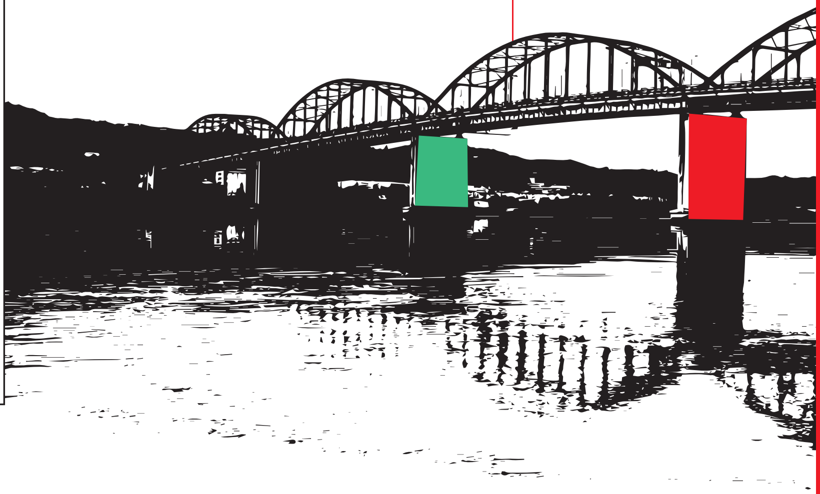
Financed by

Iceland
Liechtenstein
Norway grants

Working together
for a green, competitive
and inclusive Europe!

VILA FRANCA DE XIRA MUNICIPAL ADAPTATION PLAN FOR CLIMATE CHANGE SUMMARY

VFX - MCCAP



Promoter

CÂMARA MUNICIPAL

VILA FRANCA DE XIRA CITY COUNCIL

Project

Franc@d.PTação

Plano Municipal
de Adaptação às Alterações Climáticas
PMAAC-VFX

Operator

REPÚBLICA PORTUGUESA

AMBIENTE E AÇÃO CLIMÁTICA

MUNICIPALITY OF

VILA FRANCA DE XIRA

CÂMARA MUNICIPAL

Title
Vila Franca de Xira Municipal Adaptation Plan to Climate Change – Summary

Editorial Coordination and Design
Municipality of Vila Franca de Xira

Fernando Paulo Ferreira
Municipal President of Vila Franca de Xira
Marina Tiago
Municipal Vice-President of Vila Franca de Xira

CMVFX Technical Team
Municipality of Vila Franca de Xira

Catarina Conde (General Coordination)
Lara Almeida (Technical Coordination)
Júlia Reis
Miguel Falcão
Vasco Soares
Ana Cristina Santos
Ana Catarina Vicente

CEDRU Technical Team
Centro de Estudos e Desenvolvimento Regional e Urbano, Lda

Sérgio Barroso (General Coordination)
Gonçalo Caetano
Pedro Henriques
Sónia Vieira
João Tiago Carapau
Margot Figueiredo
Pedro Martins
Daniel Vilão
Daniel Zeferino
Francisco Rodrigues
Sérgio Den Boer

Translation
Kennis Translations

Photo Credits
Câmara Municipal de Vila Franca de Xira

Illustrations
Visuais por UpSideUp.pt

Release Date
Julho 2023

Digital version

INTRODUCTORY NOTE

Adapting territories to current climate demands means taking measures and preparing for the present and the future.

Prepared together with civil society, academia and young people, the Vila Franca de Xira Municipal Adaptation Plan for Climate Change (VFX MAPCC) sets out guidelines, measures and actions that will inform municipal decision-making to deal with the challenges of climate change, placing the safety and well-being of Citizens at the centre of our strategy.

The VFX MAPCC presents an adaptive path forward, anchored in a positive and mobilising approach towards a safer, more sustainable and more balanced framework for human relations with our environment.

In response to each of the climate vulnerabilities, the Plan defines 15 adaptation measures which cover the five main climate risks that affect the Municipality of Vila Franca de Xira and form part of the strategic reference framework, made operational through short- and medium-term Priority Actions up to 2030.

Adapting the municipality of Vila Franca de Xira to climate change will be one of the most demanding challenges in coming decades, especially due to uncertainty surrounding future climate scenarios, evidence of the role of human beings in the production of emissions and the concentration of greenhouse gases, and doubts relating to the response of the climate system to adaptive and mitigating actions implemented.

Global warming brings with it risks and impacts that will affect everyone. All sectors of society and the economy – but also all of us as individuals – have a role to play in the transformation of our planet.

Reconciling mankind's need to use the local territory (and the services it provides, particularly for cities, which are continually growing everywhere) with environmental protection and decompression zones requires us to make increasingly complex choices that are articulated on a larger scale, which in a metropolitan framework implies a supra-municipal vision. The choice of (responsible) use of space, essential from a social and economic standpoint, must increasingly take into account, among other things, the risks associated with extreme climate phenomena and rising water levels, as well as the correlation of our actions with adjacent territories. This requires new construction techniques and technologies to ensure that society continues to safely improve its quality of life.

Responsible use does not mean not using the available resources and territories; rather, it means using those which can serve the general interest (including the environmental interest) better and more intelligently.

This plan is therefore absolutely essential for us to better learn to build and act collectively and individually in a future that belongs to us all.

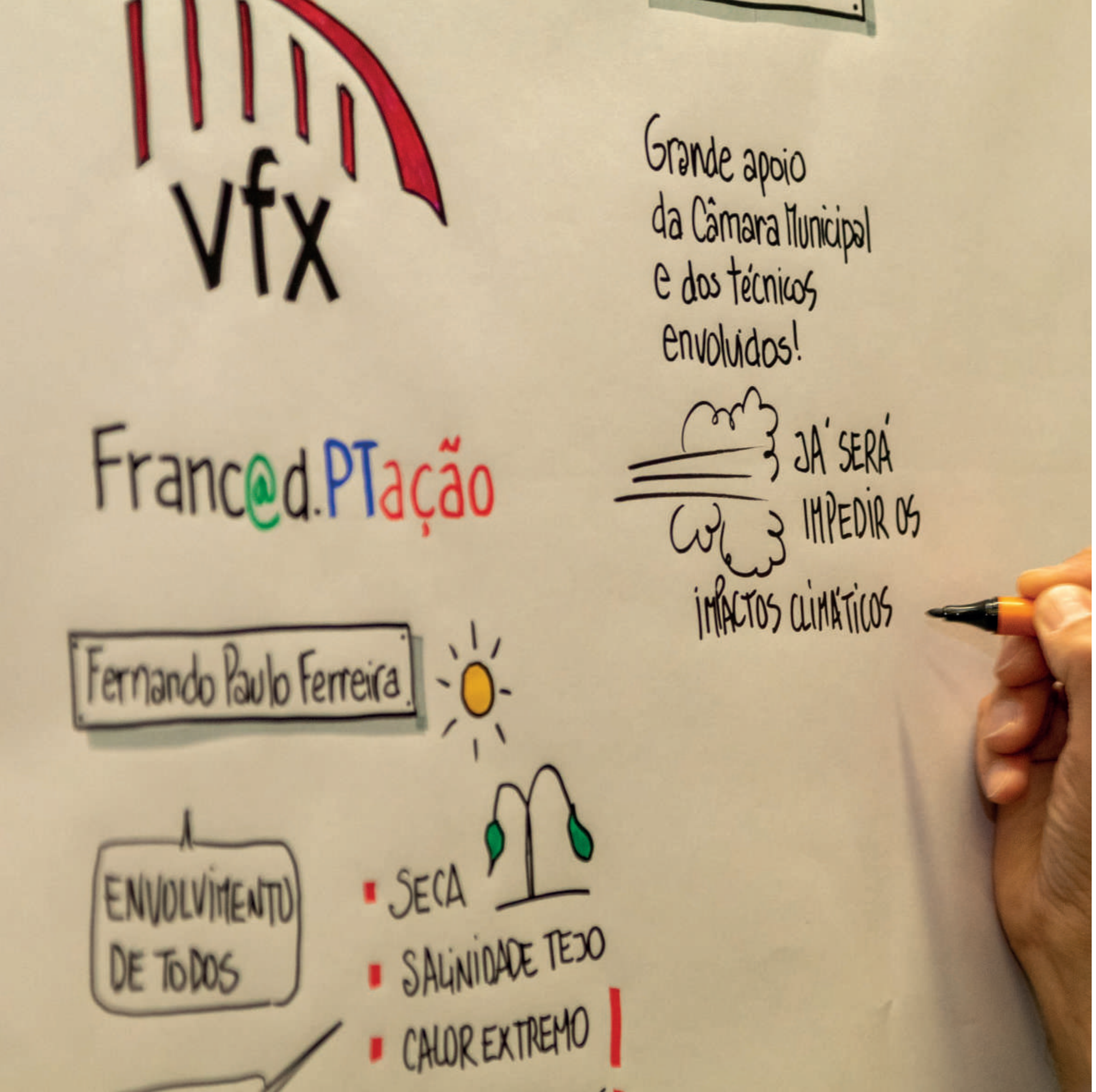
Let's do it.

Fernando Paulo Ferreira,
Municipal President of Vila Franca de Xira


08_Small Grant Scheme #3 - Franc@d.PTação
Operador
REPÚBLICA PORTUGUESA
Projeto
Franc@d.PTação
Promotor
Iceland Liechtenstein Norway grants

INDEX

FRAMEWORK



The current process of climate change began with the rapid increase in greenhouse gas (GHG) emissions from the mid-18th century, a period corresponding to the first industrial revolution.

The demand for materials with high energy density to produce electricity, fuels and tools has been increasing exponentially since then until today. During this period, atmospheric CO_2 values have increased by about 100 parts per million (ppm), from 300 to 400 ppm, and continue to rise at a rate of around 2.8 ppm/year. With around a quarter of the current total atmospheric CO_2 coming from anthropogenic sources, humankind has clearly altered the chemistry of the atmosphere, one of the main factors determining the earth's climate (the others being Milankovitch orbital cycles, ocean dynamics, and biogeochemical cycles).

Natural processes occur on a geological scale, with the cycles of external geodynamics, orbital and oceanic cycles occurring over periods in the order of tens or hundreds of thousands of years, leading to changes in climate that rarely reach current rates of change.

Climate change is a growing concern, with consequent changes in land use and GHG emissions constantly evolving. This anthropic action has strong influences on the atmosphere, modifying climate patterns (IPCC 2007a).

Among the various GHGs, carbon dioxide (CO_2) is the one that produces the greatest radiative forcing in the atmosphere. This has a strong anthropogenic component, since its increase is mainly due to the burning of fossil fuels. This primary source is essentially derived from oil, natural gas and coal, or even fossil fuel cogeneration. However, humanity has had both a direct and an indirect influence on the production of this type of gases, especially in the case of methane (CH_4) and nitrous oxide (N_2O).

The concentration of GHG in the atmosphere is at its highest point for 800,000 years, with the average concentration exceeding 400 ppm as of the year 2016. This represents a value around 40% higher than that verified in the pre-industrial era (EEA 2017), which is a threat to the agreement ratified in the 'Paris Agreement', with regard to the increase in global temperatures, as the world population continues to grow and emissions also continue with the same trend. Extremes of heat have visibly increased from a statistical point of view, and are expected to increase in comparison with extremes of cold, which are expected to decrease in frequency and duration, both in daily and seasonal terms (IPCC 2014). The vulnerabilities of territories increase with these threats, and in the case of Portugal, one of the most visible is the occurrence of forest fires, as well as the loss of territory due to the rise in the average sea level. As for the evolution of precipitation, projections indicate a probable decrease in average annual precipitation in most dry regions of the middle and subtropical latitudes (IPCC 2014), with a special propensity to aridity in mainland Portugal, especially south of the Sintra-Montejunto-Estrela mountain system.

Further in the context of climate change, the trend towards a reduction of annual precipitation in mainland Portugal, with increasingly irregular distributions and consequent changes in run-off regimes, leads to changes in river flows, subject to greater variability and a tendency to general decreases from an annual point of view. Various consequences of this will be reflected in the increased consequences of drought periods, as well as in the loss of quality of water resources, both surface and underground, even including the loss of biodiversity.

Meanwhile, the increase in the number of heat waves and prolonged drought periods, which are already extending with greater frequency until autumn, will

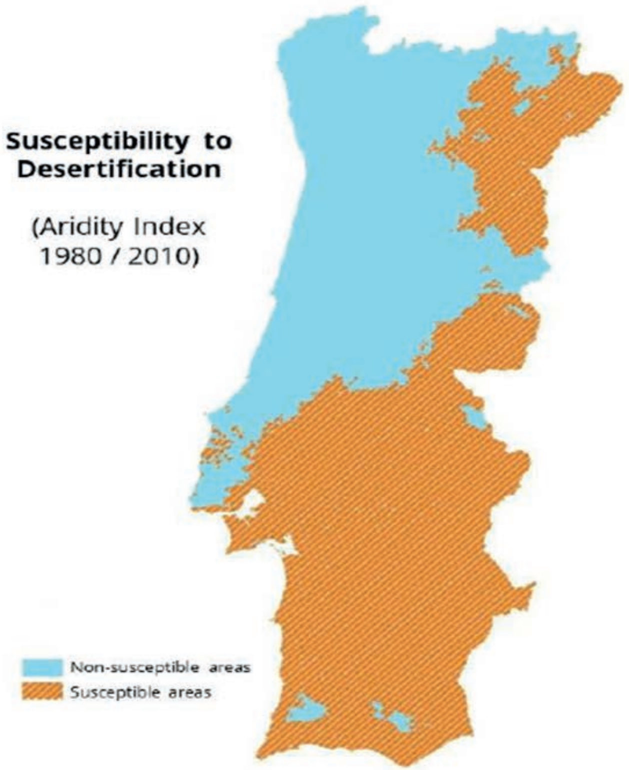


Figure 1 - Aridity index (1980/2010)
Source: ICNF-PANCD (2014-2020)

aggravate this problem, working in symbiosis with the above to increase the occurrence of rural fires in southern Europe and more specifically in the case of mainland Portugal, which have been showing a growing presence in recent decades, with an increase in the area burned. In addition to all this, extreme phenomena in general, such as intense and torrential precipitation and hail and other phenomena will be increasingly frequent (ANEPC, 2019).

Human-induced climate change is thus a doubly worrying factor, both because of its potential intensity and the rapid pace of change. Both contribute to the risk of ecological and climatic destabilisation that could be catastrophic. It is therefore essential to carry out studies to investigate, forecast and characterise climate change so that measures can be taken to mitigate the risks and reduce the human impact.

This summary presents the climate analysis and projections for the twenty-first century for the entire municipality of Vila Franca de Xira, according to the current 'state of the art' in this area of science. Still, it is essential to remember that scientific knowledge is constantly evolving and, naturally, there are constraints that make the results presented subject to some degree of uncertainty.

By the end of the century, it is expected that there will be a 20% to 25% reduction in average annual precipitation in Portugal (PMAAC-AML, 2018, adapted from IPMA, 2013). In this context, and associated with the increasing irregularity of its annual distribution, there is a tendency to increase the risk of soil erosion, associated with an increase in extreme events. This is decisive for socioeconomic, environmental and even cultural aspects, but also for the agroforestry systems present in the municipality.

The salinisation of agricultural areas, associated to the rise in the average sea level, is also a growing concern in this area of the Lezíria wetlands, which are especially vulnerable to this aspect due to its exposure to the Tagus Estuary. Projections point to progressive reductions in agricultural productivity by 2100, which could be around 15% to 30% compared to today (JRC, 2018, based on IPCC data, 2013). Everything indicates that pastures will be affected, as well as permanent crops (horticulture and vineyards). Rain fed crops such as cereals will also be significantly conditioned by climate change. The assessment of these potential impacts was based on the crossing of information regarding the main production systems of this county, consulting the guidelines of the 'Strategy of Adaptation of Agriculture and Forestry to Climate Change (Mainland Portugal)' (MAMAOT, 2013).

BIOCLIMATIC SCENARIOS

CLIMATE CHARACTERISATION

Land cover types can be very diverse and their climatic function depends on thermal characteristics, reflective properties (colour and albedo), aerodynamic roughness, water content, biomass, and other factors.

At local scales, climatic responses are different in the following classes:

- **Forested areas, of more or less dense woodlands, formed by leafy and coniferous species**. Normally, their arboreal vegetation is more than 20m high and has low wind permeability in the stem area. They normally constitute areas of aerodynamic roughness (z0) greater than 0.7m. They are normally cooler spaces due to shading (reduction of direct solar radiation) and to the evapotranspiration phenomenon that reduces the air temperature.

- **Other cultivated spaces or spaces with shrub and herbaceous vegetation**. These are areas with lower aerodynamic roughness (normally less than 0.2m) and better ventilated than in forested spaces. Although evapotranspiration occurs (depending on the amount of green biomass), its cooling potential is lower.

- **Urban areas of varying density**. Areas with aerodynamic roughness above 0.5m (in lower density areas), but often above 1m (in denser areas). Wind speed is reduced by friction caused by urban elements, although at the micro-scale some streets may experience accelerations due to the “tunnelling effect”. These accelerations occur in narrower areas such as corners of buildings, especially in aligned streets more exposed to the prevailing winds. Urban heat islands are usually formed due to several factors such as urban geometry, impermeable soils and sealed surfaces, building colours and materials that promote heat retention, pollutant and anthropic heat emissions, little vegetation and reduction of the advection effect and wind speed. They can reach intensities (between the warmest places in dense areas and the coolest in the surroundings) in the order of 3 to 6°C (average values obtained from studies undertaken in Portuguese cities).

- **Water surfaces, areas of strong evaporation, especially at high temperatures**. Potential conditions for cooling and elevation of atmospheric humidity beyond the water plane. Potential for fog formation, decrease in temperature ranges, and formation of local breezes. Modification of latent heat flows.

The morphoclimatic units with greater expression in the municipality of Vila Franca de Xira are the following:

- **Tagus Valley**: a unit consisting of the low-lying areas around the Tagus and its estuary. From a climatic point of view, given their topographical position, these areas are susceptible to the occurrence of extreme thermal conditions. They are areas favourable to the accumulation of cold air on nights with anticyclonic conditions, especially in winter; while in the hottest period of the year, the sheltered position downwind from the Sintra-Montejunto-Estrela system and greater continentality favour the occurrence of high maximum temperatures, increasing situations of thermal stress. Also noteworthy is the frequent occurrence of irradiation fogs, especially in winter, with the accumulation of pollutants and deterioration of air quality. This region is also the most vulnerable to the rise in the ocean levels, which put at risk the structures on the banks of the Tagus, the riverside areas of the main towns, and extensive areas of agricultural use.

- **Hills of the Tagus and Estremadura**: Analysed together given that they are an extension of one another. Located on the south-eastern slopes of the Sintra-Montejunto-Estrela mountain system, these units are characterised by a windier climate, with greater volumes of precipitation, lower temperatures, and less significant annual temperature ranges than the Tagus Valley. The greater wind exposure implies a greater potential risk of intense wind situations, caused either by the passage of cyclonic systems in the humid part of the year, or by episodes of intense northerly wind in the dry part, associated with the strong horizontal thermal gradients that are generated between the Atlantic Ocean and the interior of the Iberian Peninsula.

- **Valleys and Depressions**: this unit includes the areas of Vialonga, Castanheira do Ribatejo and some valleys more embedded in streams that run from the mountainous areas in the northwest to the Tagus in the southeast. With some similarities in relation to the Tagus Valley, these small valleys and more embedded depressions tend to be susceptible to the occurrence of extreme thermal conditions. They are areas favourable to the accumulation of cold air on nights with anticyclonic conditions, especially in winter; while in the hottest period of the year, the sheltered location favours the occurrence of high maximum temperatures, increasing situations of thermal stress. Also noteworthy is the frequent occurrence of irradiation fogs, especially in winter, with the accumulation of pollutants and deterioration of air quality.

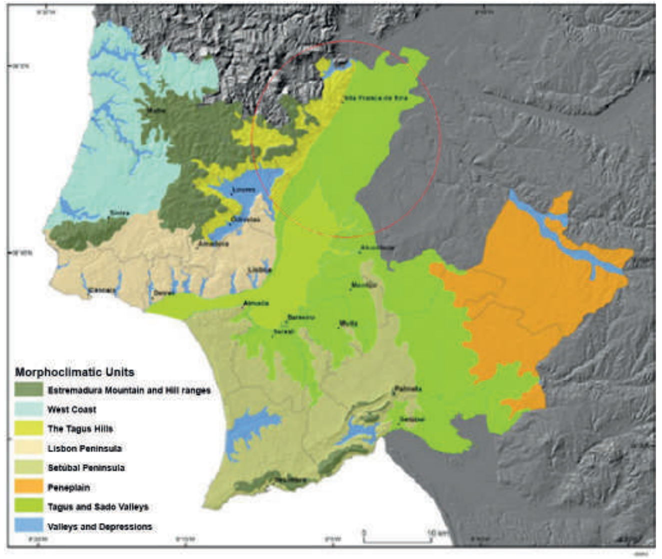


Figure 2 - Morphoclimatic units in the Lisbon Metropolitan Area

UNITS OF DOMINANT LAND USE AND OCCUPATION

The dominant land use and land cover units of the municipality of Vila Franca de Xira were defined based on the units defined in the PMAAC-AML (2018), where a methodology that uses the concept and delimitation of Local Climate Zones (LCZ) was applied and is described in that report.

Local Climate Zones (LCZ) (Steward and Oke, 2012) have been disseminated worldwide through the “World Urban Database and Access Portal Tools” (WUDAPT) project, set up to generate urban-scale “climate” cartography in various cities around the world. It is a model that can be applied at various scales, serving here to define areas of different urban densities.

