



HAJDÚBÖSZÖRMÉNY
A HAJDÚK FŐVÁROSA

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Ready4Heat

How do we protect ourselves against the heat?

Hajdúszoboszló Heat and UV Strategy and Action Plan

Hajdúszoboszló
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[Please keep it in mind: This document is only a suggestion for HHAP structure. We believe that HHAPs can be structured in different ways, for example, through local priorities and specific conditions.]



1. Summary [Fülep T.]

Climate change has many negative impacts; including an increase in the number (frequency), extent and duration of extreme temperature events. Heat waves, hot days, tropical nights take a toll on the human body; they have an adverse effect on the quality of life, increasing the risk of illness and death. The average temperature in Hajdú-Bihar County will increase by more than the national average. The number of frosty days will decrease, the number of hot days will increase (by up to 90% by 2050). Because of its low altitude, lowland location and continental climate, Hajdúböszörmény is particularly affected. **In order to adapt to the increase in temperature, to prevent and mitigate the heat island, short-, medium- and long-term local government measures are needed** in Hajdúböszörmény to help the population to protect themselves most effectively against the effects of heat waves, hot days and tropical nights.

We can learn the technique of enduring heat waves from people who are able to adapt to them, for example those indigenous people who can sustainably live in hot environments so we can consider their lifestyle, construction and behavior in this situation. Physical adaptation and tolerance to environmental loads are a fundamental part of vitality. The technique of surviving heat waves begins with enduring the heat. Heat protection techniques: keeping body temperature and mantle temperature low, preventing heat exhaustion and damage of the body. Survival techniques for enduring heat waves while developing directions of heat protection: cool building; cooling system of building; acclimatization; regular fluid intake and salt replacement; fully covering clothing; paying attention to our body's signals; sufficient rest; proper nutrition; moderate exercise; moderate traffic; airy places and activities; visiting different water and tree territories; considering taking medications; keeping medications at the appropriate temperature; visiting cooled, air-conditioned public buildings.

Sustainable urban planning aims to create a livable settlement, taking into account the natural values of the area, its role as a habitat, its ecological footprint, and the basic principles of sustainability by utilizing favorable conditions with sustainability investments; environmental, social and economic sustainability.

Hajdúböszörmény built **47 shading green islands** in the Ready4Heat project, and we are researching their effects. In 21 to 29/02/2024 we held target group-specific workshops, taking into account the results of the **Ready4Heat Hajdúböszörmény Project**, we developed the **heat action plan** [= Hajdúböszörmény HHAP (Heat and Health Action Plan = Hőség és Egészségügyi Cselekvési Terv) a heat-related action plan], which is based on the action proposals of the Hajdúböszörmény Municipality R4HH Ready4Heat Hajdúböszörmény working group, the staff members of the Green Circle (Hajdúböszörmény), the Reflex Environmental Protection Association (Győr), and the invited external environmental experts.

Three (3) major hot areas (city centre, southern commercial and industrial areas, eastern industrial zone) and a few standout hot spots can be identified in the city. The characteristics, function, and use of the individual affected city districts differ significantly from each other, thus requiring different treatment methods in each city district.



2. Introduction: Purpose and background of the document [Fülep T.]

2.1. Objectives of the Heat and Health Action Plan (HHAP)

2.1.1. Climate background of the Heat and Health Action Plan (HHAP)

Climate change has many negative impacts; one of these is the expected and experienced increase in the number (frequency), extent and duration of extreme temperature events that pose serious health risks. Heat waves, hot days, tropical nights take a heavy toll on the human body; they have an adverse effect on the quality of life and – especially in the case of vulnerable groups – increase the risk of illness and death.

