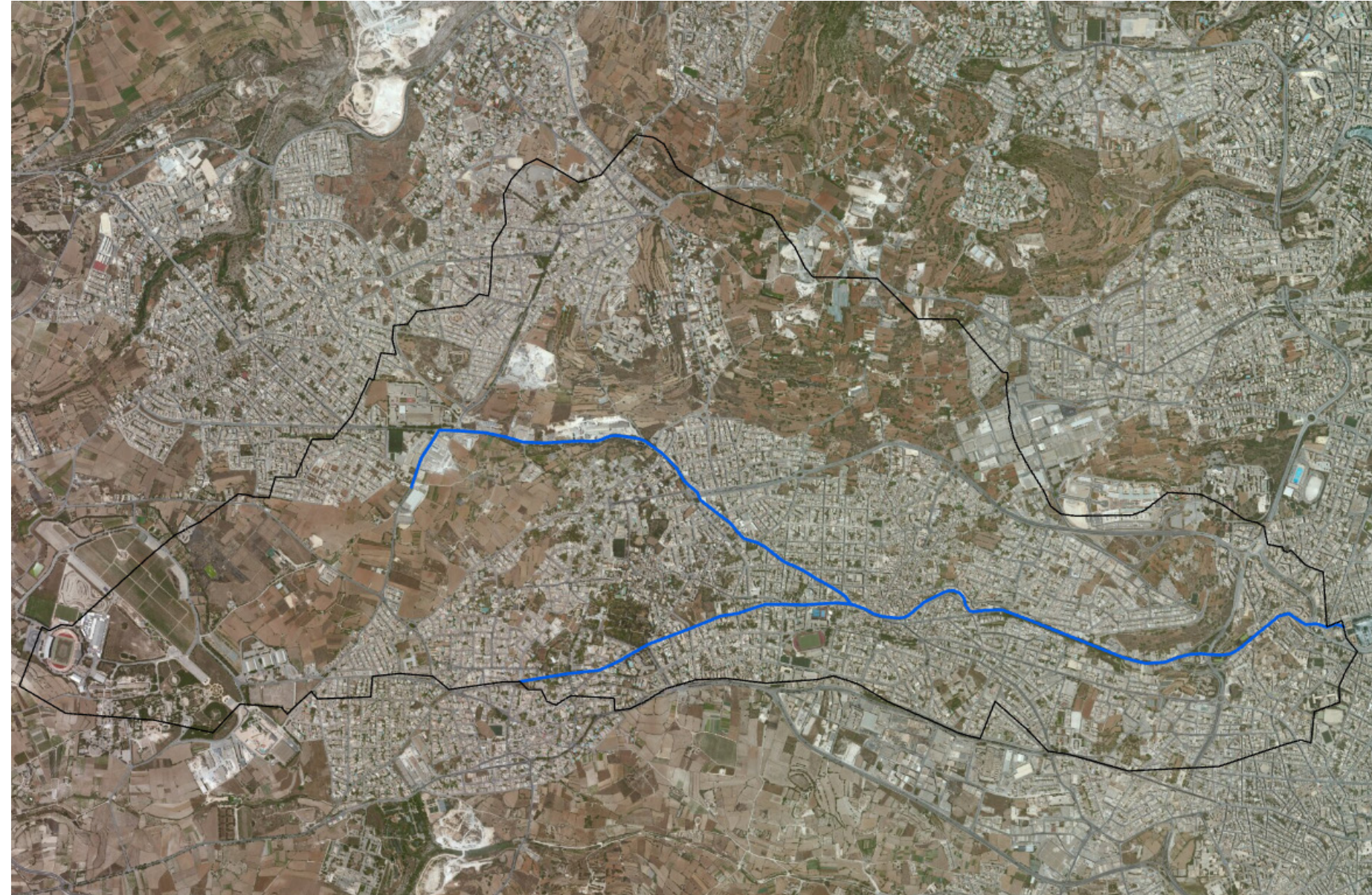




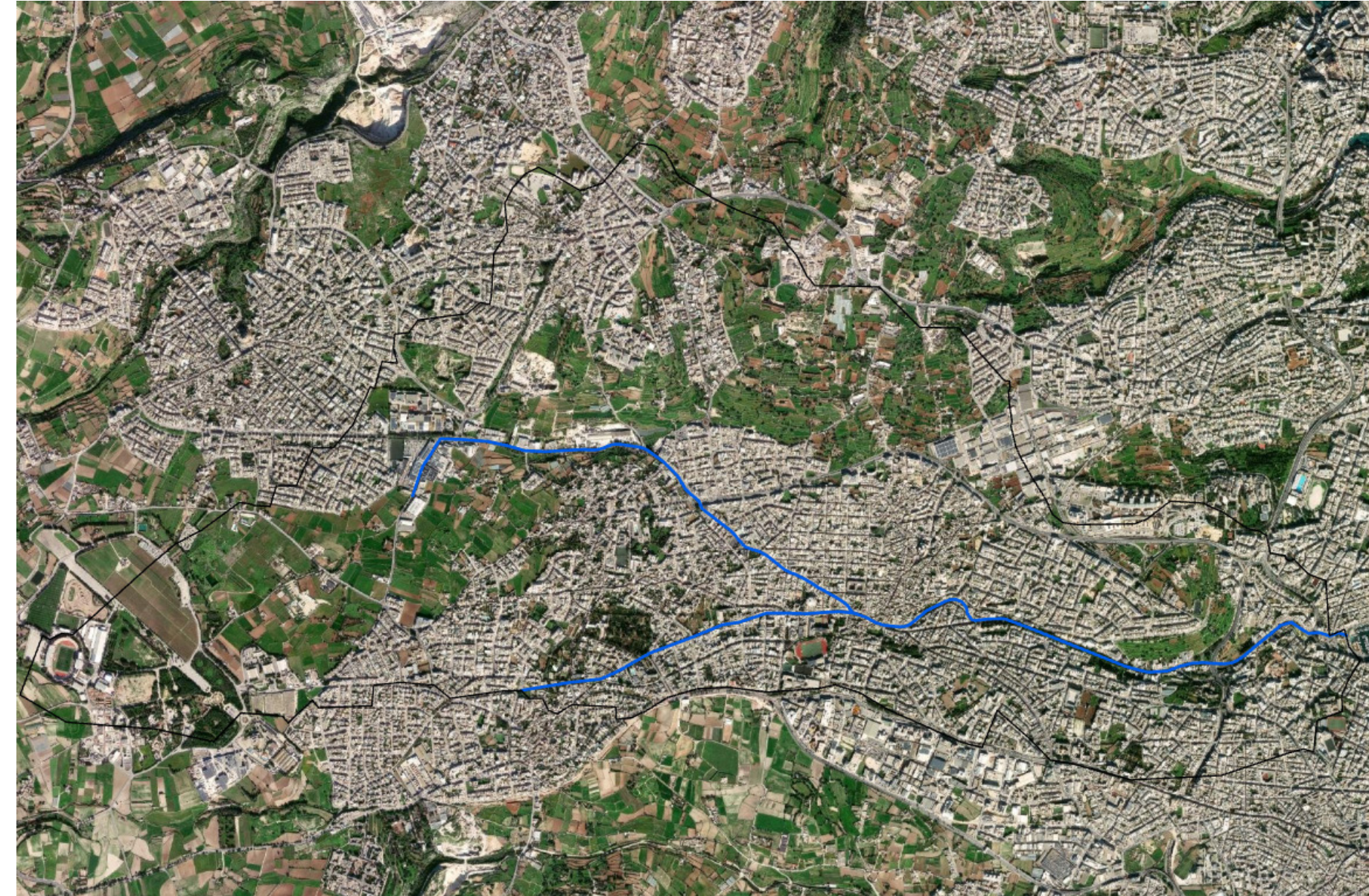


# How has the territory changed? Evolution of urbanization over time

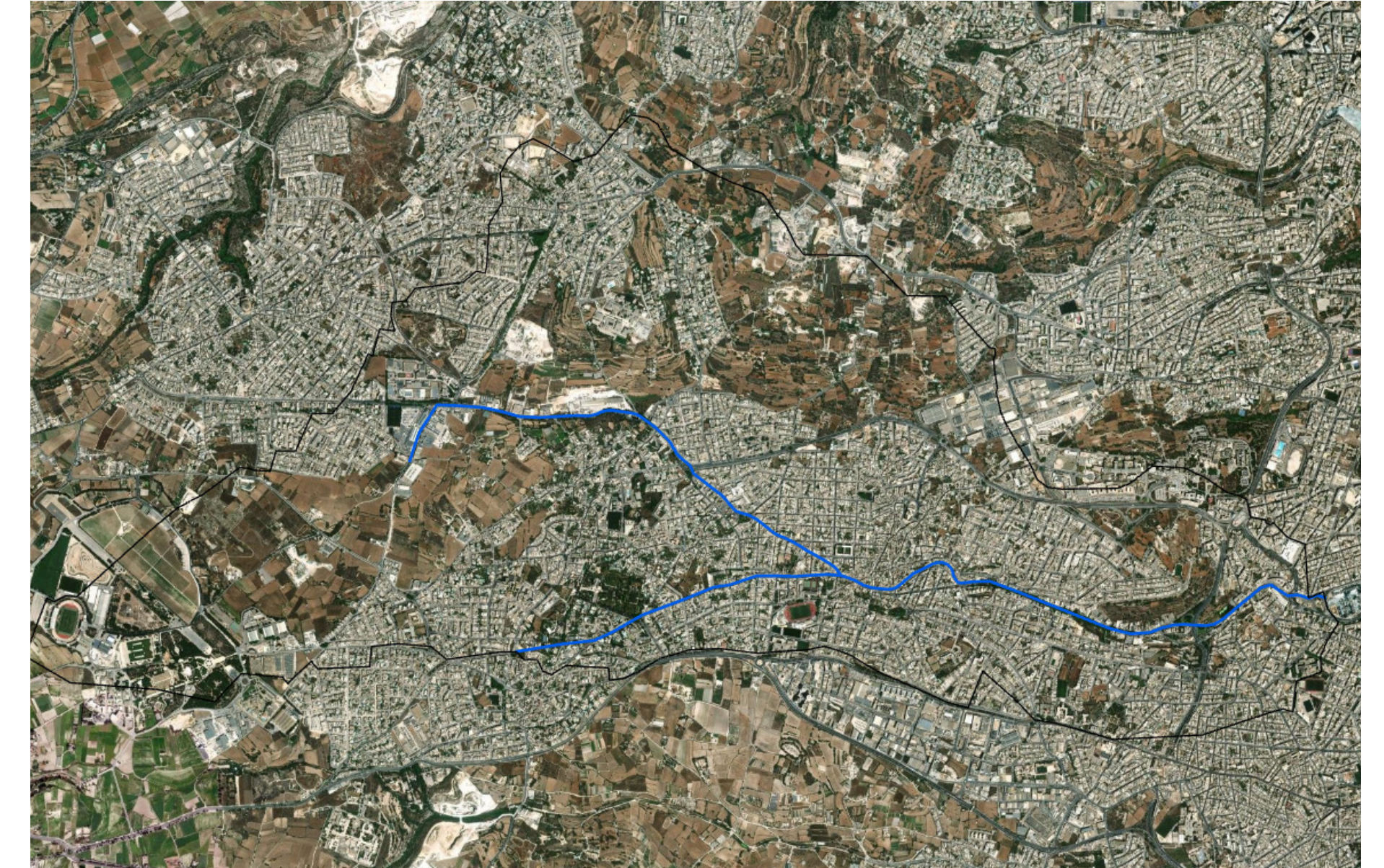
## Birkirkara



2014



2020



2025

## Burmarrad



2014



2020



2025

Source: Energy & Water Agency (EWA)

💧 Ephemeral stream    🖤 Catchment border





## What are nature-based solutions?

**Nature-based solutions** harness the power of ecosystems to address challenges like flooding or extreme heat caused by climate change.

For example, instead of building concrete infrastructure to prevent floods, restoring a wetland or planting vegetation along a river can help retain water during heavy rainfall. These living systems **act like sponges - absorbing excess water** while enhancing biodiversity, enriching the landscape, and improving quality of life. In doing so, they create not just safety, but resilience - for people and for nature alike.