Among the several advantages of LCZ, we highlight the typical morphometric and energy values of built spaces and other outdoor spaces that are normally used in local and urban climate studies.

Among the several advantages of LCZ, we highlight the typical morphometric and energy values of built spaces and other outdoor spaces that are normally used in local and urban climate studies. The system is also amenable to being applied at different scales, also allowing the characterisation of the territory beyond urban areas (Stewart and Oke, 2012).

Information was updated with the “Land Use and Occupancy Charter - 2018” (DGT, 2019) and the “European Urban Atlas” (2018). The different types of use and cover were grouped into classes according to aerodynamic roughness (z0) values, given their relevance for natural ventilation, and three degrees of urban density were distinguished (high, medium and low), according to the potential effect on both ventilation, and energy and radiative balances.

Trees, agricultural areas, shrub and herbaceous vegetation, water bodies and parks and gardens were also identified, due to the recognised moderating effect of thermal extremes in urban environments.

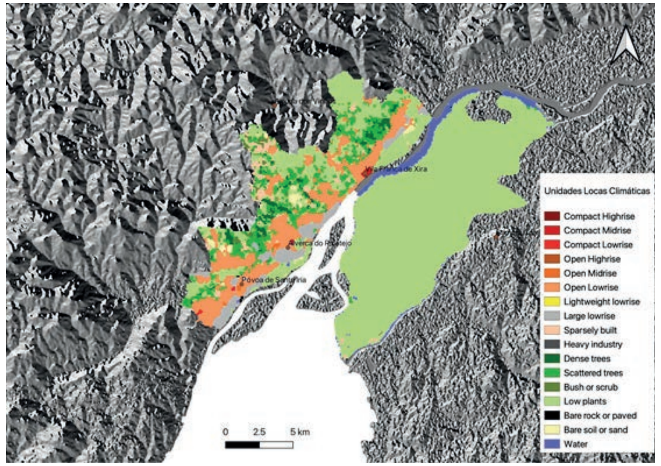


Figure 3 - Local Climate Zones (LCZ) of Vila Franca de Xira
Source: CEDRU (2021)

BIOCLIMATIC CHARACTERISATION AND GEOGRAPHIC SETTING

The municipality of Vila Franca de Xira is located in the district of Lisbon, at a latitude close to 39° north. Similarly to what predominantly occurs throughout the south of mainland Portugal, the climate of the municipality of Vila Franca de Xira represents typical characteristics of the “Mediterranean Climate” (Csa, in the Köppen-Geiger classification). It is a temperate climate type (mesothermal), with rainy winters and hot and dry summers.

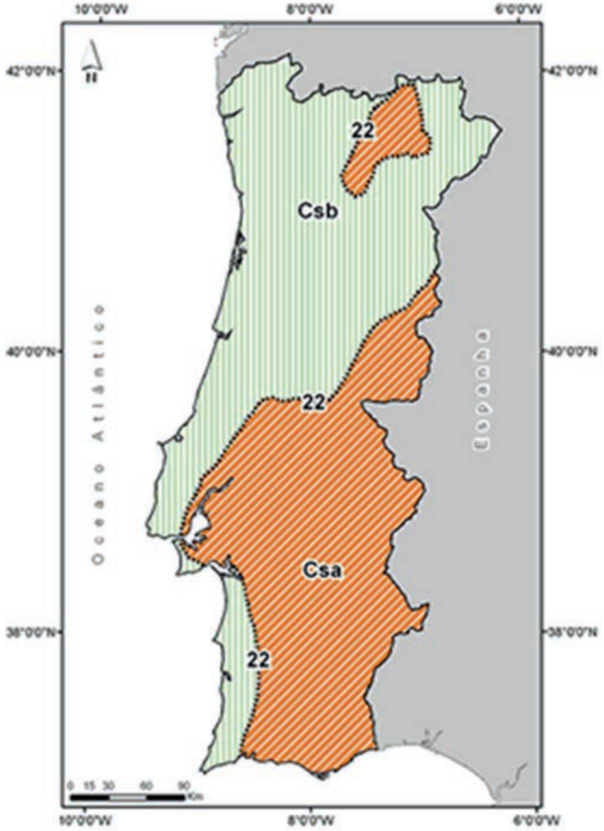


Figure 4 - Climate of Mainland Portugal (Koppen classification)
Source: IPMA

From the point of view of local characteristics, Vila Franca de Xira is positioned on the southeast slope of the Sintra-Montejunto-Estrela mountain system, at a distance of little more than 35 km in a straight line from the ocean, to the west, with the river Tagus crossing the municipality. These conditions influence the local climate, as we shall see below.

As for large scale conditions, the territory under analysis is influenced by two atmospheric systems predominant during the year:

- In the 6 months between November and April, the region is affected by the common westerly circulation of the middle latitudes, with frequent incursions of the polar jet stream. The wind regime is more complex, with variations caused by the passage of frontal disturbances. These disturbances, associated with polar fronts, make this the wettest part of the year, with the rainiest months occurring between November and January.

- Between May and October there is a predominance of subtropical circulation, with the influence of the subtropical anticyclone and the subtropical jet. At this time of year, precipitation is scarcer and irregular, temperatures are substantially higher, and the flow is markedly northwest.

Taking into account the physical conditions of the municipality of Vila Franca de Xira, the spatial diversity of air temperature behaviour is primarily conditioned by proximity to the ocean, altitude and topographic position.

The distance to the sea and the sheltering factor created by the relief impose an increase in seasonal thermal contrasts and increase the spatial diversity of temperature parameters. As altitude increases, there is a general decrease in temperature values and an increase in precipitation. The topographic position constitutes a decisive climatic factor, determining the accentuation of both winter cold and summer heat conditions, especially in the most depressed and sheltered locations.

Keeping the previous considerations in mind, we proceed to characterise the average thermal regime and the extreme values of air temperature across the three decades 1979-2020, representative of the present state of the climate. The characteristics of the thermal regime in each of the 'Morphoclimatic Units' considered are fundamental for this analysis.

In the territory of Vila Franca de Xira, the average temperature is lower in the areas of higher altitude, although with lower thermal amplitudes. In cleared areas, valleys and depressions, the average monthly and annual temperatures are higher, with a higher incidence of very hot days and heat waves, but also lower minimum temperatures due to the thermal inversion phenomenon, which occurs on days with clear skies and weak or calm wind. The radiative cooling of the surfaces means that on these nights the valleys and depressions are colder than areas at higher altitude (Oke, 1994).

The geographical position close to the Atlantic Ocean has a moderating effect on the region's temperatures, and the ocean also serves as a reservoir for the more humid air masses that affect the municipality of Vila Franca de Xira. The presence of the Sintra-Montejunto-Estrela mountain system acts to intercept the advance of air masses coming from the Atlantic on the lower layers, somewhat limiting the oceanic effect, but never completely extinguishing it.

Based on this, two predominant local climatic regions can be considered: the plain of the Tagus river basin, sheltered by the relief to the northwest; and the areas of hills and mountains to the west/northwest/north of the municipality.

The Tagus basin is an element with more continental influences, i.e. with colder winters, with the occasional occurrence of frosts and radiative fogs, and warmer summers; while the hills and mountains areas are more exposed to the oceanic flows from the west/northwest, presenting more days of cloud and precipitation, with higher average annual precipitation, temperatures tending to be lower, and with fewer extremes than the Tagus basin.

Although some details differ between the two local climatic regions, the thermo-pluviometric regime of both is typical of a Mediterranean climate, with rainfall in the cooler half of the year, and hot, dry summers (Csa, according to Koppen). The differences between the local climates of the Tagus basin and the hills and mountains are not sufficient to distinguish two climatic realities on a global macro scale.

CLIMATE SCENARIOS

The process of developing climate scenarios is an exercise based on current scientific knowledge of atmospheric dynamics, in which evolution scenarios are projected at decade and multi-decade scale, which are dependent on anthropogenic GHG emissions and their impacts on atmospheric physical and chemical processes.

Bioclimatic scenario building consists of collecting and processing future climate information (projections) using different models for different climate scenarios (RCP 4.5 and 8.5), serving as baseline information for identifying changes in the future climate.

A climate scenario is a numerical simulation of the future climate based on models of the general circulation of the atmosphere and the representation of the climate system and its subsystems (adapted from IPCC, 2013). Climate projections use greenhouse gas concentration scenarios as input data in climate models, referred to as Representative Concentration Pathways (RCP).

The production of climate scenarios is crucial for determining the risks and vulnerabilities of territories. It is in this sense that projections of the response of the earth's climate system are elaborated as a function of the radiative forcings corresponding to each RCP, which are totally dependent on the greenhouse gas concentration scenarios, directly or indirectly influenced by anthropogenic emissions scenarios.

The IPCC produces these projections with coverage up to the year 2100 for different RCPs, with RCP2.6, RCP4.5, RCP6.0 and RCP8.5 commonly used (with the numbers to the right of the acronym being the radiative forcing in W/m2). These scenarios are organised in increasing order of GHG concentration in the atmosphere at the end of this century (IPCC 2013). The higher the radiative forcing, the greater the emissions and concentration of greenhouse gases in the Earth's atmosphere. And there is a direct relationship between this and the increase in global temperature. These RCPs indicate four GHG emissions projection trajectories, having been calculated in order to contemplate the various plausible future climate scenarios (Van Vuuren et al. 2011).

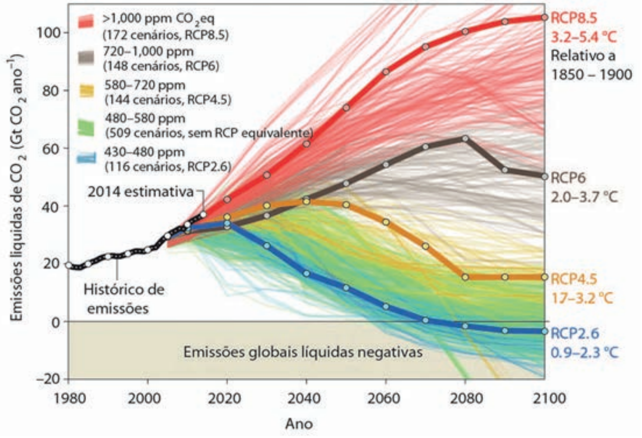


Figure 5 - Projected carbon dioxide emissions up to 2100 and historical emissions
Source: adapted from Fuss et al. (2014)

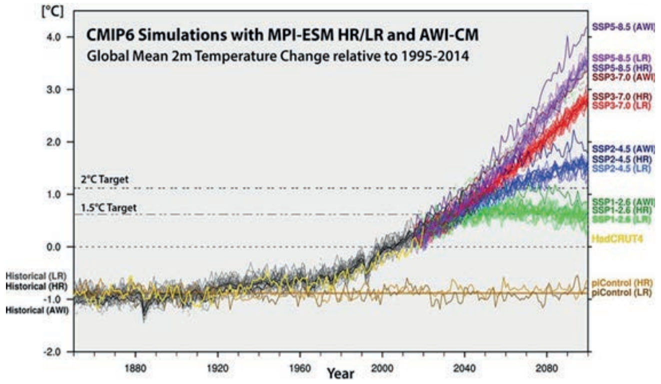


Figure 6 - Global average temperature evolution simulated as a function of different CO2 emission scenarios
Source: DKRZ - German Climate Computing Centre (2020)

These scenarios were based on the assumptions of the Special Report on Emissions Scenarios (Nakicenovic and Swart, 2000). In this way, evolution trajectories for human communities are calculated in relation to urban, industrial, land use and GHG emissions development, all of them plausible. The socio-economic challenges faced throughout these projections are closely related to both mitigation and adaptation postures to climate change (Van Vuuren et al. 2014; Kok. et al. 2019).

The GHG emissions scenarios, associated with the various RCPs, are created based on these assumptions, having clear effects on land use, as well as on decision-making regarding the analysis of territorial vulnerabilities resulting from climate change (O'Neill et al. 2017).

In the present work, from all potential scenarios, two main RCP scenarios were analysed, one of them assuming a moderate control of emissions, designated as RCP4.5, and another assuming that emissions will be maintained at an accelerated rate, with more severe consequences, designated as RCP8.5.

These will then be compared with a climatological baseline obtained by the most recent ECMWF reanalysis (ERA5) for the coordinates point 39°N latitude and 9°W longitude, for the series 1979-2020.

From these scenarios, the framework of the most likely range of variation for the evolution of climate in the territory of Vila Franca de Xira over the coming decades was obtained.

CLIMATE PROJECTIONS 2020 - 2100

METEOROLOGICAL ELEMENTS

AVERAGE ANNUAL TEMPERATURE

A trend towards an increase in the annual average temperature until 2100 is observed, naturally more accentuated in RCP8.5 than in RCP4.5. Current values are around 16-17°C, with increases expected up to around 18-19°C in RCP4.5 by the end of the century and up to more than 20°C in the most severe scenario, RCP8.5.

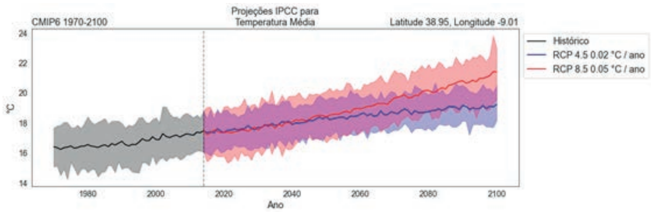


Figure 7 - Projections for the annual mean temperature evolution until 2100 in Vila Franca de Xira

ANNUAL NUMBER OF WARM DAYS (TMAX>30°C AND TMAX>35°C)

As expected, there is a tendency towards an increase in the frequency of hot days per year until 2100, more accentuated in RCP8.5 than in RCP4.5.

For the number of days with Tmax>30°C, the present values are around 40 days per year. An increase is expected by the end of the century with values close to 60 to 70 days per year in RCP4.5, and more than 80 days per year in the most severe scenario, RCP8.5.

Regarding the number of days with Tmax>35°C, the current frequency is around 15 to 20 days per year, with increases up to 25-30 days per year expected in the most moderate scenario, the RCP4.5. In the most severe scenario RCP8.5, the projection is more than 40 such days per year.

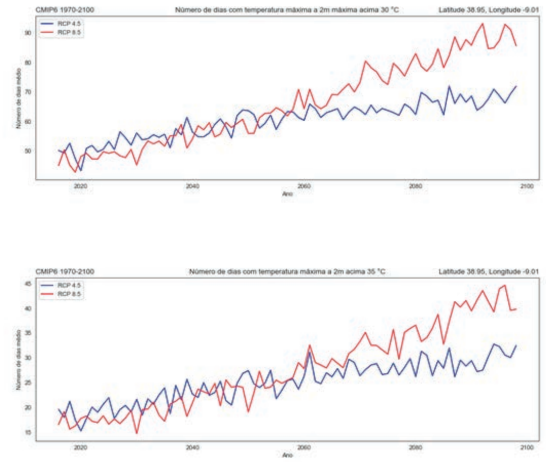


Figure 8 - Evolution of the number of days with maximum temperature above 30°C and 35°C until 2100 in Vila Franca de Xira

ANNUAL NUMBER OF WARM NIGHTS (TMIN>20°C)

Simulations point to a significant increase in the frequency of warm (tropical) nights, with minimum values above 20°C.

In this context, it is projected that the number of tropical nights will exceed 50 nights per year from 2050-2060, which, together with the increase in the frequency of hot days, will significantly increase heat stress.

The frequency of warm nights will be up to five times higher than in the period between 1980 and 2010.

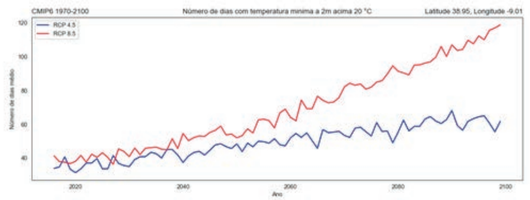


Figure 9 - Evolution of the number of days with minimum temperature above 20°C until 2100 in Vila Franca de Xira

NUMBER OF HOURS WITH AVERAGE WIND HIGHER THAN 37 KM/H (P99, INTENSE SUSTAINED WIND)

With the data that could be obtained from the CIMP6 model, a more general characterisation of the wind intensity evolution until 2100 was performed.

Using daily values, we sought to obtain daily trends for wind above 15km/h, which corresponds to the moderate wind threshold (IPMA).

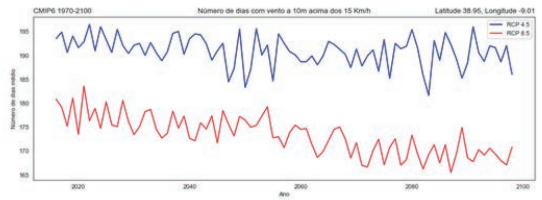


Figure 10 - Evolution of the number of days with wind above 15 km/h until 2100 in Vila Franca de Xira

There is a notable tendency to stabilisation, or even reduction in the number of days with moderate wind (daily average wind above 15km/h), which indicates that no major changes are expected in the frequency of high wind situations arising from large-scale synoptic conditions.

However, this daily analysis does not allow us to draw conclusions about extreme phenomena of small temporal and spatial scale.

HYDROLOGICAL ELEMENTS

AVERAGE ANNUAL PRECIPITATION

Simulations up to the year 2100 point to a decrease in mean annual precipitation, more accentuated in the last two decades of the century and in the RCP8.5 scenario. The average annual precipitation values are expected to decrease around 10-15% compared to current values in both scenarios of climate evolution until 2100. This reduction may seem minor, but it should be taken into account that the increase in temperature will lead to an increase in evaporation and water stress/ water requirements of plants.

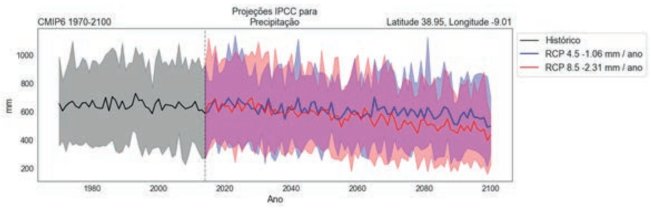


Figure 11 - Projections for the average annual rainfall until 2100 in Vila Franca de Xira

NUMBER OF DAYS WITH PRECIPITATION OVER 10MM, 25MM AND 40MM (HEAVY TO EXTREME RAINFALL)

The average number of days with precipitation higher than 10mm (designated “ days of heavy rain”) tends to decrease in the whole series until the end of the century. The current frequency is around 18-22 days per year, a value that has been maintained since the 1980s, with an expected decrease in frequency to 14-18 days in 2080-2100, with the possibility of a more marked decrease as we approach 2100.

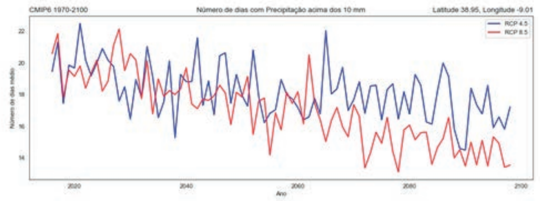


Figure 12 - Evolution of the number of days with precipitation above 10 mm in Vila Franca de Xira

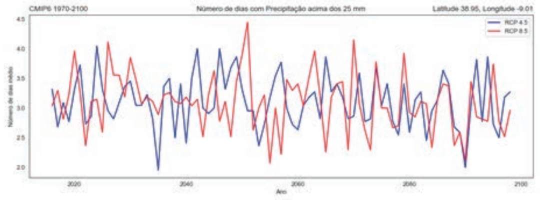


Figure 13 - Evolution of the number of days with precipitation above 25 mm in Vila Franca de Xira

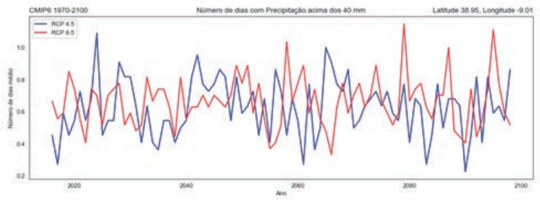


Figure 14 - Evolution of the number of days with precipitation above 40 mm in Vila Franca de Xira

With respect to annual frequencies of days of rainfall above 25 mm and 40 mm (respectively P95 and P99 from the 1979-2020 series), indicative of “days of extreme rain”, a significant change is not expected until 2100, but there might be a slight increase in the frequencies compared to the 1979-2020 series, especially for the more aggressive RCP8.5 scenario.

The respective values for the frequency of extreme rainfall situations are expected to remain between four and eight days per decade in the case of daily precipitation above 40 mm, and around 25 to 35 days per decade in the case of daily precipitation events above 25 mm. These values are slightly higher than the historical series.

ANNUAL WATER BALANCE

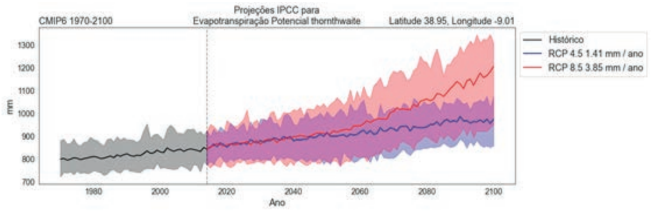


Figure 15 - Projections for Thornthwaite potential evapotranspiration until 2100 in Vila Franca de Xira

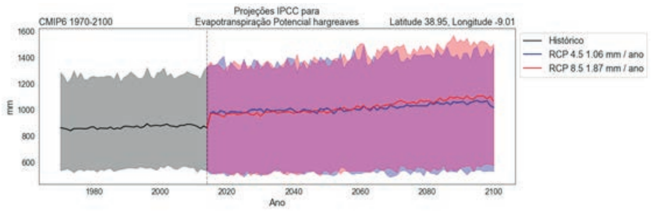


Figure 16 - Projections for Hargreaves potential evapotranspiration until 2100 in Vila Franca de Xira

Regarding the analysis of the values calculated, we observe a clear rising tendency of simulated evapotranspiration up to 2100, without giving too much importance to the exact values.