As stated in the climate strategy of Hajdú-Bihar County: “According to climate models, the average temperature in Hajdú-Bihar County will increase by more than the national average in the future. As a continuation of previously observed trends, the number of frosty days will decrease, while the number of hot days is expected to increase, in some areas of Hajdú-Bihar County by up to 90% by 2050.” (MBFSZ NAKFO 2018: page 5) Due to its low altitude, lowland location and continental climate, Hajdúböszörmény is particularly affected by this change. There are no mountains or large bodies of water near the city that could somewhat mitigate the extremes. The city is already affected by about 30 hot days per year, but this rate will increase by the end of the 21st century; and heat waves lasting up to 4-5 days and tropical nights will also become more frequent.

Moreover, the impact of heat waves is more pronounced in large cities due to the urban heat island effect. “Heading towards the inner city area, the temperature is generally higher than in the outer city; this excess heat is the so-called **heat island** phenomenon. Dense built-up areas, reduced ventilation, the presence of pavements and low vegetation and plant coverage are all factors that contribute to the formation of the urban heat island. In addition, because of the transportation and different industrial activities, heat, water vapor, and pollutants released into the air and it can also modify the climate of cities. The degree of the urban heat island can reach up to 5–10 degrees during heat waves, so it can be particularly stressful for people living there.” (Lakatos et al. 2015: 1. oldal) Air conditioning systems that cool buildings also heat the spaces between them. All this clearly shows that in addition to the human impact on the climate (air pollution), many of its other habits also lead to the formation of the urban heat island.

In order to adapt to the rise in temperature while preventing and mitigating the heat island, short-, medium- and long-term local government measures are needed in Hajdúböszörmény that can help the population - with particular attention to members of vulnerable groups - to protect themselves as effectively as possible against the effects of heat waves, hot days and tropical nights.

The legislation has not defined tasks related to heat alerts for local governments or their bodies, however, heat waves pose a public health and environmental health risk that requires forward-looking **heat protection preparations** and an effective heat action plan for the duration of heat alerts: **R4H (Ready4Heat = Ready for Heat)** project, HHAP (Heat and Health Action Plan). Historically, unfortunately, it was the general social attitude and the technical development that led



to the development of environmental crises and extremes, therefore the active participation of local governments and all stakeholders are essentials in solving these problems.

In addition to the health risk, heat waves can also cause short-term malfunctions or long-term damage to certain elements of the infrastructure. Investigating the effects of the heat waves on electricity and water supply, transport, agriculture, etc. are the responsibilities of local governments and competent authorities, while taking necessary measures against it. Rapid and coordinated action is needed for adequate defence against heatwave and heat protection. There are many examples (heat action plans and case studies) worldwide and in Hungary, more and more municipalities are developing their heat and UV alert plans: international examples (Global Heat Health Information Network 2024), Veszprém (2009–2024), Óbuda (MEGÉRTI Kft. 2020–2021), etc.

The joint activities of the local government's organizational units, the relevant sectors and partner organizations (disaster management, public utility providers), as well as partnerships (non-public service companies, social organizations, the population) must be coordinated. Since heat waves are predicted to become more frequent, longer, more extreme and more extensive, it is appropriate and justified to develop, formulate and implement the applicable measures in a professional, standardized manner.

The aim of the heat action plan and heat action plan of the city of Hajdúböszörmény is:

- Short-, medium- and long-term adaptation to climate change.
- Preparing for the increasing number (frequency), extent and duration of extreme (extreme) temperature events and heat waves.
- Establishing an effective heat and UV warning and alert system.
- Ensuring the protection of the population in connection with extreme (extreme) temperature events, thereby reducing the number of related illnesses and deaths.
- Increasing the flexibility of the heat wave-related supply system.
- Reducing exposure and vulnerability to heat waves.
- Reducing and minimizing costs, damages and losses caused by heat waves.
- Alleviating the burden on the healthcare system.
- Raising awareness and informing the public about heat-related health risks, prevention and protection options.