## Some examples of nature-based solutions that reduce flood risk

**Urban forests**



**Urban green corridors**



**Urban ponds and wetlands**



**Reforestation and afforestation**



**Permeable pavements and green parking areas**



**Terraces and soil conservation practices**



**Rain gardens and vegetated drainage channels**



**Restoration riverbanks**



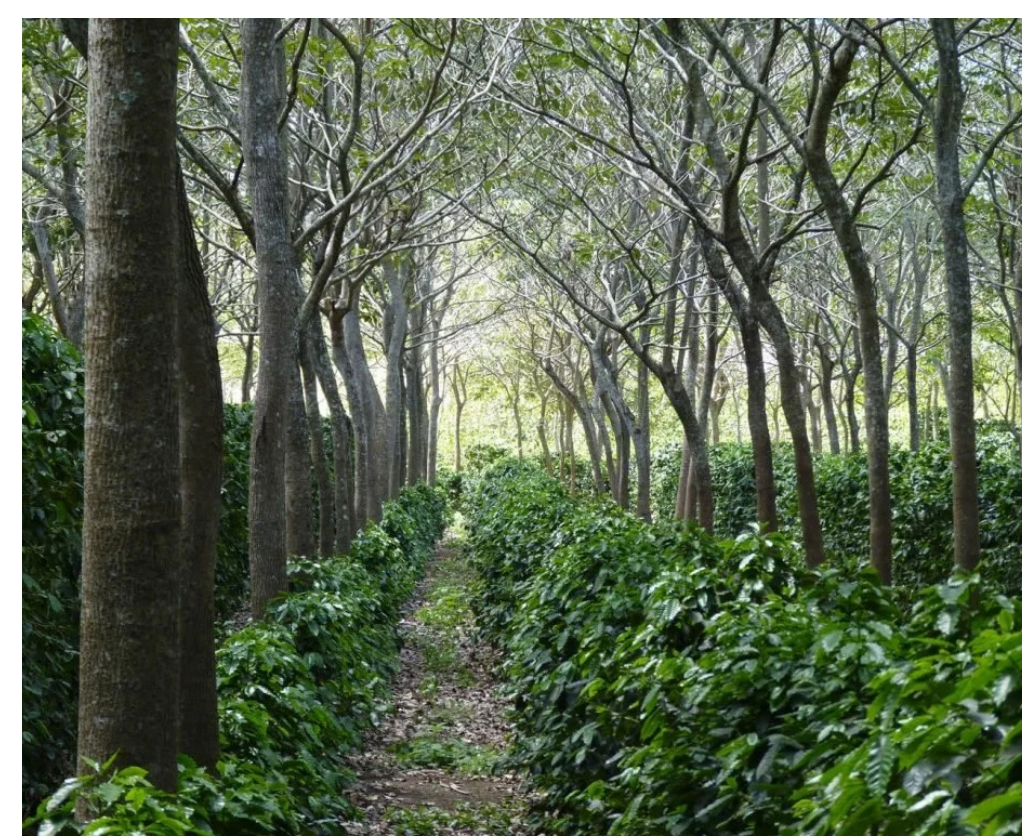
**Restoration of natural wetlands**



**Natural water retention measures**  
(e.g., small dams, retention basins, weirs)



**Soil conservation practices**  
(e.g., terracing, agroforestry, rotational grazing)



**Coastal floodplain parks, wetlands, and salt marshes**





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We know that no one can face a flood alone. That's why networks matter - they strengthen **connections between people, institutions, and organizations**. When trust grows and communication flows, everything changes - resources are shared, responses are better coordinated, and habits that can save lives become second nature. Preparedness doesn't start when the rain falls - it starts long before.

### Social and Environmental Organizations



In spaces like libraries, community centres, and cultural venues, we do more than organise activities - we build communities. We exchange knowledge, share experiences, and reflect on how environmental changes shape our lives. When people participate, learn, and connect, we foster **a society that is better prepared, more aware, and more resilient** in the face of any challenge - including floods.

### Community and social spaces







## Who should participate in flood risk management?

Flood Risk Management Plans (FRMPs) are developed through the **active involvement of stakeholders and citizens**, through public consultation and collaboration within water catchment planning frameworks. These processes strengthen resilience by encouraging cooperation across different levels of administration.

To promote shared and inclusive governance, these initiatives are framed within the **Quadruple Helix model**, which encourages collaboration among **public authorities, academia, the private sector, and civil society**. The following diagram highlights key actors to consider in a participatory approach to flood risk management.