Regarding the water balance, it can be seen that, given the slight decrease in precipitation values and the upward trend in potential evapotranspiration, a curve is established that also indicates a worsening of the water deficit, with values falling 200 to 400 mm by the end of the century. It should be noted that it is the decreasing trend/magnitude in the water balance that must be underlined and not the exact values, since the calculation method employed is by nature subject to some imprecision.

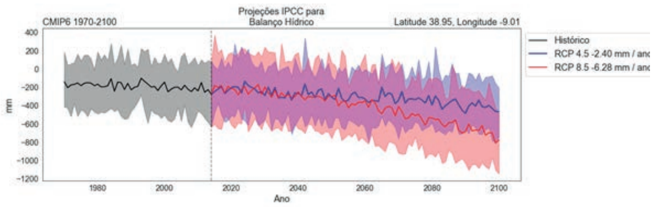


Figure 17 - Projections for hydrological balance till 2100 in Vila Franca de Xira

SEA LEVEL RISE

Based on the results of the IPCC (Intergovernmental Panel on Climate Change) model, the values for sea level rise in Cascais by 2100 are close to 60 to 70 cm in both scenarios presented, with a margin of uncertainty around 30 to 40 cm.

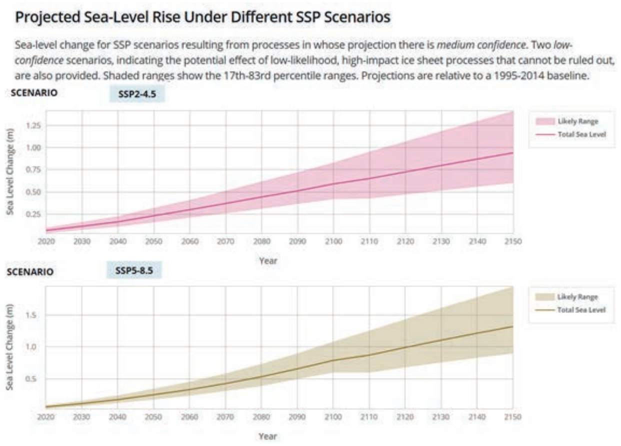


Figure 18 - Scenarios for sea level rise at Cascais (IPCC-AR6)
Source: IPCC-AR6 (2021), 'Sea Level Projection Tool'

CLIMATE CHANGE TRENDS

The clear increase in the frequency of very hot days, with maximum temperatures exceeding 35°C, will certainly have effects on public health, especially on the most sensitive population groups. This impact can be mitigated through interventions such as increasing the size or concentration of green spaces or by improving insulation in houses. However, these measures may be difficult to implement, such as in historical areas of cities, for example.

From a hydrological point of view, there are important points that should be taken into consideration. A slight decrease in annual rainfall and a change in the rainfall regime towards more torrential rainfall is expected. This means that there will be fewer rainy days, fewer days of weak/moderate rainfall, and a relative increase, as a percentage of total rainy days, of extreme precipitation events.

On the other hand, the combination of a decrease in precipitation, an increase in the number of dry days, and a rise in temperature will accentuate the water deficit. It is expected that there will be an extension of the dry season and a worsening of the number of dry and very dry days, as well as a reduction in the length of the wet season and the frequency of aquifer recharge periods, i.e. fewer months with markedly positive water balance. This will reduce the natural recharge of aquifers and lead to greater net water consumption. Mitigating this serious problem will require changes in land use, land cover, and agricultural practices to reduce water losses from soil and aquifers.

There is also the issue of rising water levels in the Tagus estuary, which will put riverfront and low-lying areas at risk. There is a risk of increased flooding, especially at equatorial high tide, as well as of the worsening of possible flood situations in the Tagus. There is a risk of artificial dykes breaking and of a loss of territory, in addition to the advance of saline water bodies inland, leading to the contamination of soils and aquifers.

Recent trends (1981-2010) and Future trends (2071-2100) for normal climatological with more severe effects

↑ **TEMPERATURE**

Average annual temperature (°C)
15,98 (observed 1981-2010)
18,92 (2071-2100 RCP 4.5)
20,44 (2071-2100 RCP 8.5)

Minimum temperature <0 °C
- 0,036 (0 days) (observed 1981-2010)
Temperatura máxima >20 °C
+ 0,022 (10,8 days) (observed 1981-2010)
+ 0,0295 (51,2 days) (2071-2100 RCP 4.5)
+ 0,1289 (89,5 days) (2071-2100 RCP 8.5)

Maximum temperature >30 °C
+ 0,20 (10,2 days) (observed 1981-2010)
+ 0,0227 (62,0 days) (2071-2100 RCP 4.5)
+ 0,0567 (80,5 days) (2071-2100 RCP 8.5)

Maximum temperature >35 °C
+ 0,0127 (27,0 days) (2071-2100 RCP 4.5)
+ 0,0427 (36,1 days) (2071-2100 RCP 8.5)

PRECIPITATION

Average annual precipitation (mm)
612,55 (observed 1981-2010)
571,4 (2071-2100 RCP 4.5)
486,6 (2071-2100 RCP 8.5)

Annual evolution of the number of days with precipitation (> 10 mm)
+ 0,68 (23,0 days) (observed 1981-2010)
- 0,059 (14,0 days) (2071-2100 RCP 4.5)
- 0,043 (16,1 days) (2071-2100 RCP 8.5)

Annual evolution of the number of days with precipitation (> 25 mm)
+ 0,013 (5,1 days) (observed 1981-2010)
- 0,004 (2,9 days) (2071-2100 RCP 4.5)
- 0,004 (2,6 days) (2071-2100 RCP 8.5)

Annual evolution of the number of days with precipitation (> 40 mm)
+ 0,004 (0,6 days) (observed 1981-2010)
- 1,244 (0,5 days) (2071-2100 RCP 4.5)
- 0,003 (0,7 days) (2071-2100 RCP 8.5)

Water balance

Annual water balance (mm)
- 700,77 (observado 1981-2010)
- 375,28 (2071-2100 RCP 4.5)
- 606,55 (2071-2100 RCP 8.5)

No. of months with negative water balance
8 (observado 1981-2010)
7,6 (2071-2100 RCP 4.5)
8,5 (2071-2100 RCP 8.5)

SEA LEVEL

Annual sea level rise (mm)
(dados referentes a Cascais)
3,1 (observado 1981-2010)
8,2 (2071-2100 RCP 4.5)
8,3 (2071-2100 RCP 8.5)

Source: CEDRU (2021), based on ERA5 and CMIP6

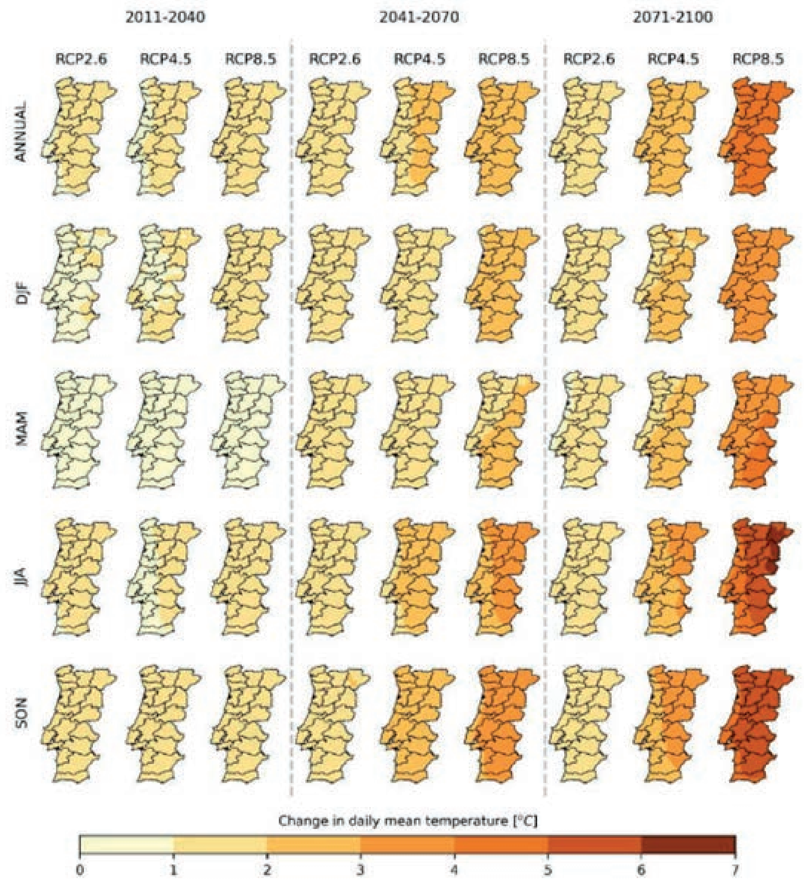


Figure 19 - Projected future changes in mean daily temperature in mainland Portugal, considering the period 1971-2000 as reference. The lines represent the averages obtained in all months. The columns represent the future periods considering different GHG emission scenarios.

Source: National Roadmap for Adaptation XXI, Portuguese Territorial Climate Change Vulnerability Assessment for XXI Century (2023)

CHARACTERISATION OF IMPACTS AND CURRENT AND FUTURE VULNERABILITIES

The territorial, economic, social and environmental reality of the municipality of Vila Franca de Xira constitutes a decisive element for the current and future climate vulnerability of this municipality. The knowledge of this contextual framework is therefore an essential starting point for the diagnosis of the municipality's sensitivity and vulnerability.

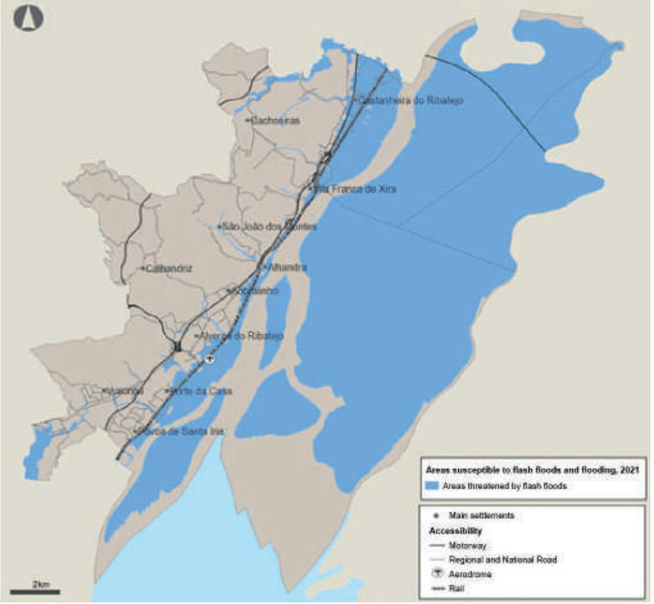
Considering the VFX MAPCC framework in the "National Strategy for Adaptation to Climate Change 2020 (ENAAC)", this analysis should be aligned with the national objective of promoting the integration of adaptation in sectoral policies.

In these terms, the approach defined by VFX MAPCC considers the various adaptation sectors defined by ENAAC, seeking to understand the starting framework of each sector in the municipality of Vila Franca de Xira and to identify the major trends and dynamics that are fundamental for the creation of a base adaptation scenario.

The contextual analysis thus considers not only the social demographic characteristics of the municipality, but also observes the territory from the viewpoint of the adaptation sectors defined by ENAAC, including: biodiversity and landscape; agriculture and forests; water resources; economy (industry, commerce and services and tourism); human health; culture; transport and communications; energy; and riverside areas.

CLIMATE RISKS

RISK OF FLASH FLOODS AND FLOODING

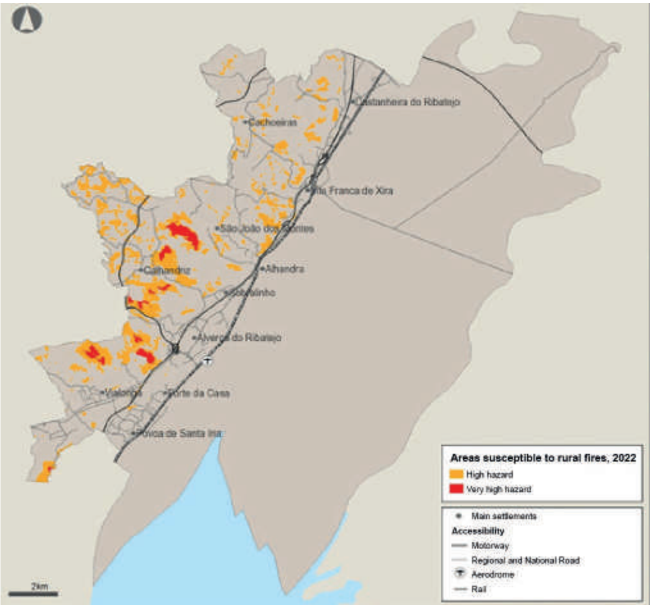


The risk of flash floods and flooding is mainly associated with the natural characteristics of the Tagus hydrographic basin and its combination with the tidal influence in the estuary.

In this sense, the eastern area of the Municipality is strongly affected by progressive flooding and estuarine flooding, especially in the area of the parish of Vila Franca de Xira.

The area of the joint parish council of Castanheira do Ribatejo and Cachoeiras is susceptible to flash flooding and the area of the joint parish council of Alverca do Ribatejo and Sobralinho is susceptible to estuarine flooding. In turn, flash floods occur along the flood beds of the Silveira river, the Santo António stream, the Santa Sofia stream, the Carregado ditch and Grande da Pipa river, particularly in the village of Quintas, affecting all the parishes in the municipality, with the exception of the joint parish council of Póvoa de Santa Iria and Forte da Casa. The parishes of Vialonga and Castanheira do Ribatejo and Cachoeiras are more susceptible to flash flooding phenomena.

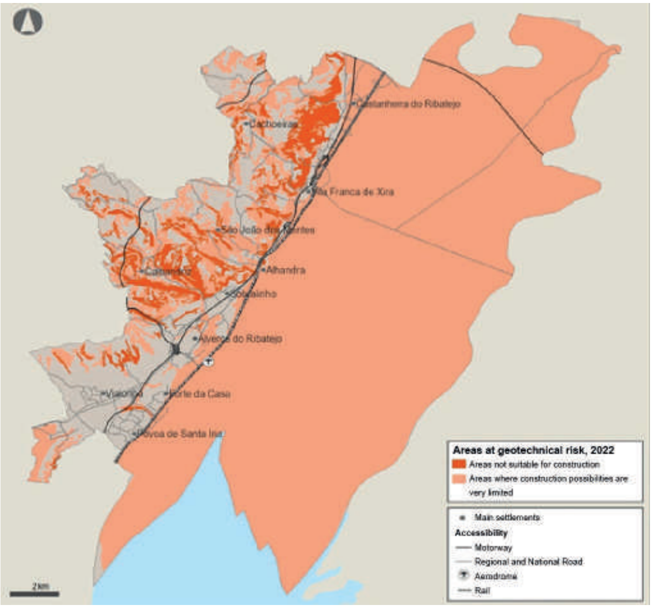
FIRE RISK



The western area of the municipality is particularly susceptible to fire, including the joint parish council of Alhandra, São João dos Montes and Calhandriz area, the joint parish council of Alverca do Ribatejo and Sobralinho, and the parish of Vialonga. This is due to the combination of the orographic characteristics of the territory, since the combination of sloping areas with forested spots results in the presence of high and very high hazard ranges. Around 16% of Vialonga and the joint parish council of Alhandra, São João dos Montes and Calhandriz is covered by one of these two hazard classes.

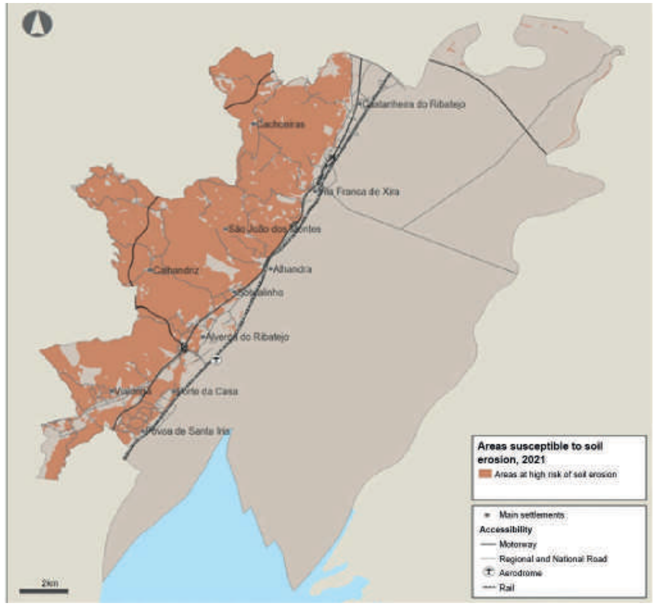
On the contrary, the characteristics of the joint parish council of Póvoa de Santa Iria and Forte da Casa do not include any area covered by these hazard levels. In the case of the parish of Vila Franca de Xira, the proportion covered is only 1% of its total territory.

RISK OF SLOPE INSTABILITY



The geomorphologic and lithologic characteristics of the municipality result in a framework of particular complexity regarding the instability of its slopes, which is reflected in the extent of areas where construction is inadvisable and areas where construction possibilities are limited.
The areas not advisable correspond to spaces with very high susceptibility, with slopes or lithology that are very unfavourable for construction. Areas with very limited possibilities for construction are areas of high susceptibility, in situations of slopes and/ or unfavourable lithology, including alluvium and slope deposits. This typology justifies the fact that the entire left bank of the Tagus is categorised as an area with very limited possibilities for construction, since it corresponds to an area of alluvial deposits. In this context, the analysis of slope instability focuses on areas where construction is inadvisable, whose typology refers to situations of greater geotechnical complexity, which, in several cases, results from the presence of water lines and valley bottoms with a high level of insertion. moisture.
Its location is therefore more circumscribed, including the central area of the joint parish council of Alhandra, São João dos Montes and Calhandriz, and the territory north of the town of Vila Franca de Xira.

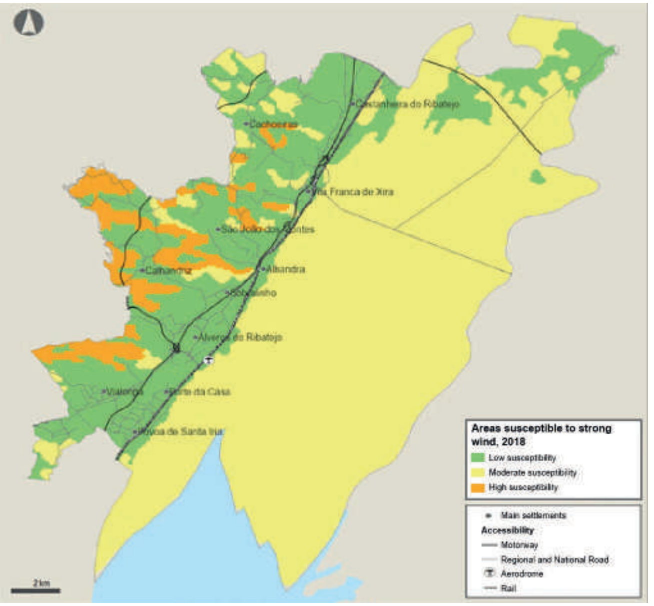
SOIL EROSION RISK



Regarding the risk of soil erosion, and given the parameterisation of the basic methodology (“universal equation of soil loss”), we observe that the areas susceptible to this risk typology are again concentrated in the territory north of the Tagus River, mainly due to topographic factors and the erodibility of the soil.

For this reason, 89% of the soil of the joint parish council of Alhandra, São João dos Montes and Calhandriz area presents a high risk of water erosion, followed by the parish of Vialonga, with 72% of its territory in this condition. The fact that no part of the left bank territory presents susceptibility to this phenomenon and it is the larger territorial dimension justifies the parish of Vila Franca de Xira presenting only 5% of its area in a situation of susceptibility to soil erosion.

WINDSTORM RISK

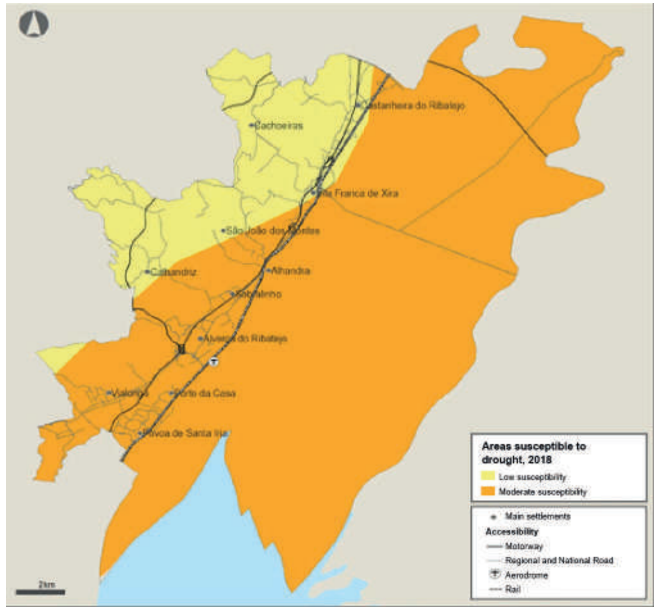


Similar to the situation observed for other risks, in the susceptibility to strong winds there is a marked dichotomy between the two banks of the River Tagus which make up the municipality.