2.1.2. The legal background of the heat action plan HHAP (Heat and Health Action Plan)

The legal background of the HHAP (Heat and Health Action Plan) was taken from the Óbuda heat and UV alert plan (MEGÉRTI Kft. 2020–2021):

- Act LXXXII of 1995 on the Promulgation of the United Nations Framework Convention on Climate Change.
- Act LIII of 1995 on General Rules for Environmental Protection.
- Act CCXVII of 2012 on Participation in the Community Greenhouse Gas Trading Scheme and the Implementation of the Effort-Sharing Decision, 410/2012 (28/12)
- Government Decree on Certain Rules for the Implementation of Act CCXVII of 2012 on Participation in the Community Greenhouse Gas Trading Scheme and the Implementation of the Effort-Sharing Decision.
- Act LX of 2007 on the Implementation Framework for the United Nations Framework Convention on Climate Change and its Kyoto Protocol. The National Climate Change Strategy (NCCS) was developed under the authority of the Act on the Implementation of the Kyoto Protocol.
- Green Book of the European Commission. “Adapting to climate change in Europe – Possibilities for EU action”. June 2007.
- Act CXXVIII of 2011 on disaster management and amending certain related acts.
- 234/2011. (10/XI) Government Decree on the implementation of Act CXXVIII of 2011 on disaster management and amending certain related acts.
- 385/2016. (2/XII) Government Decree on the performance of public health tasks of the capital and county government offices and the district (capital, district) offices, and on the designation of the health state administration body.
- 1384/2014. (17/VII) Government Decision on the Hungarian national disaster risk assessment methodology and the report on its results.

2.2. Groups at risk from heat

2.2.1. The concept of heatwave

The concept of **heatwave** in **Hungary**: A heatwave is a period in which *the temperature is 30 degrees Celsius or higher for several consecutive days.*

The concept of **heatwave** according to the **World Meteorological Organization**: A heatwave is a period in which the average temperature for *at least five consecutive days exceeds the long-term average temperature by five or more degrees Celsius (5 °C = 9 °F)* for the given month. (Rafferty é.n.).



2.2.2. Population groups that are particularly vulnerable and at risk during heatwaves

According to the latest data from 2023, there are nearly 30 thousand people living in Hajdúszoboszló (Table 1), of which the following population groups vulnerable and at risk due to heat can be identified:

- premature babies, newborns, infants, young children: 2000< people (Table 1);
- pregnant and lactating mothers;
- elderly people: ~5500 people (Table 1);
- people with chronic diseases, primarily cardiovascular diseases: 12000< people; people with chronic respiratory diseases: ~5000 people; people with diabetes or other metabolic diseases; overweight people (Table 2);
- people with mental or movement disorders (Alzheimer's disease, Parkinson's disease, dementia, people with psychiatric diseases);
- elderly people and patients living alone;
- people permanently bedridden: ~300 people (Table 2), unable to provide for themselves;
- socially isolated, homeless people;
- people with altered working capacity (disabled, reduced working capacity);
- people exposed to hot work (energy industry, heavy industry, construction industry);
- outdoor workers (agriculture, construction, etc.);
- stuck in traffic jams (car drivers and passengers of public transport vehicles that they have caused to get stuck in traffic jams).

Year	Number of inhabitants	0-6 years old (person)	Over 65 years old (person)	Number of birth (person)	Number of death (person)
2014	31264	2011	4530	298	344
2015	31072	1924	4723	286	372
2016	30898	1969	4832	286	358
2017	30701	1909	4941	276	370
2018	30573	1985	4994	326	379
2019	30392	2044	5102	306	389



2020	30188	2078	5178	328	430
2021	29979	2115	5277	317	487
2022	29741	2143	5386	319	417
2023	29487	2145	5449	287	408

Table 1: Population data of Hajdúböszörmény city
(Hajdúböszörmény Mayor's Office 2024a)