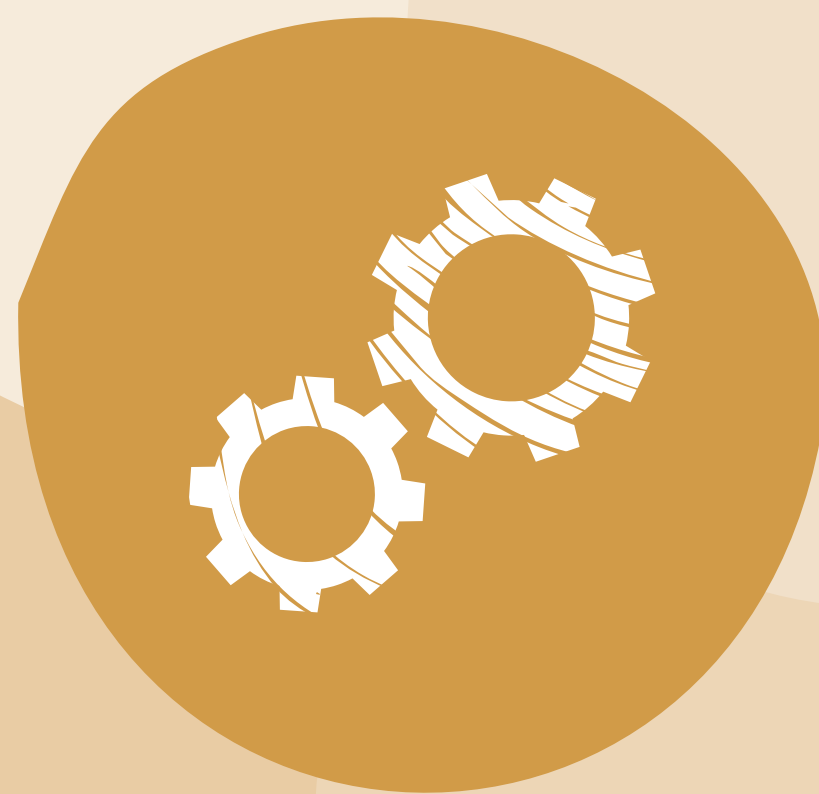
## Quadruple Helix: a model of participation

### ACADEMIA AND RESEARCH

- Public, semi-private, and private universities
- Think tanks and public policy institutes
- Public and private research centers and institutes

### PRIVATE SECTOR

- Private schools and kindergartens
- Companies and industries located in risk-prone areas
- Agricultural and livestock sectors within the risk zone
- Private and semi-private healthcare providers
- Media outlets
- Managers of critical infrastructures
- Professional associations and guilds
- Insurance companies and financial institutions
- Stakeholders in the water and energy sectors



### ADMINISTRATION AND POLICY MAKERS

- Civil Protection and territorial emergency services
- River basin confederations
- Urban planning, land management, and infrastructure departments of municipalities
- Local and regional police forces
- Forest rangers and natural park wardens
- Fire departments
- City councils
- National, regional, and local administrations responsible for water management
- Institutional press offices
- Citizen participation bodies (e.g., advisory or basin committees)
- Finance departments at national, regional, and local levels

### CIVIL SOCIETY AND LOCAL COMMUNITIES

- Neighborhood associations
- Community centers and libraries
- Public and charter schools, kindergartens, and high schools
- Nature and environmental associations
- Youth groups, scouts, and extracurricular programs
- Cultural centers and senior centers
- Hiking clubs
- Religious centers
- Public health sector
- Civil protection volunteers



Which  
key actor  
are you?