In the case of the left bank, there is a predominance of moderate susceptibility to windstorms, resulting from a greater homogeneity in orographic terms and exposure to the prevailing winds. On the right bank, resulting from its orographic diversity and greater complexity in terms of aerodynamic roughness, the situation is more diverse. There is a great variability between areas of low and high susceptibility caused by small-scale orographic issues (valley orientation) that impact this phenomenon.

In territorial terms, it is the western parishes (the joint parish council of Alhandra, São João dos Montes and Calhandriz, the joint parish council of Alverca do Ribatejo and Sobralinho, and the parish of Vialonga) that present the highest susceptibility to windstorm phenomena.

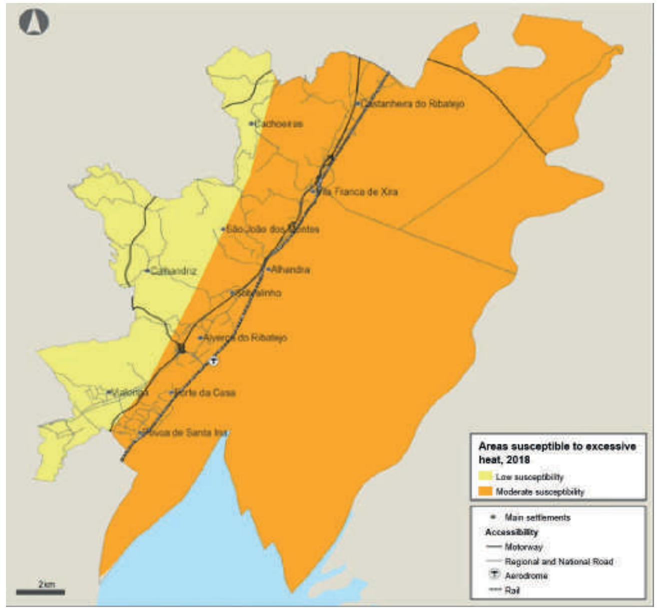
DROUGHT RISK



The characterisation of meteorological drought events carried out through the application of the SPI ('Standardised Precipitation Index') allows for the conclusion that he municipality of Vila Franca de Xira has low to moderate susceptibility. In this context it is important to highlight that the entire left bank of the Tagus, where agricultural activities prevail, is framed in the moderate classification of susceptibility. Likewise, the presence of several classified natural areas (Natural Reserve of the Tagus Estuary, and the Special Protected Area and Environmental Conservation Zone of the Tagus Estuary) also contribute to the complexity of this situation.

The susceptibility of the parish of Vila Franca de Xira stands out within the administrative organisation of the territory, with 94% of its territory in moderate susceptibility, especially considering the nature of its occupation of the south bank. Indeed, the entirety (100%) of the joint parish council of Póvoa de Santa Iria and Forte da Casa is in the same situation, although the nature of its occupation is not as sensitive to these events.

RISK OF EXCESSIVE HEAT (HEAT WAVE)



The municipality of Vila Franca de Xira presents a low to moderate susceptibility to excessive heat, increasing from west to east. Similarly to drought, the parish of Vila Franca de Xira and the joint parish council of Póvoa de Santa Iria and Forte da Casa has the highest proportion of their territory falling within the most severe scale in the municipality, with 100% and 97%, respectively.

Meanwhile, the parish of Vialonga (93%) and the joint parish council of Alhandra, São João dos Montes and Calhandriz (77%) are those with the largest relative area framed in the low heat susceptibility class.

SENSITIVITY OF THE TERRITORY

Climate sensitivity is defined as “the degree to which a system is affected, either negatively or positively, by climate-related stimuli. The effect can be direct (e.g. change in crop yield in response to a change in mean, range or variability of temperature), or indirect (e.g. damage caused by an increase in flood frequency due to sea level rise)” (IPCC, 2007).

Based on the available literature, and considering that not all elements of the system are sensitive to all climatic stimuli, it is important to clarify which specific stimulus affects each element of the system.

Moreover, the same stimulus may affect various systems differently, depending on the particularities of the territory. For example, changes in the summer temperature pattern may affect the tourism sector positively or negatively depending on existing climatic conditions, while the agricultural sector may benefit from an increase in rainfall or not, depending on various local factors.

The following provides an overview of the sensitivity indicators used under the VFX MAPCC to which the exposure indicators have been linked. This link between sensitivity and exposure will be further considered when projecting future climate impacts and vulnerabilities.

Indicators of climate sensitivity	Indicators of climate exposure								
	Increase in average annual temperature	Decrease in the number of days with frost	Increase in number of summer days	Changes in average winter precipitation	Decrease in average summer precipitation	Increase in number of days of heavy rainfall	Increased average annual evaporation	Increased occurrence of flooding	Rise in average sea level
Environmental sensitivity									
Flash floods and flooding									
Areas with high ecological value sensitive to flash floods and flooding						●		●	●
Urban ecological structure sensitive to flash floods and flooding						●		●	●
Fire									
Areas of high ecological value sensitive to fires			●		●*				
Urban ecological structure sensitive to fires			●		●*				
Soil erosion									
Areas of high ecological value sensitive to soil erosion						●			
Urban ecological structure sensitive to soil erosion						●			
Drought									
Areas with high ecological value sensitive to drought						●			
Urban ecological structure sensitive to drought						●			
Urban green areas sensitive to drought						●			
Heat wave									
Areas with high ecological value sensitive to heat						●			
Urban ecological structure sensitive to heat						●			
Urban areas with traffic congestion sensitive to heat						●			

Indicators of climate sensitivity	Increase in average annual temperature	Decrease in the number of days with frost	Increase in number of summer days	Changes in average winter precipitation	Decrease in average summer precipitation	Increase in number of days of heavy rainfall	Increased average annual evaporation	Increased occurrence of flooding	Rise in average sea level
Physical sensitivity									
Flash floods and flooding									
Dwellings sensitive to flash floods and flooding						●		●	●
Buildings sensitive to flash floods and flooding						●		●	●
Equipment and services sensitive to flash floods and flooding						●		●	●
Transport infrastructure sensitive to flash floods and flooding						●		●	●
Energy infrastructure sensitive to flash floods and flooding						●		●	●
Fire									
Dwellings sensitive to fire			●		●				
Buildings sensitive to fire			●		●				
Transport infrastructure sensitive to fire			●		●				
Energy infrastructure sensitive to fire			●		●				
Slope instability									
Dwellings sensitive to slope instability						●		●	
Buildings sensitive to slope instability						●		●	
Equipment and services sensitive to slope instability						●		●	
Transport infrastructure sensitive to slope instability						●		●	
Energy infrastructure sensitive to slope instability						●		●	
Heat wave									
Continuous built areas sensitive to heatwaves	●		●						

Indicators of climate sensitivity	Increase in average annual temperature	Decrease in the number of days with frost	Increase in number of summer days	Changes in average winter precipitation	Decrease in average summer precipitation	Increase in number of days of heavy rainfall	Increased average annual evaporation	Increased occurrence of flooding	Rise in average sea level
Social sensitivity									
Flash floods and flooding									
Populations sensitive to flash floods and flooding						●		●	●
Fire									
Populations sensitive to fires			●		●				
Slope instability									
Populations sensitive to slope instability						●			
Heat wave									
Populations sensitive to heat waves			●						
Cultural sensitivity									
Flash floods and flooding									
Cultural facilities sensitive to flash floods and flooding						●		●	●
Classified heritage sensitive to flash floods and flooding						●		●	●
Fire									
Classified heritage sensitive to fires			●		●				
Slope instability									
Cultural facilities sensitive to slope instability						●		●	
Classified heritage sensitive to slope instability						●		●	

Indicators of climate sensitivity	Indicators of climate exposure								
	Increase in average annual temperature	Decrease in the number of days with frost	Increase in number of summer days	Changes in average winter precipitation	Decrease in average summer precipitation	Increase in number of days of heavy rainfall	Increased average annual evaporation	Increased occurrence of flooding	Rise in average sea level

Economic sensitivity									
Flash floods and flooding									
Economic activities sensitive to flash floods and flooding								●	●
Tourist activities sensitive to flash floods and flooding								●	●
Fire									
Agricultural areas sensitive to fires			●		●*				
Economic activities sensitive to fires			●		●*				
Tourism activities sensitive to fires			●		●*				
Slope instability									
Economic activities sensitive to slope instability						●		●	
Tourism activities sensitive to slope instability						●		●	
Soil erosion									
Agricultural areas susceptible to soil erosion						●			
Drought									
Agricultural areas susceptible to drought							●		
Heat wave									
Tourist activities sensitive to heat			●		●				

CURRENT IMPACTS AND VULNERABILITIES

The analysis of current impacts and vulnerabilities obtained through the analysis of the "Local Climate Impacts Profile (LIC-P)" indicates that the observed climate impacts in the county are mainly associated with the following climate events:

- Excessive precipitation (flash floods and flooding), with a total of 63 events recorded;

- Mass movements on slopes or landslides associated with rainfall or other climatic factors, with seven recorded events;

- High temperatures/heat waves, with three recorded events;

- Strong wind, with two recorded events.

Besides these occurrences, no other significant events were identified, particularly those related to ice formation, frost or snowfall, fog and mist, thunderstorms / lightning or situations of extreme drought.

ADAPTIVE CAPACITY

The adaptive capacity of a territory is reflected in the way local actors deal with adverse climatic phenomena, with the availability of resources to respond to the various occurrences being an important indicator of the capacity for prevention and intervention.

A territory with adequate resources and structured measures to face this type of events will be better prepared to face the impacts of climate change, and thus, mitigate the negative effects of climate phenomena across the various areas of society.

Over the last few years, the Municipality of Vila Franca de Xira has been particularly affected by excessive precipitation events, which have resulted in floods and landslides, and which triggered several response actions, systematised below by typology:

- Emergency civil protection actions, including rescue and salvage operations, hospital relief and transportation, rehousing of the homeless, recovery of property, pumping of water and restoration of normality;

- Regularisation and cleaning of water lines (Grande da Pipa River);

- Cleaning, expansion and remodelling of the Crós-Cós river, complemented by a retention basin, at the back of Avenida Infante D. Pedro in Alverca, which functions to retain rainwater and at the same time send it to the Tagus River through three existing underground outfalls;

- Slope stabilisation;

- Delimitation of the zones threatened by floods in the Municipal Master Plan and the National Ecological Reserve map.

PERCEIVED ADAPTIVE CAPACITY

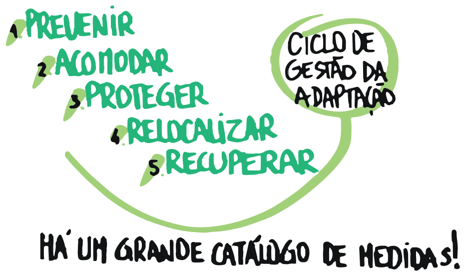
In the context of the development of the VFX MAPCC, several moments of contact relevant to climate change took place with local and regional actors.

In this context, a participatory methodology was developed to collect the perceptions of participants regarding adaptive capacity in terms of knowledge and human capital, as well as in terms of social and financial capital.

For this purpose, participants were organised into working groups and the levels of perceived adaptive capacity of several typologies of entities in these two domains were identified:

Central Administration;
Health Authorities;
Municipal Council;
Parish Councils;
Police and security;
Fire fighters;
Local Associations / Private Institutions of Social Solidarity;
Schools;
Citizens.

The data found allow us to conclude that there are slightly higher levels of adaptive capacity in the domain related to knowledge and human capital. The high level of recognition of climate change as a problem attributed to the Central Administration is clear, even though a less favourable situation is identified regarding the availability of human resources.
In this particular field, there are five types of entities framed in the intermediate level of adaptive capacity, three of which (local associations and private institutions of social solidarity, parish councils and citizens in general) are attributed a lower level of adaptive capacity, resulting from the lower availability of human resources (where applicable) and a medium level of sensitivity to the issue of climate change.



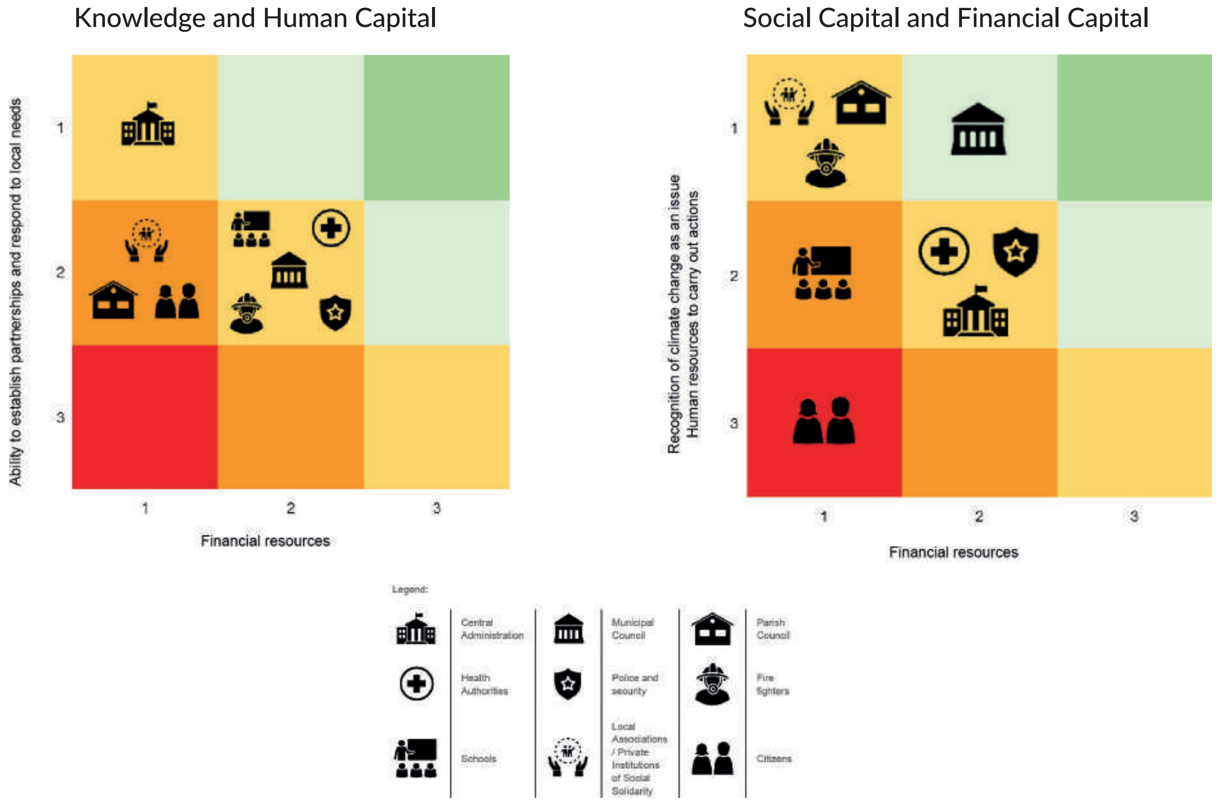


Figure 20 - Perceived adaptive capacity

Adaptive capacity in terms of social and financial capital is somewhat disperse, a situation which is justified by the diverse nature of entities analysed. We highlight the lower adaptive capacity attributed to citizens in general, owing to the reduced availability of resources and the inability to establish partnerships, as well as schools, although in this case the result is mainly due to the lower availability of financial resources.

Meanwhile, the highest adaptive capacity is attributed to the Municipal Council, resulting from a greater ability to respond to local needs and establish commitments and partnerships, even though the availability of financial resources is attributed an intermediate level. The availability of financial resources also reflects the lower adaptive capacity attributed to the Fire Brigade, Parish Councils and Local Associations / Social Solidarity Organisations, despite their good capacity to establish partnerships and respond to needs. Health Authorities, Police and Central Administration are also attributed an intermediate level.

FUTURE IMPACTS AND VULNERABILITIES

The analysis of the territory's climate assessment, its climate projections, the territorial context, the sensitivity to climate stimuli and the current climate impacts and vulnerabilities allow us to anticipate the main negative impacts associated with climate change that will affect the municipality of Vila Franca de Xira in the future.

The main direct and indirect negative impacts that are expected to affect the municipality, organised according to the nine sectors of the ENAAC 2020, are presented in the next table.

Sector	Direct negative impacts (threats)	Indirect negative impacts (threats)
Agriculture and forestry	Soil more exposed to extreme weather events will be more subject to potential loss of agricultural productivity; Erosion of the topsoil, composed of organic matter leaching from the soil, and potential contamination of water; Temporary crops and possibly permanent crops will suffer significant damage and losses; Significant damage and losses in agricultural and livestock activity due to reduced availability of food/feed; A tendency towards an increase in the occurrence of forest/rural fires, with more serious impacts on forest canopies and understorey; Decrease in native forest mass, with the possibility of the introduction of invasive woody species; Saline intrusion in the Lezíria wetlands.	Transformations in the agricultural and forestry mosaic, with a reduction in native species; Decrease in water storage levels for irrigation; Increased contamination of surface and underground water; Possible depopulation/abandonment of small farms due to loss of soil fertility; Possible damage: to agricultural support facilities, to buried and suspended water and electricity supply infrastructure, to access roads (rural tracks); Possible reduction in agroforestry yields associated with current crops and species/ varieties.
Biodiversity and landscape	Changes in the territorial distribution of biodiversity and in the potential of vegetation; Changes in land use and occupation; Reduced availability of water in ponds and reservoirs; Decrease in the extent of salt marsh vegetation; Decrease in agricultural crop productivity with greater dependence on water availability;	Increase in landslides; Changes in the mosaic of agricultural and forestry landscapes; Spread of invasive exotic species in burnt areas; Increase in periods of food shortage for livestock in extensive raising.

	Decrease in the productivity of forest stands, especially eucalyptus and pine; Decrease in fish farm productivity; Changes in ecosystem behaviour and the occurrence of eutrophication problems due to the conditioning of chemical and biological processes in water environments; Increase in environmental stress on fish and aquatic species; Decrease in freshwater fish and amphibian populations; Phenological changes with effects on the life cycle of species (birds, plants).	
Economy	Increased occurrence and intensification of damage in areas of economic activity; Increase in energy consumption in hotels and local accommodation; Increased thermal discomfort of tourists; Increasing occurrence and intensification of damage to elements of built historical and cultural heritage, especially archaeological heritage, which is the most vulnerable.	Possible extension of epidemic-prone geographical areas for some diseases due to changes in survival thresholds of pathogens and vectors; Increased possibility of disease transmission resulting from degradation of water quality; Restrictions on domestic water consumption; Reduced air quality and increased respiratory problems.

Sector	Direct negative impacts (threats)	Indirect negative impacts (threats)
Human health	Increased morbidity and mortality associated with summer heat spikes and discomfort; Increased levels of ozone and air pollutants associated with high temperatures; Increase in vector-borne diseases.	Possible extension of epidemic-prone geographical areas for some diseases due to changes in survival thresholds of pathogens and vectors; Increased possibility of disease transmission resulting from degradation of water quality; Restrictions on domestic water consumption; Reduced air quality and increased respiratory problems.
Safety of people and goods	Increased fire frequency and burned area, related to increased dryness of combustible material; Increased frequency and intensity of droughts; Increased exposure of people to extreme heat events (heat waves); Increased frequency of flash floods and flooding in urban areas; Increased frequency of surface slope movements; Increased damage to equipment and infrastructure.	Interruption of normal road circulation; Increased soil erosion; Loss of agricultural and forest productivity; Reduction of water availability for urban consumption; Reduction of thermal comfort; Reduced air quality and increased respiratory problems; Decreased efficiency of emergency and rescue services due to increased demand.
Transport and communications	Increased need for weather-appropriate (mainly high-temperature resistant) surfacing of infrastructure; Increased damage to communication routes.	Increased congestion on roads; Decreased safety conditions.

Sector	Direct negative impacts (threats)	Indirect negative impacts (threats)
Energy	Increase in peak energy consumption with the occurrence of heat waves; Imbalances between demand and supply of electricity; Increased damage to energy infrastructure; Reduction of efficiency and possible failure in energy distribution and transport systems; Loss of efficiency of power generation equipment.	Reduced thermal comfort of homes in summer: Difficulties in cooling processes or equipment using water; Reduction of electricity production in thermoelectric power stations: Reduction of hydroelectric production capacity; Decrease of biomass for thermoelectric biomass power plants.
Water resources	Changes in surface runoff and in aquifer recharge, resulting in a decrease in water availability; Decrease in the quality of water resources; Reduction of freshwater inflows into the Tagus River; Advance of the salt/fresh water interface towards the interior; Restrictions in water supply and consumption.	Increased water needs for domestic and agricultural consumption; Decrease in hydroelectric power production capacity; Impacts on biodiversity; Degradation of the quality of water resources in burnt areas; Restrictions on the conservation of urban green spaces and the use of collective equipment, such as swimming pools.
Riverside areas	Alterations to biodiversity and riverside landscape; Alterations to the temperature and pH of the water in the estuary; Effects on recreational and leisure spaces.	Saline intrusion, contamination of aquifers, and loss of agricultural productivity; Aggradation of the estuarine body; Damage to urbanised areas.

Sector	Direct negative impacts (threats)	Indirect negative impacts (threats)
Agriculture and forestry	Increase in the productivity of some agricultural systems resulting from the projected increase in the average minimum temperature (orchards, cereals, vineyards, etc.).	Directing the planning policy for farming and forestry areas affected by fires towards environmental sustainability and the promotion and enhancement of endogenous resources; Introducing more resilient native agroforestry and livestock species, in a process of replanting and plant and animal regeneration that is better adapted to the new climate conditions; Implementation of policies leading to greater rationality and efficiency in the use of water in agricultural and forestry production.
Biodiversity and landscape	Increase in the area of mudflats exposed at low tide.	Increase in crops characteristic of warmer thermal regions; Increased availability of food for wading bird populations, with the increase in uncovered mudflats; Increase in the number of birds that stop migrating in autumn and winter and become residents, extending the tourist season associated with their observation.
Economy	Increase in tourist demand in the autumn, winter and spring months, reducing seasonality.	Increase in energy efficiency of the hotel/ local accommodation and tourism support equipment; Changes in biodiversity and landscape, in particular by increasing areas of Mediterranean sclerophyllous scrubland, with potential interest for tourists from central and northern Europe.

Sector	Direct negative impacts (threats)	Indirect negative impacts (threats)
Human health	Potential decrease of cold-related diseases, namely circulatory and respiratory diseases, and consequent reduction of excess mortality during winter.	Incorporation of bioclimatic guidelines in new building and urban planning rules.
Safety of people and goods	Changes in vegetation composition and conditions, with implications for the reduction of forest fuel and the potential for fire propagation; Decreased impacts resulting from cold spells; Reduction of road accidents caused by bad weather conditions (reduction in the number of rainy days).	Possibility of introducing species adapted to dryness and more resilient to fires; New rules for building and urban planning in more sensitive areas; Regulation of land use according to the territorial incidence of risks in climate change scenarios, guaranteeing the safety of people and goods and environmental quality.
Transport and communications	Less degradation of road infrastructure due to the decrease in temperature ranges and precipitation volumes; Possibility of using new pavement types and road seals with greater adaptability and better drainage.	Reduction of accidents and landslides and, consequently, damage to infrastructures; Reinforcement of intermodality and connectivity of public transport.
Energy	Reduction in energy needs for heating; Increased potential for solar photovoltaic energy production; Increase in the production potential of biomass power stations.	Greater thermal comfort in winter; Possibility of investment in photovoltaic plants and micro generation; Renewal of air conditioning equipment/ increased energy efficiency; Building renovation (insulation, windows).
Riverside areas	ncreasing the attractiveness of riverside areas in the summer.	Articulation of the Tagus River drought management plans in Portugal and Spain.

Sector	Direct negative impacts (threats)	Indirect negative impacts (threats)
Water resources	(-)	Reinforcement of water supply and treatment infrastructure; Search for alternative/new water catchments; Efficient use of water.

EVALUATION OF CLIMATIC RISK

With the aim of evaluating the potential evolution of climate risk for the municipality of Vila Franca de Xira in a more systematic way, an analysis based on risk tables was carried out, which allows a prioritisation of the different climate risks regarding potential adaptation needs. The climate risk assessment was based on the climate and vulnerability assessment work developed throughout the preparation of the VFX MAPCC and the internal climate risk assessment process developed by the Municipality of Vila Franca de Xira.

The level of risk identified is based on the evolution of climate variables considering the change scenarios projected for the medium and long term, and on the research and analysis carried out on the climate sensitivity of the territory and on current and future impacts and vulnerabilities.

Climate Risk	Risk Level: Present (up to 2040)	Risk Level: Medium Term (2041/2070)	Risk Level: Long Term (2071/2100)	Risk Trend
A. Excessive rainfall	6	9	9	↑
B. High temperatures/heat waves	4	9	9	↑
C. Reduced precipitation/drought	2	6	9	↑
D. Frost	2	1	1	↓
E. Low temperatures/cold waves	3	2	1	↓
F. Strong winds	2	2	2	→
G. Rise in mean sea level	2	3	6	↑

Key:
Risk level: Low – Moderate – High
↑ Increased Risk → Maintained Risk ↓ Decreased Risk

Figure 21 - Risk level and trends by climate risk
Source: CEDRU (2022)

The climate scenarios point towards an aggravation of the impacts associated with climate risks that are already having a significant impact on the municipality, namely events associated with excessive precipitation and heat waves.

With regard to precipitation, the climate scenarios project an increase during winter and a progressive reduction in autumn, spring and summer. While the scenarios project a decrease in the number of days of precipitation, they also foresee an increase in the frequency of days with very intense precipitation (equal to or greater than 20mm) in winter. Heavy precipitation events already have significant impacts, with the risk expected to worsen in the medium and long term.

The most significant changes projected for the climatic parameters of the municipality of Vila Franca de Xira are associated with the increase in minimum and maximum air temperatures, as well as with a significant increase in the number of summer days and tropical nights and an increase in the number of very hot days and the number of heat wave days. The current consequences of high temperature/heat wave events are considered moderate and are mainly associated with increased morbidity. Considering the projected scenarios and taking into account the negative impacts of reduced precipitation and increased occurrence of droughts, the level of climate risk associated with high temperatures/heat waves is expected to increase over the next century, becoming very high in the 2041-2070 period. The projections point to an increase in the frequency and intensity of droughts that, associated with the decrease in total precipitation and the number of days of precipitation, will make these climate hazards that are currently infrequent in Vila Franca de Xira increasingly common, with consequences of greater magnitude.

Regarding the climate risk associated with frost, currently at a low risk level, the projections point to a generalised trend of reduction and may even cease to occur in the county.

The climate risk trend associated with strong winds will remain unchanged in the medium and long term, taking into account that climate scenarios do not project significant changes for the territory in these periods. There is a tendency for the number of days with moderate wind (average daily wind >15km/h) to stabilise (or even reduce), which indicates that no major changes are expected in the frequency of high wind situations caused by large-scale synoptic conditions. It is expected that the level of risk associated with this climatic event will remain low until 2100. However, this daily analysis does not allow us to draw conclusions about extreme phenomena of small temporal and spatial scale.

It is important to highlight the implications of the rise in mean sea level for the occurrence of estuarine flooding, either on the right bank of the Tagus River, or in Alhandra, Póvoa and Lombo do Tejo wetland islands, which will be seriously affected in an Extreme Scenario of Coastal Flooding for the period to 2100 (long-term future), with mean sea level rise according to the “Mod. FC_2” projection (of 1.15 m relative to Cascais vertical data of 1938), and with a maximum high tide (with meteorological elevation) of the 100-year return period (Antunes C., Rocha C. and Catita C. (2017)).

From the analysis carried out, we conclude that the risks with a more pronounced and worrying probability of increase, and therefore of the highest priority, are those related to the increase of excessive precipitation, high temperatures / heat waves, and the reduction of precipitation / drought.

The figure on the evolution of climate risk for the main impacts associated with climate events presents, in a schematic way, the risk evolution for the main impacts associated with climate events in the municipality of Vila Franca de Xira, indicating the evaluation of priorities. All impacts that present climate risk values (resulting from the multiplication of the frequency of occurrence by the magnitude of the impact) equal to or greater than 6, in the present or in any of the future periods considered, are considered to be a priority.

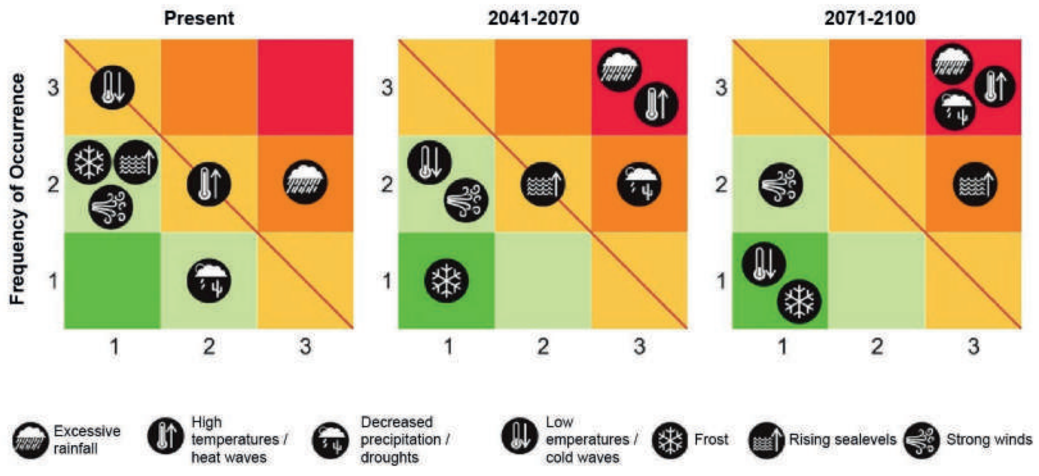


Figure 22 - Evolution of climate risk
Source: CEDRU (2022)

PRIORITY VULNERABLE TERRITORIES

Priority vulnerable territories are territorial units with relatively homogeneous characteristics, distinguished in the municipal context by their greater sensitivity and vulnerability to certain climatic stimuli and which, as such, deserve special attention in the definition of short- and medium-term climate change adaptation options.

Several criteria were taken into consideration in the identification of priority vulnerable territories, including:

- the results of territorial contextualisation studies and the delimitation of flood, fire and erosion risk areas
- the bioclimatic assessment of the municipality;

- assessment of the environmental, physical, economic, social and cultural sensitivity of the territory to climatic stimuli;

- analysis of the recent history of the impacts and consequences of extreme climatic events registered in the municipality;

- the representativeness of the different climatic stimuli and vulnerabilities (droughts, excessive precipitation associated with flash floods, high temperatures/heat waves, erosion and flooding).

As a result, the following priority vulnerable territories were identified for the municipality of Vila Franca de Xira, characterised in the table below and located in the following figure.

Priority Vulnerable Territory	Main Climate Vulnerabilities	Risk Level		
		Present (up to 2040)	Medium Term (2041/2070)	Long Term (2071/2100)
PVT1 | Rio Grande da Pipa	Flash floods and flooding	6	9	9
PVT2 | Ribeira de Santa Sofia				
PVT3 | Ribeira de Santo António				
PVT4 | Rio da Silveira e Rio Crós-Cós				
PVT5 | Ribeira dos Povos				
PVT6 | Ribeira de Castanheira				
PVT7 | Ribeira dos Caniços				
PVT8 | Ribeira da Verdelha				
PVT9 | Areas and high fire risk	Forest / Rural fires	4	9	9
PVT10 | Lezíria wetlands	Meteorological droughts	2	6	9
PVT11 | Western Agricultural Sector				
PVT12 | Vila Franca de Xira Riverfront	Rise in mean sea level and estuary flooding	2	3	9
PVT13 | Alhandra Riverfront				
PVT14 | Alhandra, Lombo do Tejo and Póvoa wetland islands				
PVT15 | Lezíria wetlands				
PVT16 | Ribeirinha Ponte Marechal Carmona Riverfront – Vala do Carregado				
PVT17 | Alverca/Sobralinho Riverfront – Parque Linear Ribeirinho				
PVT18 | Póvoa de Santa Iria Urban Park Riverfront – Solvay				
PVT19 | Vila Franca de Xira	Heat waves	4	9	9
PVT20 | Alhandra				
PVT21 | Alverca do Ribatejo/Sobralinho				
PVT22 | Forte da Casa				
PVT23 | Póvoa de Santa Iria				
PVT24 | Vialonga				
PVT25 | Castanheira do Ribatejo				

Figure 23 - Priority Vulnerable Territories
Source: CEDRU (2022)

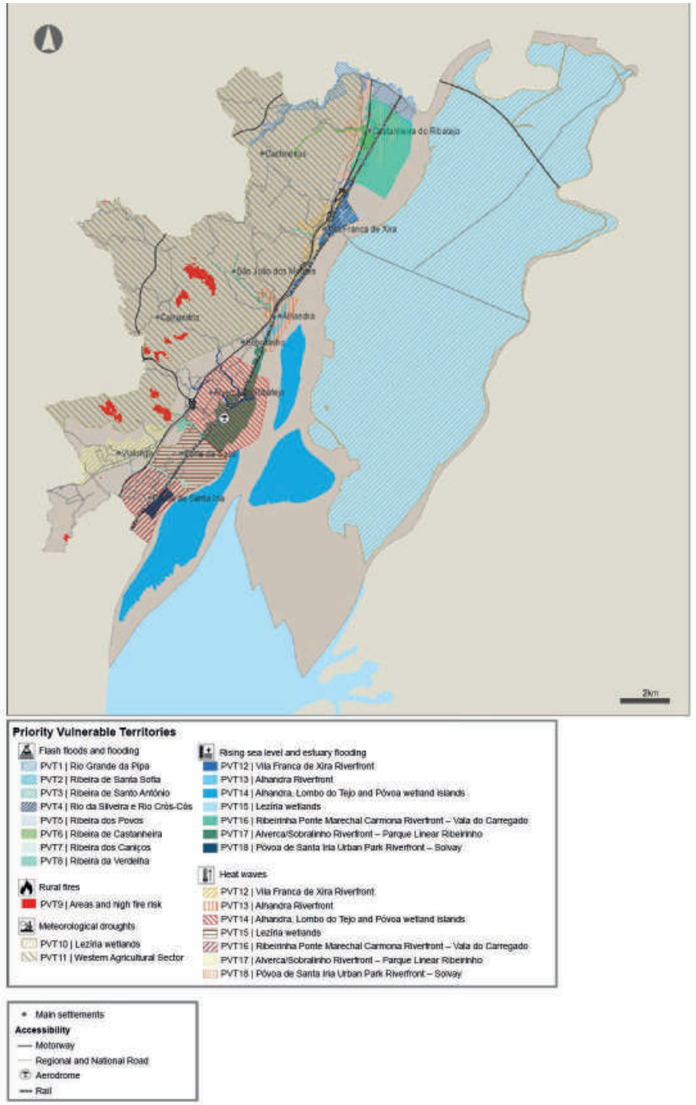


Figure 24- Priority Vulnerable Territories
Source: CEDRU (2022)


PLANO MUNICIPAL DE ADAPTAÇÃO ÀS ALTERAÇÕES CLIMÁTICAS
II SEMINÁRIO | ENCERRAMENTO
30 MAIO 2023
CHEIAS RÁPIDAS E INUNDAÇÕES
CALOR EXCESSIVO
SECAS
INCÊNDIOS RURAIS
SUBIDA DO NÍVEL MÉDIO DO MAR
vfx
Franc@d.PTação
APRESENTAÇÃO DO PLANO
Sérgio Barroso
JÁ HÁ MUITOS MUNICÍPIOS A ADAPTAREM-SE ÀS ALTERAÇÕES CLIMÁTICAS
Grande apoio da Câmara Municipal e dos técnicos envolvidos!
JÁ SERÁ IMPOSSÍVEL IMPEDIR OS IMPACTOS CLIMÁTICOS JÁ EM CURSO!
SENDO POSSÍVEL MITIGÁ-LOS!
VILA FRANCA DE XIRA JÁ ESTÁ NESTE MAPA!
AGO 2021 METODOLOGIA
OUT 2021 CENARIZAÇÃO SEMINÁRIO LANÇAMENTO
MAIO 2022 VULNERABILIDADES WORKSHOP
FEV. 2023 AÇÃO WORKSHOP
MAIO 2023 GOVERNANÇA ENCERRAMENTO
CLIMA EM MUDANÇA
TEMPERATURA
EXTREMOS TÉRMICOS
PRECIPITAÇÃO
VENTO
SUBIDA DO MAR
MUITO MAIS GRAVE EM 2100
NEM TODO O TERRITÓRIO ESTÁ SUJEITO AOS MESMOS RISCOS
CHEIAS
INCÊNDIOS
VERTENTES
ONDAS DE CALOR
SECA
EROSÃO
HÁ TERRITÓRIOS MAIS VULNERÁVEIS!
A HISTÓRIA AJUDA-NOS A IDENTIFICAR PONTOS CRÍTICOS
2071-2100
2041-2070
PRESENTE
AGRAVAMENTO EM TODOS OS RISCOS
ZONAS RIBEIRINHAS INUNDAÇÕES
ZONAS URBANAS ONDAS DE CALOR
HÁ UMA CLARA ESTRATÉGIA PARA LIDAR COM OS DESAFIOS DAS ALTERAÇÕES CLIMÁTICAS!
PRINCÍPIOS
1. SUSTENTABILIDADE
3. PRECAUÇÃO
2. JUSTIÇA CLIMÁTICA
4. FLEXIBILIDADE
5. PARCERIA
1. PREVENIR
2. ACOMODAR
3. PROTEGER
4. RELOCALIZAR
5. RECUPERAR
CICLO DE GESTÃO DA ADAPTAÇÃO
HÁ UM GRANDE CATÁLOGO DE MEDIDAS!
Fernando Paulo Ferreira
ENVOLVIMENTO DE TODOS
SECA
SALINIDADE TEJO
CALOR EXTREMO
PROBLEMAS GIGANTESCOS
ESTÃO AÍ PARA FICAR...
É PRECISO ADAPTAR!
DESTACA-SE O PAPEL FUNDAMENTAL DOS JOVENS
TODOS TEMOS UM PAPEL NA PREVENÇÃO E NA ADAPTAÇÃO
TEMOS QUE DAR OS PASSOS CERTOS
ESCOLA BÁSICA E SECUNDÁRIA PROFESSOR REYNALDO DOS SANTOS
BALANÇO POSITIVO
FEZ-NOS PENSAR
PROBLEMAS E SOLUÇÕES
FALÁMOS DOS CINCO PROBLEMAS
CHEGÁMOS A SOLUÇÕES PARECIDAS
SAÚDE
SANTUÁRIOS PARA PLANTAS
CONSTRUÇÃO ADEQUADA
ARQUITETURA "BIOLÓGICA"
RENTABILIZAR A ÁGUA
PODEMOS FAZER MUITO INDIVIDUALMENTE!
SOMOS OTIMISTAS!
WORKSHOP ESQUECIDO!
Iceland Liechtenstein Norway grants
Ambiente e Ação Climática
REPÚBLICA PORTUGUESA
Lara Almeida
EQUIPA DE 7 NO ACOMPANHAMENTO DO PROJETO
OBJETIVOS
Aumentar CAPACIDADE DE ADAPTAÇÃO
Identificar MEDIDAS E AÇÕES DE ADAPTAÇÃO
Partilhar E DISSEMINAR INFORMAÇÃO
PROJETO Franc@d.PTação
1.2.2021 – 31.7.2023
ATIVIDADES
1. ELABORAÇÃO PLANO MUNICIPAL (PMAAC)
2. IMPLEMENTAÇÃO DO PLANO DE COMUNICAÇÃO
CONTEXTUALIZAÇÃO
DEFINIÇÃO DE CENARIZAÇÃO
CARACTERIZAÇÃO DE IMPACTES
ESTRATÉGIA
MODELOS E INSTRUMENTOS DE GESTÃO
5 SUB-ATIVIDADES
4 WORKSHOPS
8.4.22
14.11.22
3.5.22
13.1.23
2 SEMINÁRIOS
APRESENTAÇÃO 25.11.21
ENCERRAMENTO 30.5.23
VÁRIAS AÇÕES
580 ALUNOS ENVOLVIDOS
RESULTADOS
MEDIDAS E INDIVÍDUOS...
META: 41.000
RESULTADO: 165.827 INDIVÍDUOS
VAMOS A ISSO!
Marina Tiago
FIM DO PRINCÍPIO OU PRINCÍPIO DO FIM?
AGORA... UM GRANDE CADERNO DE ENCARGOS
OS JOVENS JÁ O DISSERAM: "É PRECISO FALAR"
E O PROFESSOR REFERIU: "NÃO É SÓ O PLANETA QUE É PRECISO SALVAR!"
A TAREFA NÃO É FÁCIL...
...MAS AS EQUIPAS SÃO RESILIENTES!
OBRIGADA!
DANIEL UPSIDEUP.PT
UpSideUp

CLIMATE ADAPTATION STRATEGY

PRINCIPLES FOR ACTION

Within the framework of the uncertainty established by climate science, climate change constitutes one of the greatest challenges for humanity, not only due to the profound impacts resulting from the increase in the regularity and magnitude of extreme climate events, but also due to the transversality of its impacts.

The response to this challenge in the framework of European, national and metropolitan policies is, of course, to meet the decarbonisation targets set for 2050, avoiding a further increase in the average temperature of the planet, in line with the Paris Agreement on climate change and the consequences resulting therefrom. But it also involves an eminently local approach to reducing climate vulnerability, without prejudice to the needs of national coordination and financing.

The location of Vila Franca de Xira in the global, European and regional context, the geographical characteristics expressed in the mosaic of 'Climate Response Units', and the historical process of development and occupation of the territory give this municipality a unique situation in the metropolitan framework, with: (i) an extensive estuarine front strongly affected by the rise in the average sea level; (ii) a succession of small hydrographic basins highly integrated in the urban environment and increasingly subject to flash floods and flooding; (iii) an extensive compact built-up area, mostly protected to the northwest by the relief and facing southeast, in which the high thermal gradients that are already currently felt will be aggravated by the gradual rise in average temperatures and the greater intensity and duration of extreme heat events.

The response to these different challenges cannot, however, be limited to a mitigating/repair approach. Indeed, it should constitute an opportunity to promote the energy, ecological and urban transition of Vila Franca de Xira, increasing its sustainability indicators, environmental quality, and social inclusion and cohesion. That is, it is important to accept the limits of the adaptation solutions and understand that the territorial resilience to climate change also depends on the capacity to reduce ecological, social and economic vulnerability.

The approach of the "Vila Franca de Xira Municipal Adaptation Plan For Climate Change (VFX MAPCC)" and the way it proposes to respond to the climate problem is therefore supported on five fundamental principles that reflect the intention to pursue a transformational adaptation of the municipality territory.

The approach of the VFX MAPCC and the way it proposes to respond to the climate problem is therefore supported on five key principles that reflect our intention to pursue a transformative adaptation of the municipality.