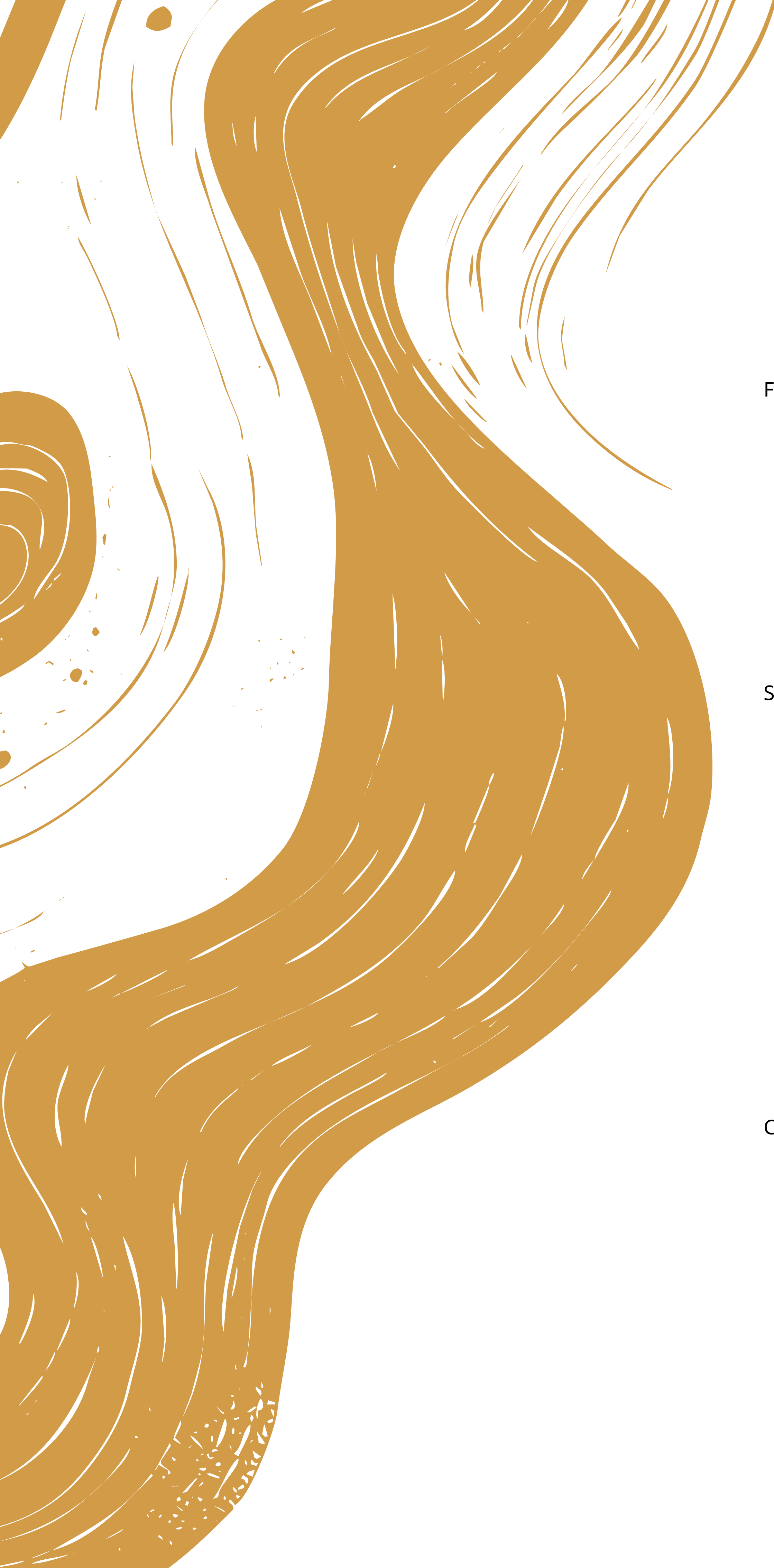
## Download and explore!

Within the LocAll4Flood project, several educational and awareness-raising materials have been developed — all **freely available online in multiple languages**:

- 💧 Infographics and emergency preparedness magnets
- 💧 This traveling exhibition
- 💧 Informational brochures
- 💧 An online decision-making game
- 💧 A printable board game
- 💧 A teacher's guide
- 💧 A giant puzzle
- 💧 A card game on flood risk management







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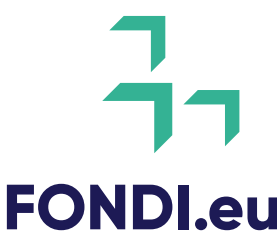
LocAll4Flood



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## CREDITS

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Survey illustration: LocAll4Flood project team

Collage illustrations: *Domingo Recreativos*

### 💧 **Acknowledgments**

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### 💧 **Texts:**

LocAll4Flood project team

### 💧 **Design:**

*Domingo Recreativos*