Principles of Action	Description
Sustainability	Climate adaptation in Vila Franca de Xira should not be a mere impact mitigation response, but a regenerative approach that makes the municipality more sustainable, making the co-benefits of adaptation a catalyst for the realisation of Sustainable Development Goals (SDGs).
Climate Justice	Climate adaptation in Vila Franca de Xira shall act as a priority to increase the resilience of individuals and socially vulnerable communities in situations of exposure and greater susceptibility to climate risks, thus contributing to increasing cohesion and combating social exclusion.
Prudence	Climate adaptation in Vila Franca de Xira should emphasise anticipatory adaptation solutions that prevent the worsening of exposure to climate risks, reducing future adaptation costs within a framework of intergenerational solidarity.
Flexibility	Climate adaptation in Vila Franca de Xira should integrate the uncertainty principle of climate evolution, defining a future approach that allows the best solutions to be pursued at each moment based on the best scientific knowledge and with regular monitoring of the climate and local vulnerability.
Partnership	Climate adaptation in Vila Franca de Xira should be understood as an action that mobilises the entire local community to achieving its aims, implemented in partnership, with shared knowledge, resources and responsibilities and transparent accountability.

VISION

With the principles of action and objectives set for the Municipal Plan of Adaptation to Climate Change of the Municipality of Vila Franca de Xira as a reference, the vision of adaptation for the municipality reflects a positive and mobilising approach to adaptation, i.e. a transformation towards a safer and more sustainable life, generating a better balance in the relationship between humans and their environment, but also generating opportunities for prosperity and well-being.

The centrality given to citizens in this process implies giving priority attention to those who, exposed to climate risk, have fewer resources and capacity for self-protection. The implementation of the Plan must also be transparent and participatory, with accountability but also awareness-raising among all citizens and strategic actors for the changes to be made.

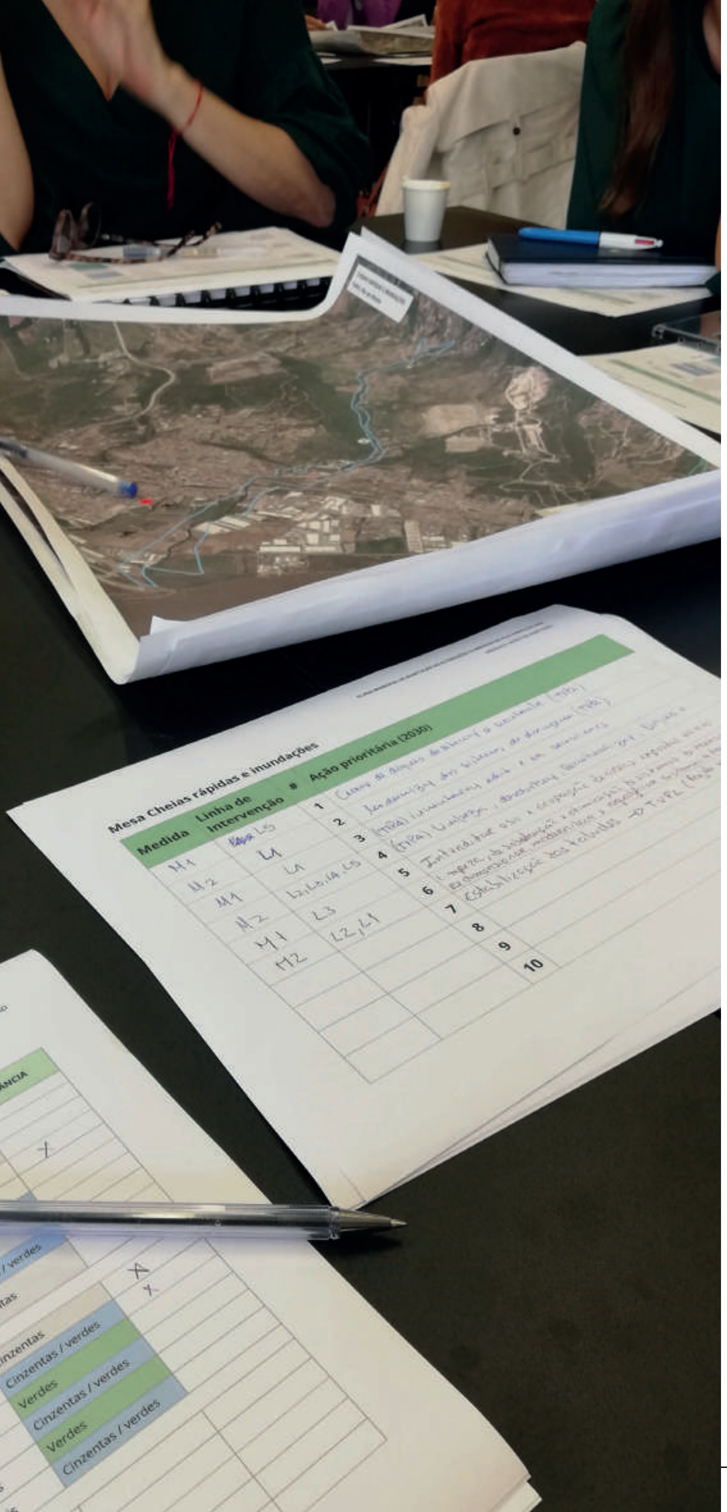
AREAS OF ACTION

The operational approach of the VFX MAPCC considers that reducing vulnerability requires a diverse – sometimes alternative and sometimes complementary – range of solutions. The various measures/actions not only take into account the different traditional adaptation alternatives to cope with hydrological risks (accommodate, protect or relocate) but also consider the essential dimensions to cope with risk and its associated disasters (prevent and rescue and recover), in a cycle of resilience.

That is, it is important not only to mitigate the impacts of extreme events through measures that reduce exposure to risk, but also to promote actions that increase individual and collective precautionary capacity and action in the event of serious disasters.

Vila Franca de Xira being prepared to deal with the challenges of climate change, placing the safety and well-being of citizens at the centre of its actions, using adaptation as an opportunity to create a more resilient, more sustainable, more inclusive, more qualified, and more attractive territory.

Areas of action	Description
Prevent	Adoption of measures and actions to mitigate exposure to climate risks (for example: surveys of equipment, services and activities exposed; identification of vulnerable groups; adoption of restrictions on land use and occupation; creation of warning systems).
Accommodate	Adoption of measures and actions to enable the continued occupation and use of vulnerable territories by changing habits of life and work, or by modifying buildings and infrastructure (for example, changing drainage networks, installing green roofs, foresting urban spaces, raising the level of transport routes, and electrical infrastructures).
Protect	Adoption of measures and actions to enable vulnerable territories to continue to be occupied and used in the same way as they are today (e.g. creation of dykes and protective walls, retention basins, green ventilation corridors).
Relocate	Adoption of measures and actions to enable the relocation of services, equipment, buildings, infrastructure or economic activities exposed to risk from vulnerable areas by planned retreat.
Rescue and Recover	Adoption of measures and actions to increase the capacity to respond and recover in an emergency situation related to extreme climate events (e.g. planning and capacity building for disaster response and recovery, acquisition of resources for response).



ADAPTATION MEASURES

Considering the climate risk framework identified, by the end of this century the municipality of Vila Franca de Xira will face an increase in both the frequency and magnitude of impacts of extreme precipitation, heat and drought events, as well as sea level rise. This means that the risk of flash floods, estuarine floods, droughts, heat waves and rural fires will worsen. For this reason, climate risks are considered a priority, notwithstanding the fact that the greater likelihood of the occurrence of slope movements or the worsening of soil erosion is also relevant, but due to their specific nature, they already have an adaptive response in legal land use planning instruments.

These climatic risks have a spatial distribution that is highly differentiated, both in terms of exposure and vulnerability. The Priority Vulnerable Territories are the areas of the municipality where each of these risks is greater and where the implementation of measures and adaptation actions should be implemented with greater urgency.

To respond to each of the priority climate vulnerabilities, 15 Adaptation Measures were defined and broken down into Lines of Intervention. They constitute the strategic framework that is operationalised through short- and medium-term Priority Actions to be carried out by 2030. The Measures cover the five main climate risks that affect the municipality of Vila Franca de Xira, seeking to reduce current and future impacts of climate change on people and property, and to globally increase the climate resilience of the municipality.

Climate Risk	Adaptation Measure	Priority Vulnerable Territories
Flash floods and flooding	**M1.** Decrease the exposure of equipment and infrastructure to flash floods and flooding **M2.** Improve drainage efficiency **M3.** Improving early warning and response capacity for flash floods and flooding	**PVT1 |** Rio Grande da Pipa **PVT2 |** Ribeira de Santa Sofia **PVT3 |** Ribeira de Santo António **PVT4 |** Rio da Silveira and Rio Crós-Cós **PVT5 |** Ribeira dos Povos **PVT6 |** Ribeira da Castanheira **PVT7 |** Ribeira dos Caniços **PVT8 |** Ribeira da Verdelha
Excessive heat	**M4.** Thermal comfort of urban spaces **M5.** Improve buildings' thermal and energy performance **M6.** Mitigate the impacts of extreme heat events on human health	**PVT19 |** Vila Franca de Xira **PVT20 |** Alhandra **PVT21 |** Alverca do Ribatejo/Sobralinho **PVT22 |** Forte da Casa **PVT23 |** Póvoa de Santa Iria **PVT24 |** Vialonga **PVT25 |** Castanheira do Ribatejo
Droughts (agrometeorological and hydrological	**M7.** Mitigate consequences on biodiversity	**PVT10 |** Lezíria wetlands **PVT11 |** Western Agricultural Sector Also on the water lines of the: **PVT1 |** Rio Grande da Pipa **PVT2 |** Ribeira de Santa Sofia **PVT3 |** Ribeira de Santo António **PVT4 |** Rio da Silveira and Rio Crós-Cós **PVT5 |** Ribeira dos Povos **PVT6 |** Ribeira da Castanheira **PVT7 |** Ribeira dos Caniços **PVT8 |** Ribeira da Verdelha
	M8. Increase resilience to agrometeorological droughts **M9.** Increase water efficiency	**PVT10 |** Lezíria wetlands **PVT11 |** Western Agricultural Sector

Climate Risk	Adaptation Measure	Priority Vulnerable Territories
Rural fires	**M10.** Reduce exposure of people and property to fire risk	**PVT9 |** High fire risk areas
	M11. Improve rural fire prevention capacity	
	M12. Improve early-warning and response capacity for rural fires	
Rise in mean sea level and estuary flooding	**M13.** Adapt urban spaces to estuarine flooding	**PVT12 |** Vila Franca de Xira Riverfront **PVT13 |** Alhandra Riverfront **PVT17 |** Alverca/Sobralinho Riverfront – Parque Linear Riverfront **PVT18 |** Póvoa de Santa Iria Urban Park Riverfront – Solvay
	M14. Adapt natural spaces to estuarine flooding	**PVT14 |** Mouchões de Alhandra, Lombo do Tejo and Póvoa **PVT15 |** Lezíria wetlands **PVT16 |** Ponte Marechal Carmona Riverfront – Vala do Carregado
	M15. Protect sensitive areas to saline intrusion	**PVT15 |** Lezíria wetlands

Source: CEDRU (2022)

ACTION PLAN

Adaptation to flash floods and flooding

Measure 1	Decrease the exposure of equipment and infrastructure to flash floods and flooding
Specific Objectives	- To reduce the impacts of flash floods and flooding on people, activities, infrastructure and buildings - To reduce future exposure to climate risk - To increase the resilience of built-up areas to flash floods and flooding
Vulnerability Context Framework — Climate Scenarios	Increase in the number of days with daily precipitation values higher than P95 (25 mm) in the wettest month - Increased occurrence of extreme precipitation events
Vulnerability Context Framework — Main impacts	- Damage to houses - Damage to public facilities and services - Damage to industrial and commercial facilities - Damage to public spaces, roads and infrastructure - Interruption of services
Vulnerability Context Framework — Priority Vulnerable Territories (PVT)	**PVT1** | Rio Grande da Pipa **PVT2** | Ribeira de Santa Sofia **PVT3** | Ribeira de Santo António **PVT4** | Rio da Silveira and Rio Crós-Cós **PVT5** | Ribeira dos Povos **PVT6** | Ribeira da Castanheira **PVT7** | Ribeira dos Caniços **PVT8** | Ribeira da Verdelha

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	2031/40	2041/70	20712100
Prevent				
» Inventory sensitive buildings, equipment and services exposed to risk	◆ ⊙			
» Make the use and occupation of areas exposed to risk compatible	◆ ⊙			
» Apply urban and public space occupation constraints	◆ ⊙			
» Integrate the DNSH principle into public procurement	◆ ⊙			
Accommodate				
» Accommodate buildings (leakage of ground floors or change of use)		◆		
» Accommodate transport, energy and communications infrastructure (e.g., raising levels)		◆		
Protect				
» Install protection systems (dykes and barriers in built-up areas and buildings)			◆	
» Protect transport, energy and communications infrastructure (dykes and barriers)			◆	
Relocate				
» Relocate sensitive equipment and services			◆	
» Relocate residential buildings exposed to risk			◆	
» Relocate transport, energy and communications infrastructures exposed to risk			◆	
» Relocate economic activities exposed to risk			◆	

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 2	Improve drainage efficiency
Specific Objectives	- To reduce the impacts of flash floods and flooding on people, activities, infrastructure and buildings - Increase the response capacity of drainage infrastructure

Vulnerability Context Framework

Climate Scenarios	- Increase in the number of days with daily precipitation values higher than P95 (25 mm) in the wettest month - Increased occurrence of extreme precipitation events
Main impacts	- Damage to houses - Damage to public facilities and services - Damage to industrial and commercial and service facilities - Damage to public spaces, roads and infrastructure - Interruption of services
Priority Vulnerable Territories (PVT)	**PVT1** | Rio Grande da Pipa **PVT2** | Ribeira de Santa Sofia **PVT3** | Ribeira de Santo António **PVT4** | Rio da Silveira and Rio Crós-Cós **PVT5** | Ribeira dos Povos **PVT6** | Ribeira da Castanheira **PVT7** | Ribeira dos Caniços **PVT8** | Ribeira da Verdelha

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	204170	20712100
Prevent				
»	◆ ⊙			
» Stabilising slopes	◆ ⊙			
» Monitoring water lines	◆			
» Monitoring landslides	◆			
Accommodate				
» Re-dimensioning, modernisation (separating networks) and requalification of drainage systems	◆		⊙	
» Re-naturalise drainage basins	◆	⊙		
» Create permeable and infiltration areas		◆	⊙	
Protect				
» Create roller dams and overflow and retention basins	◆		⊙	
» Create flow diversion systems			◆	⊙

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 3	Improving early warning and response capacity for flash floods and flooding
Specific Objectives	- To reduce the impacts of flash floods and flooding on people, activities, infrastructure and buildings - Increase preparedness levels to deal with extreme climate events - Increase capacity to respond to extreme climate events
Vulnerability Context Framework – Climate Scenarios	- Increase in the number of days with daily precipitation values higher than P95 (25 mm) in the wettest month - Increased occurrence of extreme precipitation events
Vulnerability Context Framework – Main impacts	- Damage to houses - Damage to public facilities and services - Damage to industrial and commercial facilities - Damage to public spaces, roads and infrastructure - Interruption of services
Vulnerability Context Framework – Priority Vulnerable Territories (PVT)	**PVT1** | Rio Grande da Pipa **PVT2** | Ribeira de Santa Sofia **PVT3** | Ribeira de Santo António **PVT4** | Rio da Silveira and Rio Crós-Cós **PVT5** | Ribeira dos Povos **PVT6** | Ribeira da Castanheira **PVT7** | Ribeira dos Caniços **PVT8** | Ribeira da Verdelha

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Flood forecasting and warning systems	◆			
» Raise awareness among the population and strategic entities	◆			
» Supervise the use and occupation of sensitive areas	◆ ⊙			
Rescue and Recover				
» Planning and training evacuation, rescue and relief actions	◆			
» Acquire means and resources for disaster response	◆ ⊙			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Adapting to excessive heat

Measure 4	Thermal comfort of urban spaces
Specific Objectives	- Increase urban cooling and limit the urban heat island effect - Reduce thermal discomfort in urban spaces - Improve air quality in urban areas - Preserve human health, especially that of the most vulnerable groups
Vulnerability Context Framework – Climate Scenarios	- Generalised increase in air temperature - Increase in the frequency of very hot days - Increased frequency of tropical nights - Increased frequency of summer days - Increased frequency and persistence of heat waves
Vulnerability Context Framework – Main impacts	- Negative effects on human health - Negative effects on natural systems - Increased levels of ozone and atmospheric pollutants - Degradation of air quality
Vulnerability Context Framework – Priority Vulnerable Territories (PVT)	**TVP19** | Vila Franca de Xira **TVP20** | Alhandra **TVP21** | Alverca do Ribatejo/Sobralinho **TVP22** | Forte da Casa **TVP23** | Póvoa de Santa Iria **TVP24** | Vialonga **TVP25** | Castanheira do Ribatejo

Operationalisation of the Measure – Adaptive Pathway				
Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Bioclimatic mapping	◆ ⊙			
» Safeguarding ventilation corridors in urban planning instruments	◆			
» Inventory, mapping and characterisation of urban arborisation and the ecoservices provided	◆ ⊙			
» Integrate the DNSH principle into public procurement	◆			
Accommodate				
» Expanding and renewing the urban tree structure (streets, squares, parks, gardens)	◆			
» Install shading structures in pedestrian streets	◆	⊙		
» Install cooling structures for public urban spaces (micro sprinklers, micro waterclimates)	◆	⊙		
» Install cooling structures for school grounds (tree planting, shading structures and paving)	◆	⊙		
Protect				
» Create green and blue ventilation and amenity corridors	◆		⊙	
» Create urban green spaces (gardens, vegetable gardens, parks, woods)	◆		⊙	
» Renaturalise artificialised, empty or vacant spaces and create permeable pavements	◆			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 5	Improve the thermal and energy performance of buildings
Specific Objectives	- Improve thermal comfort and energy efficiency in buildings - Combating energy poverty - Preserve human health, especially that of the most vulnerable groups
Vulnerability Context Framework – Climate Scenarios	- Generalised increase in air temperature - Increase in the frequency of very hot days - Increased frequency of tropical nights - Increased frequency of summer days - Increased frequency and persistence of heat waves
Vulnerability Context Framework – Main impacts	- Increase in energy consumption for air conditioning in buildings - Increased energy costs - Negative effects on human health
Vulnerability Context Framework – Priority Vulnerable Territories (PVT)	**TVP19** | Vila Franca de Xira **TVP20** | Alhandra **TVP21** | Alverca do Ribatejo/Sobralinho **TVP22** | Forte da Casa **TVP23** | Póvoa de Santa Iria **TVP24** | Vialonga **TVP25** | Castanheira do Ribatejo

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	204170	20712100
Prevent				
» Promoting the construction of new nearly zero-energy buildings (NZEB)	◆			
» Raise awareness among the construction sector of bioclimatic architecture	◆			
» Integrate the DNSH principle into public procurement	◆			
Accommodate				
» Improve and encourage thermal performance and thermal quality of equipment and services buildings	◆	⊙		
» Improve thermal performance of social housing buildings	◆	⊙		
» Encourage the improvement of the energy performance and thermal quality of buildings for private housing	◆			

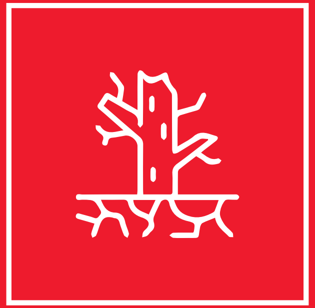
Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 6	Mitigate the impacts of extreme heat events on human health
Specific Objectives	- Increase prevention and warning capacity for extreme climate events - Increase capacity to respond to extreme climate events - Preserve human health, especially that of the most vulnerable groups
Vulnerability Context Framework – Climate Scenarios	- Generalised increase in air temperature - Increase in the frequency of very hot days - Increased frequency of tropical nights - Increased frequency of summer days - Increased frequency and persistence of heat waves
Vulnerability Context Framework – Main impacts	- Increased levels of ozone and air pollutants associated with high temperatures - Reduced air quality - Damage to human health
Vulnerability Context Framework – Priority vulnerable territories (PVT)	**TVP19** | Vila Franca de Xira **TVP20** | Alhandra **TVP21** | Alverca do Ribatejo/Sobralinho **TVP22** | Forte da Casa **TVP23** | Póvoa de Santa Iria **TVP24** | Vialonga **TVP25** | Castanheira do Ribatejo

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Create alert and monitoring systems for heat waves	◆ ⊙			
» Raise awareness among the population and institutions for self-protection in the event of extreme heat	◆			
» Raise awareness among the population of the effects of atmospheric pollution	◆			
» Create a network of climate refuges (equipment and open spaces)	◆	⊙		
» Seasonal bans on cars in congested areas	◆			
Accommodate				
» Reducing car traffic in compact and poorly ventilated urban areas	◆	⊙		
Rescue and Recover				
» Creating support and rescue systems for vulnerable groups	◆ ⊙			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion



Adaptation to droughts (agrometeorological and hydrological)

Measure 7		**Mitigate consequences on biodiversity**
Specific Objectives		- Ensuring the preservation of riparian ecosystems and the provision of their ecosystem services - Ensuring the good ecological status of riparian and estuarine habitats - Reducing the impact of droughts on water resources and on riverside habitats
Vulnerability Context Framework	Climate Scenarios	- Decrease the number of days of precipitation - Decrease in total precipitation - Increase in the frequency of days with negative water balance - Widening and accentuation of the dry season in the annual rainfall regime - More frequent and severe droughts
	Main impacts	- Alteration in the visual quality of the landscape - Alteration in biodiversity patterns - Phenological changes with effects on the life cycle of species
	Priority Vulnerable Territories (PVT)	**TVP10** | Lezíria wetlands **TVP11** | Western Agricultural Sector **TVP17** | Alverca/Sobralinho Riverfront – Parque Linear Riverfront Also on the water lines of the: **TVP1** | Rio Grande da Pipa **TVP2** | Ribeira de Santa Sofia **TVP3** | Ribeira de Santo António **TVP4** | Rio da Silveira e Rio Crós-Cós **TVP5** | Ribeira dos Povos **TVP6** | Ribeira da Castanheira **TVP7** | Ribeira dos Caniços **TVP8** | Ribeira da Verdelha

Operationalisation of the Measure – Adaptive Pathway				
Area of action / Line of Intervention	**Adaptive Pathway**			
	2023/30	**203140**	**2041/70**	**20712100**
Prevent				
» Biomonitoring of riparian fauna and flora	◆			
» Recover and conserve riparian woods and riverside vegetation	◆	⊙		
» Recover and conserve estuarine conditions and, consequently, their characteristic fauna and flora	◆			
» Educate and raise environmental awareness about the protection of rivers and water lines	◆			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 8		**Increase resilience to agrometeorological droughts**
Specific Objectives		- Increase the resilience of agroforestry systems to water scarcity - Increase the retention capacity of water resources, guaranteeing their quality - Increase water efficiency in agriculture
Vulnerability Context Framework	Climate Scenarios	- Decrease the number of days of precipitation - Decrease in total precipitation, with a linear trend of about -80mm/decade - Increased frequency of days with negative water balance, i.e. increased water loss from soils through evaporation processes - Widening and accentuation of the dry season in the annual rainfall regime - More frequent and severe droughts: weak drought in the period 2041-2070 and moderate drought in the period 2071-2100
	Main impacts	- Increased occurrence of hydrological and agricultural droughts - Extended periods of water scarcity for agriculture - Damage to temporary crops - Damage to irrigation systems
	Priority vulnerable territories (PVT)	**TVP10** | Lezíria wetlands **TVP11** | Western Agricultural Sector

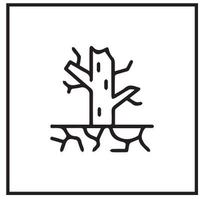
Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	204170	20712100
Prevent				
» Raise farmers' awareness about water efficiency	◆ ⊙			
Accommodate				
» Promote retention of rainwater in agriculture		◆		
» Promote the use of treated wastewater in agriculture		◆		
» Encourage more water-efficient irrigation and precision farming	◆			
» Promote the adoption of more resilient and adapted plant varieties	◆			
Protect				
» Facilitate the creation of small dams and ponds for agricultural use		◆		
» Promote the regularisation of river and stream flows	◆			
» Create municipal water retention infrastructure for agricultural use			◆	

Effectiveness of the intervention

◆ Moment of decision/beginning of implementation

⊙ Moment of completion



Measure 9	Increase water efficiency
Specific Objectives	- Promote the efficient use of water - Ensure the availability and quality of water resources - Increase monitoring of water quality - Promote water reuse
Vulnerability Context Framework – Climate Scenarios	- Decrease the number of days of precipitation - Decrease in total precipitation, with a linear trend of about -80mm/decade - Increased frequency of days with negative water balance, i.e. increased water loss from soils through evaporation processes - Widening and accentuation of the dry season in the annual rainfall regime - More frequent and severe droughts: weak drought in the period 2041-2070 and moderate drought in the period 2071-2100
Vulnerability Context Framework – Main impacts	- Changes in run-off and aquifer recharge - Reduction of water availability - Decrease in the quality of water resources - Shortage of water supply for consumption
Vulnerability Context Framework – Priority Vulnerable Territories (PVT)	**TVP10** | Lezíria wetlands **TVP11** | Western Agricultural Sector

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Define contingency procedures in case of drought	◆ ⊙			
» Monitor losses	◆			
» Assess the potential for reuse of rainwater drainage	◆ ⊙			
Accommodate				
» Upgrade supply, transport and storage infrastructure to reduce losses	◆		⊙	
» Promote water use efficiency in building systems and collective facilities	◆			
» Rainwater harvesting systems for cooling buildings	◆	⊙		
» Encourage the installation of rainwater harvesting systems in agricultural, industrial and commercial activities	◆			
Protect				
» Use wastewater for irrigation of green spaces and urban cleaning	◆	⊙		
» Promote rainwater retention solutions (cisterns, retention basins, among others) for non-potable uses (irrigation, washing) in municipal buildings and equipment		◆		⊙

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Adaptation to rural fires

Measure 10	**Reduce exposure of people and property to fire risk**
Specific Objectives	- Reduce the impacts of forest and rural fires on people, activities, infrastructure and buildings - Reduce the extent of burnt area - To reduce future exposure to climate risk - Increase the resilience of the built environment to rural fires
Vulnerability Context Framework – Climate Scenarios	- Generalised increase in air temperature - Increase in the frequency of very hot days - Increased frequency of tropical nights - Increase of minimum temperatures - Increased frequency of summer days - Increase in the frequency and persistence of heat waves - Increase in the frequency of intense wind situations
Vulnerability Context Framework – Main impacts	- Alteration in the visual quality of the landscape - Alteration in soil use - Alteration in biodiversity patterns - Phenological changes with effects on the life cycle of species - Increase in atmospheric pollution and airborne dust - Contamination of water lines with fire debris - Material damage and loss of human and animal life - Damage to forest cover - Proliferation of non-endemic species in burnt areas
Vulnerability Context Framework – Priority Vulnerable Territories (PVT)	**TVP9** | High fire risk areas

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Adopt restrictions on land use and occupation that reduce exposure to risk	◆ ⊙			
» Ensure the effectiveness of measures to reduce exposure to risk	◆			
Accommodate				
» Adopt urban planning measures that increase the resilience of dispersed buildings and rural settlements	◆ ⊙			
» Create mechanisms for fire protection and safety in buildings at risk	◆			
Protect				
» Establish fuel management strips in fire risk zones	◆ ⊙			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 11	Improve rural fire prevention capacity
Specific Objectives	- Reduce the impacts of rural fires on people, activities, infrastructure and buildings - Reduce the extent of burnt area - Reduce the number of ignitions - Increase prevention capacity
Vulnerability Context Framework — Climate Scenarios	- Generalised increase in air temperature - Increase in the frequency of very hot days - Increased frequency of tropical nights - Increase of minimum temperatures - Increased frequency of summer days - Increase in the frequency and persistence of heat waves - Increase in the frequency of intense wind situations
Vulnerability Context Framework — Main impacts	- Alteration in the visual quality of the landscape - Alteration in soil use - Alteration in biodiversity patterns - Phenological changes with effects on the life cycle of species - Increase in atmospheric pollution and airborne dust - Contamination of water lines with fire debris - Material damage and loss of human and animal life - Damage to forest cover - Proliferation of non-endemic species in burnt areas
Vulnerability Context Framework — Priority Vulnerable Territories (PVT)	**TVP9** | High fire risk areas

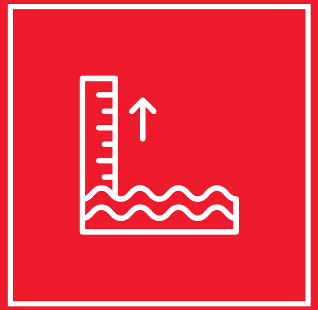
Operationalisation of the Measure – Adaptive Pathway				
Area of action / Line of Intervention	**Adaptive Pathway**			
	2023/30	2031/40	2041/70	20712100
Prevent				
» Raise awareness among the population about how to prevent risky behaviour	◆			
» Reinforce resources and systems of forest fire prevention and surveillance	◆	⊙		
» Implement temporary access limitations to highly susceptible areas	◆			
Accommodate				
» Promote diverse forest areas that are less vulnerable to fire	◆			
Protect				
» Encourage private parties to manage the fuel load on forest land	◆			
Rescue and Recover				
» Reinforce the capacity of municipal civil protection services to act in prevention activities	◆ ⊙			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 12	**Improve early-warning and response capacity for rural fires**
Specific Objectives	- Reduce the impact of rural fires on people, ecosystems, activities, infrastructure and buildings - Decrease the extent of burnt areas - Increase control and response capacity to rural fires
Vulnerability Context Framework — Climate Scenarios	- Generalised increase in air temperature - Increase in the frequency of very hot days - Increased frequency of tropical nights - Increase of minimum temperatures - Increased frequency of summer days - Increase in the frequency and persistence of heat waves - Increase in the frequency of intense wind situations
Vulnerability Context Framework — Main impacts	- Alteration in the visual quality of the landscape - Alteration in soil use - Alteration in biodiversity patterns - Phenological changes with effects on the life cycle of species - Increase in atmospheric pollution and airborne dust - Contamination of water lines with fire debris - Material damage and loss of human and animal life - Damage to forest cover - Proliferation of non-endemic species in burnt areas
Vulnerability Context Framework — Priority Vulnerable Territories (PVT)	**TVP9** | High fire risk areas

Operationalisation of the Measure – Adaptive Pathway				
Area of action / Line of Intervention	**Adaptive Pathway**			
	2023/30	2031/40	2041/70	2071/2100
Rescue and Recover				
» Promote the population's self-protection capacity	◆			
» Implement evacuation protocols and places of shelter and assembly	◆ ⊙			
» Reinforce resources and capacity to respond to occurrences	◆			
» Reinforce means and resources to respond to disasters	◆ ⊙			
» Build the capacity of civil protection services	◆			

Effectiveness of the intervention   ◆ Moment of decision/beginning of implementation   ⊙ Moment of completion



Adaptation to sea level rise and estuarine flooding

Measure 13	Adapt urban spaces to estuarine flooding
Specific Objectives	- Minimise exposure of people and assets to risk - Reduce impacts of estuarine flooding on urban spaces - Prevent the loss of urban spaces as a result of sea level rise
Vulnerability Context Framework – Climate Scenarios	- Trend of rising mean sea level - Expected increase in the rate of sea level rise
Vulnerability Context Framework – Main impacts	- Permanent or temporary flooding of natural and urban spaces - Damage to roads and infrastructure - Damage to public equipment - Damage to industrial and commercial facilities
Vulnerability Context Framework – Priority vulnerable territories (PVT)	**TVP12** | Vila Franca de Xira Riverfront **TVP13** | Alhandra Riverfront **TVP17** | Alverca/Sobralinho Riverfront – Parque Linear Riverfront **TVP18** | Póvoa de Santa Iria Urban Park Riverfront – Solvay

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	204170	20712100
Prevent				
» Inventory sensitive buildings, equipment and services exposed to risk	◆ ⊙			
» Create alert and monitoring systems for sea level rise and estuarine flooding	◆ ⊙			
» Make the use and occupation of areas exposed to risk compatible	◆ ⊙			
» Adopt urban planning rules that guarantee the accommodation of buildings	◆ ⊙			
Accommodate				
» Accommodate buildings (leakage of ground floors or change of use)		◆		
» Accommodate transport, energy and communications infrastructure (e.g., raising levels)		◆		
» Create floodable multifunctional open spaces	◆			
Protect				
» Install protection systems (dykes and barriers in built-up areas)	◆			
» Protect transport, energy and communications infrastructure (dykes and barriers)			◆	
Relocate				
» Relocate sensitive equipment and services exposed to risk			◆	
» Relocate residential buildings exposed to risk			◆	
» Relocate economic activities exposed to risk			◆	
» Remove/retract transport, energy and communications infrastructure			◆	

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

Measure 14	**Adapt natural spaces to estuarine flooding**
Specific Objectives	- Reduce impacts of estuarine flooding on agricultural/natural spaces - Prevent loss of agricultural/natural spaces as a result of sea level rise
Vulnerability Context Framework – Climate Scenarios	- Trend of rising mean sea level - Expected increase in the rate of sea level rise
Vulnerability Context Framework – Main impacts	- Permanent or temporary flooding of natural and agricultural areas - Damage to agricultural activities and economic losses - Loss of natural heritage
Vulnerability Context Framework – Priority Vulnerable Territories (PVT)	**TVP14** | Mouchões de Alhandra, Lombo do Tejo e Póvoa **TVP15** | Lezíria wetlands **TVP16** | Frente Ribeirinha Ponte Marechal Carmona – Vala do Carregado

Operationalisation of the Measure – Adaptive Pathway

Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Inventory sensitive buildings, equipment and services exposed to risk	◆ ⊙			
» Clean, unclog and optimise drainage systems	◆ ⊙			
» Stabilising slopes	◆ ⊙			
» Flood forecasting and warning systems	◆			
» Raise awareness among the population and strategic entities	◆			
Accommodate				
» Re-dimensioning, modernisation (separating networks) and requalification of drainage systems	◆			
Protect				
» Build/maintain walls and natural bank protection systems	◆			
» River de-silting	◆			
Rescue and Recover				
» Planning and training evacuation, rescue and relief actions	◆			

Effectiveness of the intervention ◆ Moment of decision/beginning of implementation ⊙ Moment of completion

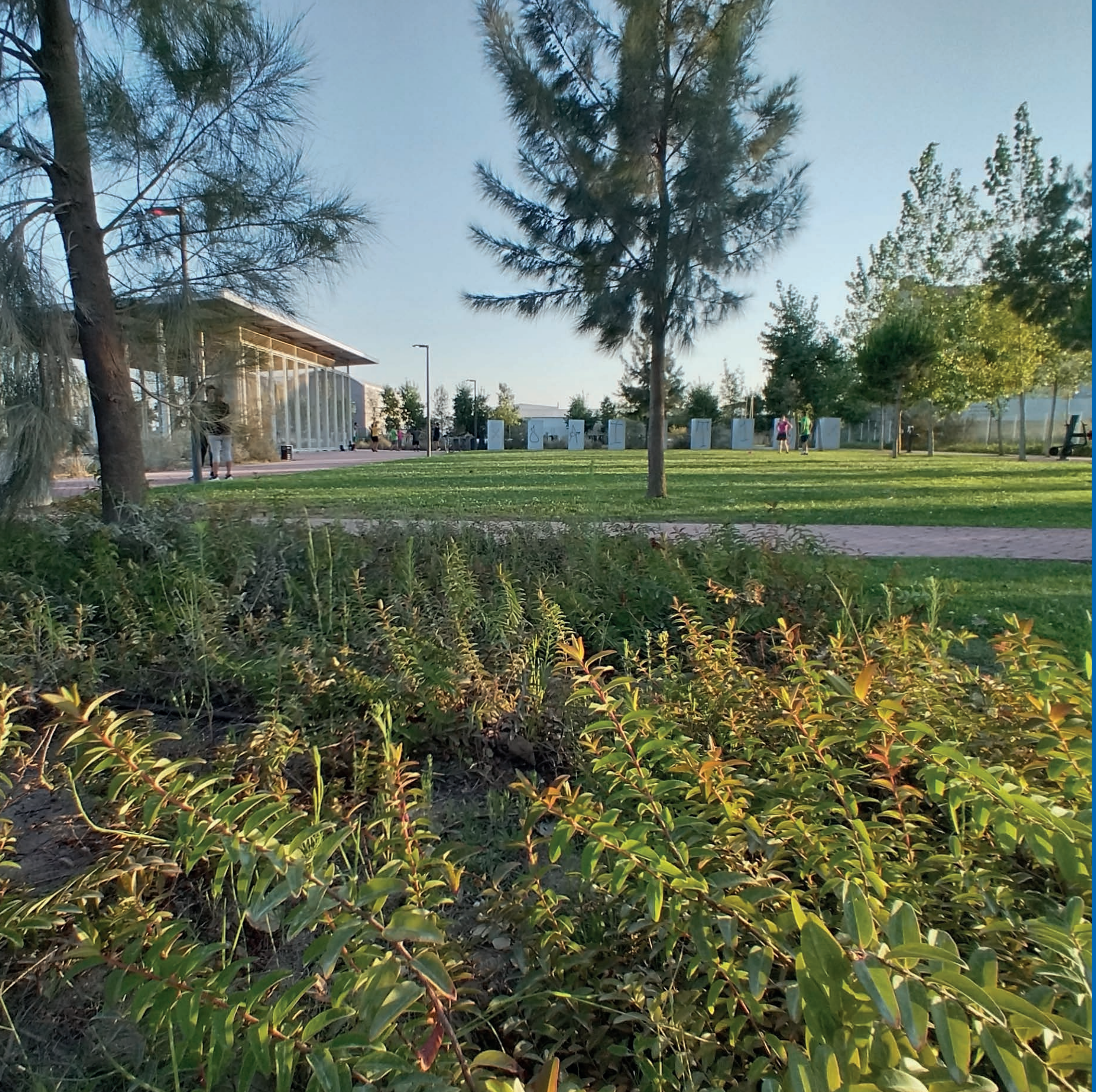
Measure 15	Protect sensitive areas to saline intrusion
Specific Objectives	- Mitigate impacts on water resources - Prevent loss of agricultural land
Vulnerability Context Framework — Climate Scenarios	- Trend of rising mean sea level - Expected increase in the rate of sea level rise
Vulnerability Context Framework — Main impacts	- Salinisation of agricultural areas and crop losses - Damage to water resources - Use of water catchments
Vulnerability Context Framework — Priority Vulnerable Territories (PVT)	**TVP15** | Lezíria wetlands

Operationalisation of the Measure – Adaptive Pathway				
Area of action / Line of Intervention	Adaptive Pathway			
	2023/30	203140	2041/70	20712100
Prevent				
» Monitor the quantitative and qualitative status of surface and underground water bodies	◆ ⊙			
» Raise awareness of users and managers of water resources on the dangers of saline intrusion	◆ ⊙			
» Plan the prioritisation of uses in drought situations, based on flow thresholds / storage levels	◆ ⊙			
Accommodate				
» Optimise the location and flow rates of catchments	◆ ⊙			

Effectiveness of the intervention

◆ Moment of decision/beginning of implementation

⊙ Moment of completion



CO-BENEFITS

As referenced in the Plan's action principles, the adaptive approach of the VFX MAPCC goes beyond a simple accommodation of the territory to climate risks. It is therefore vital to adopt a transformative approach that makes the Municipality more resilient to climate change. It should thus act in a lasting and effective way on the key areas of resilience, promoting adaptation that also preserves ecological systems, social inclusion and sustainability.

In this context, it is important that the various measures and lines of intervention enhance the ecological transition, the energy transition, and the urban transition, but also promote a sustainable development model, making a positive contribution to the achievement of the SDGs Agenda in the municipality of Vila Franca de Xira.

Having this transforming reference as a starting point, and supported by the most recent IPCC[1] studies on climate change adaptation, the co-benefits of the set of actions expressed in the VFX MAPCC were evaluated through the dimensions presented for each of the 15 measures of the Plan.

[1] IPCC, 2022: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

Guiding principles for climate change adaptation in Vila Franca de Xira

Relationship with risk sectors and groups	In order to maximise adaptation, making Vila Franca de Xira more resilient to climate change, the operational approach must prioritise action in those sectors that face more risks and with those social groups more vulnerable to climate change. **Ecosystems and their services** Nature provides several extremely valuable and indispensable services for human life. Provisioning services, regulating services (e.g. pollination, temperature regulation, carbon sequestration, ...) and cultural services. Promoting adaptation that enhances the preservation of ecosystems and habitats, or enhances urban foresting, will not only maximise results but also achieve a more lasting and meaningful action, with lower costs. **Disadvantaged groups** The most economically disadvantaged groups not only tend to occupy the territories most exposed to climatic risks, but also have the worst conditions (material, relational and knowledge) for adaptation. For this reason, they should be discriminated against positively by the adaptive approach. **Elderly people and children** The elderly and children are more vulnerable to several climate risks, with special emphasis on extreme temperature events. The adaptation plan should thus pay special attention to them.
Synergies with mitigation	Climate adaptation not only constitutes, together with mitigation, one of the two arms of the municipal policy on climate action, but in various domains it can establish synergetic relations between them, boosting the results in terms of emission reductions. Leveraging these synergies through adaptation that accelerates the energy transition is essential for the achievement of municipal decarbonisation targets.
Relationship with SDGs	Agenda 2030 - SDGs constitutes a global transformation agenda with implications at diverse scales of governance. The local adaptation policy should be a vehicle for Vila Franca de Xira to progress in terms of the various goals, improving quality of life, prosperity, protection of life on the planet, qualification of institutions, and strengthening partnerships.

Adaptation to flash floods and flooding

Risk / Measure / Line of Intervention	Relationship with risk sectors and groups: Ecosystems and their services	Disadvantaged groups	Elderly people	Children	Synergies with mitigation	Relationship with SDGs: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Adaptation to flash floods and flooding																						
Measure 1. Decrease the exposure of equipment and infrastructure to flash floods and flooding																						
Inventory sensitive buildings, equipment and services exposed to risk	•	+	+	+	Low	•	•	•	•	+	•	•	•	•	•	+	•	+	+	•	•	•
Make the use and occupation of areas exposed to risk compatible	+	•	•	•	Medium	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Apply urban and public space occupation constraints	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Integrate the DNSH principle into public procurement	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Accommodate buildings (leakage of ground floors or change of use)	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Accommodate transport, energy and communications infrastructure (e.g., raising levels)	•	•	•	•	Low	•	•	•	•	•	•	•	•	+	•	+	•	+	+	•	•	•
Install protection systems (dykes and barriers in built-up areas and buildings)	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Protect transport, energy and communications infrastructure (dykes and barriers)	•	•	•	•	Low	•	•	•	•	•	•	•	•	+	•	+	•	+	+	•	•	•
Relocate sensitive equipment and services	•	+	+	+	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Relocate residential buildings exposed to risk	•	+	+	+	Medium	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Relocate transport, energy and communications infrastructures exposed to risk	•	•	•	•	Low	•	•	•	•	•	•	•	•	+	•	+	•	+	+	•	•	•
Relocate economic activities exposed to risk	•	•	•	•	Medium	•	•	•	•	•	•	•	+	+	•	+	•	+	+	•	•	•
Measure 2. Improve drainage efficiency																						
	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	+	+	+	+	•	•
Stabilising slopes	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	+	+	•	•
Monitoring water lines	+	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	•	•	•	•
Monitoring landslides	+	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	•	+	•	•	•	•
Re-dimensioning, modernisation (separating networks) and requalification of drainage systems	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	+	+	+	+	•	•
Re-naturalise drainage basins	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	+	+	+	+	+	•	•
Create permeable and infiltration areas	+	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	+	+	+	+	•	•
Create roller dams and overflow and retention basins	-	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	+	+	+	•	•	•
Create flow diversion systems	-	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	+	+	+	+	•	•	•
Measure 3. Improving early warning and response capacity for flash floods and flooding																						
Flood forecasting and warning systems	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	+
Raise awareness among the population and strategic entities	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	+
Reinforce the means to control the use and occupation of sensitive areas	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	•
Planning and training evacuation, rescue and relief actions	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	•
Acquire means and resources for disaster response	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	•

Source: CEDRU (2022)

Relationship with Sustainable Development Goals

1 Eradicate poverty
2 Eradicate hunger
3 Access to quality health care and promoting well-being
4 Access to inclusive, quality and equitable education
5 Gender Equality
6 Availability and sustainable management of drinking water and sanitation
7 Reliable, sustainable and clean energy for all
8 Inclusive and sustainable economic growth
9 Resilient infrastructure, inclusive and sustainable industrialisation and innovation
10 Reducing inequalities
11 Inclusive, safe, resilient and sustainable cities
12 Sustainable consumption and production
13 Climate action
14 Conserving the oceans
15 Protecting terrestrial ecosystems
16 Effective, accountable and inclusive institutions
17 Partnerships for Sustainable Development

Relationship with risk sectors and groups

Ecosystems and their services
Disadvantaged groups
Elderly people
Children

Types of relationships

+ With benefits
- With harms
• No evidence / Mixed

Degree of synergy

High
Medium
Low

Adapting to excessive heat

Risk / Measure / Line of Intervention	Relationship with risk sectors and groups: Ecosystems	Disadvantaged groups	Elderly people	Children	Synergies with mitigation	SDG 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Adapting to excessive heat																						
Measure 4 Thermal mitigation in urban spaces																						
Bioclimatic mapping	•	+	+	+	Medium	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	+	•
Safeguard ventilation corridors in urban planning instruments	+	+	+	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Inventory, mapping and characterisation of urban arborisation and the ecoservices provided	+	+	+	+	Medium	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Integrate the DNSH principle into public procurement	+	+	+	+	Medium	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Expand and renew the urban tree structure (streets, squares, parks, gardens)	+	+	+	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Install shading structures in pedestrian streets	+	+	+	+	Low	•	•	+	•	•	•	•	•	•	•	+	•	+	•		•	•
Install cooling structures for public urban spaces (micro sprinklers, micro waterclimates)	+	+	+	+	Low	•	•	+	•	•	•	•	•	•	•	+	•	+	•		•	•
Install cooling structures for school grounds (tree planting, shading structures and paving)	+	•	•	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Create green and blue ventilation and amenity corridors	+	+	+	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Create urban green spaces (gardens, vegetable gardens, parks, woods)	+	+	+	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Renaturalise artificialised, empty or vacant spaces and create permeable pavements	+	+	+	+	Medium	•	•	+	•	•	•	•	•	•	•	+	•	+	•	+	•	•
Measure 5. Improve the thermal and energy performance of buildings																						
Promote the construction of new nearly zero-energy buildings (NZEB)	•	•	•	•	High	+	•	+		•	•	•	•	•	•	+	•	+	•	•	•	•
Raise awareness among the construction sector of bioclimatic architecture	•	•	•	•	High	+	•	+		•	•	•	•	•	•	+	•	+	•	•	•	•
Integrate the DNSH principle into public procurement	•	•	•	•	High	+	•	+		•	•	•	•	•	•	+	•	+	•	•	•	•
Improve and encourage thermal performance and thermal quality of equipment and services buildings	•	+	+	+	High	•	•	+	+	•	•	•	•	•	•	+	•	+	•	•	•	•
Improve thermal performance of social housing buildings	•	+	+	+	High	+	•	+		•	•	•	•	•	•	+	•	+	•	•	•	•
Encourage the improvement of the energy performance and thermal quality of buildings for private housing	•	+	+	+	High	+	•	+		•	•	•	•	•	•	+	•	+	•	•	•	•
Measure 6. Mitigate the impacts of extreme heat events on human health																						
Create alert and monitoring systems for heat waves	•	+	+	+	Low	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	+	+
Raise awareness among the population and institutions for self-protection in the event of extreme heat	•	+	+	+	Low	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	•	+
Raise awareness among the population of the effects of atmospheric pollution	•	+	+	+	Medium	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	•	+
Create a network of climate refuges (equipment and open spaces)	+	+	+	+	Medium	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	•	+
Seasonal bans on cars in congested areas	•	+	+	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	•	•
Reduce car traffic in compact and poorly ventilated urban areas	•	+	+	+	High	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	•	•
Create support and rescue systems for vulnerable groups	•	+	+	+	Low	•	•	+	•	•	•	•	•	•	•	+	•	+	•	•	•	•

Source: CEDRU (2022)

Relationship with Sustainable Development Goals

1 Eradicate poverty
2 Eradicate hunger
3 Access to quality health care and promoting well-being
4 Access to inclusive, quality and equitable education
5 Gender Equality
6 Availability and sustainable management of drinking water and sanitation
7 Reliable, sustainable and clean energy for all
8 Inclusive and sustainable economic growth
9 Resilient infrastructure, inclusive and sustainable industrialisation and innovation
10 Reducing inequalities
11 Inclusive, safe, resilient and sustainable cities
12 Sustainable consumption and production
13 Climate action
14 Conserving the oceans
15 Protecting terrestrial ecosystems
16 Effective, accountable and inclusive institutions
17 Partnerships for Sustainable Development

Relationship with risk sectors and groups

- Ecosystems and their services
- Disadvantaged groups
- Elderly people
- Children

Degree of synergy

- High
- Medium
- Low

Types of relationships

- + With benefits
- - With harms
- • No evidence / Mixed

Adaptation to droughts (agrometeorological and hydrological)

Risk / Measure / Line of Intervention	Relationship with risk sectors and groups				Synergies with mitigation	Relationship with SDGs																
	Ecosystems and their services	Disadvantaged groups	Elderly people	Children		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Adaptation to droughts (agrometeorological and hydrological)																						
Measure 7. Mitigate consequences on biodiversity																						
Biomonitoring of riparian fauna and flora	+	●	●	●	Medium	●	●	●	●	●	●	●	●	●	●	●	●	+	●	+	+	●
Recover and conserve riparian woods and riverside vegetation	+	●	●	●	Medium	●	●	●	●	●	●	●	●	●	●	●	●	+	●	+	●	●
Recover and conserve estuarine conditions and, consequently, their characteristic fauna and flora	+	●	●	●	Medium	●	●	●	●	●	●	●	●	●	●	●	●	+	+	+	●	●
Educate and raise environmental awareness about the protection of rivers and water lines	+	●	●	●	Low	●	●	●	●	●	●	●	●	●	●	●	●	+	●	+	●	●
Measure 8. Increase resilience to agrometeorological droughts																						
Raise farmers' awareness about water efficiency	+	●	●	●	Low	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●		+
Promote retention of rainwater in agriculture	+	●	●	●	Low	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●	+	●
Promote the use of treated wastewater in agriculture	●	●	●	●	Low	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●	●	+
Encourage more water-efficient irrigation and precision farming	●	●	●	●	Medium	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●	●	+
Promote the adoption of more resilient and adapted plant varieties	●	●	●	●	Medium	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●	●	+
Facilitate the creation of small dams and ponds for agricultural use	+	●	●	●	Low	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●	●	+
Promote the regularisation of river and stream flows	+	●	●	●	Low	●	+	●	●	●	●	●	●	●	●	●	+	+	●	●	●	+
Create municipal water retention infrastructure for agricultural use	●	●	●	●	Low	●	+	●	●	●	●	●	●	●	+	●	+	+	●	●	●	+
Measure 9. Increase water efficiency																						
Define contingency procedures in case of drought	●	●	●	●	Low	●	●	●	●	●	●	●	●	●	●	●	+	+	●	●	+	●
Monitor losses	●	●	●	●	Low	●	●	●	●	●	●	●	●	●	●	+	+	+	●	●	+	●
Assess the potential for reuse of rainwater drainage	●	●	●	●	Low	●	●	●	●	●	●	●	●	●	●	+	+	+	●	●	+	●
Upgrade supply, transport and storage infrastructure to reduce losses	●	●	●	●	Low	●	●	●	●	●	●	●	●	●	+	+	+	+	●	●	●	●
Promote water use efficiency in building systems and collective facilities	●	●	●	●	Low	●	●	●	●	●	●	●	●	●	+	+	+	+	●	●	●	+
Rainwater harvesting systems for cooling buildings	●	●	●	●	Medium	●	●	●	●	●	●	●	●	●	+	+	+	+	●	●	●	●
Encourage the installation of rainwater harvesting systems in agricultural, industrial and commercial activities	●	●	●	●	Medium	●	●	●	●	●	●	●	●	●	+	●	+	+	●	●	●	+
Use wastewater for irrigation of green spaces and urban cleaning	+	●	●	●	Low	●	●	●	●	●	●	●	●	●	+	+	+	+	●	+	●	●
Promote rainwater retention solutions (cisterns, retention basins, among others) for non-potable uses (irrigation, washing) in municipal buildings and equipment	+	●	●	●	Low	●	●	●	●	●	●	●	●	●	+	+	+	+	●	+	●	●

Source: CEDRU (2022)

Relationship with Sustainable Development Goals

1 Eradicate poverty
2 Eradicate hunger
3 Access to quality health care and promoting well-being
4 Access to inclusive, quality and equitable education
5 Gender Equality
6 Availability and sustainable management of drinking water and sanitation
7 Reliable, sustainable and clean energy for all
8 Inclusive and sustainable economic growth
9 Resilient infrastructure, inclusive and sustainable industrialisation and innovation
10 Reducing inequalities
11 Inclusive, safe, resilient and sustainable cities
12 Sustainable consumption and production
13 Climate action
14 Conserving the oceans
15 Protecting terrestrial ecosystems
16 Effective, accountable and inclusive institutions
17 Partnerships for Sustainable Development

Relationship with risk sectors and groups

Ecosystems and their services
Disadvantaged groups
Elderly people
Children

Degree of synergy

High
Medium
Low

Types of relationships

+ With benefits
- With harms
● No evidence / Mixed

Adaptação aos incêndios rurais

Risk / Measure / Line of Intervention	Relationship with risk sectors and groups				Synergies with mitigation	Relationship with SDGs																
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Adaptation to rural fires																						
Measure 10. Reduce exposure of people and property to fire risk																						
Adopt restrictions on land use and occupation that reduce exposure to risk	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•
Ensure the effectiveness of measures to reduce exposure to risk	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•
Adopt urban planning measures that increase the resilience of dispersed buildings and rural settlements	•	+	+	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•
Create mechanisms for fire protection and safety in buildings at risk	•	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•
Establish fuel management strips in fire risk zones	+	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•
Measure 11. Improve rural fire prevention capacity																						
Raise awareness among the population about how to prevent risky behaviour	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	•	+
Reinforce resources and systems of forest fire prevention and surveillance	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	+	+
Implement temporary access limitations to highly susceptible areas	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	•	•
Promote diverse forest areas that are less vulnerable to fire	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	•	+
Encourage private parties to manage the fuel load on forest land	+	•	•	•	Low	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	•	+
Reinforce the capacity of municipal civil protection services to act in prevention activities	+	•	•	•	High	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	+	•
Measure 12. Improve early-warning and response capacity for rural fires																						
Promote the population's self-protection capacity	•	+	+	+	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	+
Implement evacuation protocols and places of shelter and assembly	•	+	+	+	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	+
Reinforce resources and capacity to respond to occurrences	•	+	+	+	High	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	•
Reinforce means and resources to respond to disasters	•	+	+	+	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	•
Build the capacity of civil protection services	•	+	+	+	Low	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	+	+

Source: CEDRU (2022)

Relationship with Sustainable Development Goals

1 Eradicate poverty
2 Eradicate hunger
3 Access to quality health care and promoting well-being
4 Access to inclusive, quality and equitable education
5 Gender Equality
6 Availability and sustainable management of drinking water and sanitation
7 Reliable, sustainable and clean energy for all
8 Inclusive and sustainable economic growth
9 Resilient infrastructure, inclusive and sustainable industrialisation and innovation
10 Reducing inequalities
11 Inclusive, safe, resilient and sustainable cities
12 Sustainable consumption and production
13 Climate action
14 Conserving the oceans
15 Protecting terrestrial ecosystems
16 Effective, accountable and inclusive institutions
17 Partnerships for Sustainable Development

Relationship with risk sectors and groups

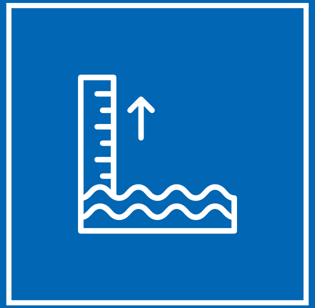
Ecosystems and their services
Disadvantaged groups
Elderly people
Children

Degree of synergy

High
Medium
Low

Types of relationships

+ With benefits
- With harms
• No evidence / Mixed



Adaptation to sea level rise and estuarine flooding

Risk / Measure / Line of Intervention	Relationship with risk sectors and groups				Synergies with mitigation	Relationship with SDGs																
	Ecosystems and their services	Disadvantaged groups	Elderly people	Children		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Adaptation to sea level rise and estuarine flooding																						
Measure 13. Adapt urban spaces to estuarine flooding																						
Inventory sensitive buildings, equipment and services exposed to risk	•	+	+	+	🔵	+	•	•	+	•	•	•	•	•	+	+	•	+	+	•	•	•
Create alert and monitoring systems for sea level rise and estuarine flooding	•	+	+	+	🔵	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Make the use and occupation of areas exposed to risk compatible	•	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Adopt urban planning rules that guarantee the accommodation of buildings	•	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Accommodate buildings (leakage of ground floors or change of use)	•	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Accommodate transport, energy and communications infrastructure (e.g., raising levels)	•	•	•	•	🔵	•	•	•	•	•	•	•	•	+	•	+	•	+	+	•	•	•
Create floodable multifunctional open spaces	+	•	•	•	🟡	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Install protection systems (dykes and barriers in built-up areas)	•	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	+	•	+	+	•	•	•
Protect transport, energy and communications infrastructure (dykes and barriers)	•	•	•	•	🔵	•	•	•	•	•	•	•	•	+	•	+	•	+	+	•	•	•
Relocate sensitive equipment and services exposed to risk	•	+	+	+	🔵	•	•	•	+	•	•	•	•	•	•	+	•	+	+	•	•	•
Relocate residential buildings exposed to risk	•	+	•	•	🔵	+	•	•	•	•	•	•	•	•	+	+	•	+	+	•	•	•
Relocate economic activities exposed to risk	•	•	•	•	🔵	•	•	•	•	•	•	•	+	+	•	+	•	+	+	•	•	•
Remove/retract transport, energy and communications infrastructure	•	•	•	•	🔵	•	•	•	•	•	•	•	•	+	•	+	•	+	+	•	•	•
Measure 14. Adapt natural spaces to estuarine flooding																						
Build/maintain walls and natural bank protection systems	+	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	•	•	•	+	+	•	•
River de-silting	-	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Measure 15. Protect sensitive areas to saline intrusion																						
Monitor the quantitative and qualitative status of surface and underground water bodies	•	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	•	•
Raise awareness of users and managers of water resources on the dangers of saline intrusion	+	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	•	+	+	•	+	•	+
Plan the prioritisation of uses in drought situations, based on flow thresholds / storage levels	+	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	•	+	+	•	•	•	+
Optimise the location and flow rates of catchments	+	•	•	•	🔵	•	•	•	•	•	•	•	•	•	•	•	+	+	•	•	•	+

Source: CEDRU (2022)

Relationship with Sustainable Development Goals

1 Eradicate poverty
2 Eradicate hunger
3 Access to quality health care and promoting well-being
4 Access to inclusive, quality and equitable education
5 Gender Equality
6 Availability and sustainable management of drinking water and sanitation
7 Reliable, sustainable and clean energy for all
8 Inclusive and sustainable economic growth
9 Resilient infrastructure, inclusive and sustainable industrialisation and innovation
10 Reducing inequalities
11 Inclusive, safe, resilient and sustainable cities
12 Sustainable consumption and production
13 Climate action
14 Conserving the oceans
15 Protecting terrestrial ecosystems
16 Effective, accountable and inclusive institutions
17 Partnerships for Sustainable Development

Relationship with risk sectors and groups

Ecosystems and their services
Disadvantaged groups
Elderly people
Children

Degree of synergy

🔴 High
🟡 Medium
🔵 Low

Types of relationships

+ With benefits
- With harms
• No evidence / Mixed

BIBLIOGRAPHICAL REFERENCES

ANEPC 2019 - National Authority for Emergency and Civil Protection, 2019: National Risk Assessment

EEA 2017 - European Environment Agency, 2017: Fluorinated greenhouse gases 2017: Data reported by companies on the production, import, export and destruction of fluorinated greenhouse gases in the European Union, 2007-2016, ISSN 1977-8449

Gaetani, M., Janicot, S., Vrac, M. *et al.* 2020 - Gaetani M, Janicot S, Vrac M, Famien AM, Sultan B. Robust assessment of the time of emergence of precipitation change in West Africa. Sci Rep. 2020 May 6;10(1):7670. doi: 10.1038/s41598-020-63782-2. PMID: 32376898; PMCID: PMC7203108

ICNF (PANCD 2014-2020) - National Action Programme to Combat Desertification, Desertification Susceptibility Map (aridity index 1980/2010)

IPCC 2007a - Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK.

IPCC 2014 - Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

IPCC, 2013 - Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp

JRC 2018 - Climate Impacts in Europe. Final report of the JRC PESETA III project.

Kok. *et al.* 2019 - Kok, K., Pedde, S., Gramberger, M. et al. New European socio-economic scenarios for climate change research: operationalising concepts to extend the shared socio-economic pathways. Reg Environ Change 19, 643–654 (2019). https://doi.org/10.1007/s10113-018-1400-0

MAMAOT 2013 - Ministry of Agriculture, Sea, Environment and Spatial Planning, 2013: Strategy for the Adaptation of Agriculture and Forestry to Climate Change

NOAA Climate.gov, adapted from NAS 2016 - Extreme event attribution: the climate versus weather blame game, NOAA – NAS2016, updated 2021 https://www.climate.gov/news-features/understanding-climate/extreme-event-attribution-climate-versus-weather-blame-game

O'Neill *et al.* 2017 - O'Neill, Brian & Oppenheimer, Michael & Warren, Rachel & Hallegatte, Stéphane & Kopp, Robert & Pörtner, Hans-Otto & Scholes, Robert & Birkmann, Joern & Foden, Wendy & Licker, Rachel & Mach, Katharine & Marbaix, Philippe & Mastrandrea, Michael & Price, J. & Takahashi, Kiyoshi & van Ypersele, Jean-Pascal & Yohe, Gary. (2017). IPCC reasons for concern regarding climate change risks. Nature Climate Change. 7. 28-37. 10.1038/nclimate3179

PMAAC AML 2018 - Lisbon metropolitan area, 2018 - Metropolitan plan for adaptation to climate change. https://sig.aml.pt/portal/apps/sites/#/pmaacaml

Roth, M., and T. R. Oke, 1994 - Comparison of modelled and "measured" heat storage in suburban terrain. Beitr. Phys. Atmos.,67, 149–156.

Solomon *et al.* 2007 - Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, New York

Sousa, *et al* 2020 - Santana, R., Sousa, J. S., Soares, P., Lopes, S., Boto, P., & Rocha, J. V. (2020). The demand for hospital emergency services: trends during the first month of COVID-19 response. Portuguese Journal of Public Health, 38(1), 30-36.

Stewart ID, Oke TR 2012 - Local Climate Zones for urban temperature studies. Bulletin of the American Meteorological Society, 93: 1879-1900.

Van Vuuren *et al.* 2011 - Van Vuuren, D.P., Edmonds, J., Kainuma, M. et al (2011) The representative concentration pathways: an overview. Climatic Change 109, 5 (2011). https://doi.org/10.1007/s10584-011-0148-z.

Van Vuuren *et al.* 2014 - Van Vuuren, D.P., Kriegler, E., O'Neill, B.C. et al. A new scenario framework for Climate Change Research: scenario matrix architecture. Climatic Change 122, 373–386 (2014). https://doi.org/10.1007/s10584-013-0906-1

vfx

C Â M A R A
M U N I C I P A L

Visit us

Ligações Fortes
cm-vfxira.pt

STRONG LINKS

Praça Afonso de Albuquerque, nº 2
2600-093 **Vila Franca de Xira**
Lisboa // PORTUGAL

+351 263 285 600

pmaac.vfx@cm-vfxira.pt