Hajdúböszörmény health data for 2023				
Adult family doctor's offices	Number of people with cardiovascular complaints	Number of people with kidney failure	Number of people with respiratory complaints	Number of bedridden people
Number I.	1617	46	582	5
Number II.	863	20	116	19
Number III.	1832	36	824	17
Number IV.	633	307	1007	40
Number V.	2286	47	770	100
Number VI.	456	134	350	10
Number VII.	873	43	148	30
Number VIII.	1474	44	561	8
Number IX.	113	0	190	6
Number X.	962	188	106	8
Number XI.	677	12	107	8
Number XII.	500	2	93	10
Number XIII.	81	25	115	18
Total	12.367	904	4969	279

Table 2: Health data of Hajdúböszörmény in 2023
(Hajdúböszörmény Mayor's Office 2024b)

2.2.3. Concurrent factors that exacerbate the effects of heat waves (cocktail effect)

Concurrent factors: The negative impact of heat on our daily lives is not only increasing due to (1) the increase in the number, extent and length of hot days, but also (2) the spread of uninhabitable built environments and (3) the deteriorating health of the population. Thus, they have a simultaneous impact:

1. **Warming climate:** Increasing the number, extent and length of hot days; increasingly frequent extreme weather events.
2. **Misguided urbanization habits: Increasing heat islands, reduced mobility, uninhabitable built environments.**
 - a) **Increase in heat islands (asphalt pavement) and increase in air pollution, decrease in movement:** In the last 6 decades, the number of cars has increased 125-fold:

In Hungary, there were 31,268 passenger cars in 1960, 238,563 in 1970 (KSH 2021b). In 2000, 2,364,706, and in 2020, 3,920,799 vehicles were in circulation (KSH 2021c), the increase in **20 years was 66%**.

In Hajdú-Bihar County, there were 99,691 vehicles in 2000, 186,493 in 2020 (KSH 2021c), the increase in **20 years was 87%**.

The rapid increase in the number of cars has led to the widening of asphalt pavements, and new lanes and parking lots have displaced green areas and trees, contributing to the formation of heat islands. Car traffic has become the most important air pollutant in cities, especially in the summer semester. Car-centric transportation and lifestyle have had an adverse effect on movement habits and people's fitness.

b) Growth of heat islands – paving stones and green deserts: The architectural fashion of our time has become the prominent appearance of paving stones in public areas, from which green areas are either pushed out or are relegated to narrow spaces to play a subordinate role. The fashionable covering of gardens and yards is a uniform, monotonous and species-poor, low-cut lawn (green desert), or also some kind of stone or paving stones. All this has facilitated the formation of heat islands.

c) Increase in heat islands – foreign architecture: A widespread architectural feature is foreign architecture, made with a large proportion of metal and glass surfaces, completely ignoring the climatic characteristics. Such buildings are cooled with energy-intensive air conditioning, which further enhances the formation of urban heat islands.

3. **Deteriorating public health:** Little exercise, obesity, weakening physical performance, decreasing fitness and vitality, spreading common diseases, aging society.

a) Severely little exercise: 71% of the domestic population, the vast majority, does not exercise at all, the Hungarian people exercise dramatically little (Dívány 2019; Fintor 2022; Egészségkalauz 2024). The population has a huge demand for comfort in all areas of life, which entails the elimination of exercise. Little exercise leads to a decrease in fitness, which worsens the ability to tolerate heat. The steps taken towards getting people moving have not yet achieved their goal. (In my opinion, the school physical education subject has no significant influence on movement habits and does not instill a love of physical activity. Everyday physical education is a fundamentally flawed solution in terms of getting the population moving. Weekend sports activities are time-consuming, do not reach everyone, and are not sufficient. First of all, changes affecting everyday life and everyday lifestyles are needed, where physical activity is an integral part of life, in line with the objectives of sustainable and livable cities – this is offered by the emphasis on walking and cycling and the organization of multimodal transport; Fülep 2021a).

b) Overnutrition and obesity: The nutrient and energy intake of a significant part of the population is not in harmony with the exercise and lifestyle, and Hungarian cuisine is



notoriously fatty and heavy. 58.2% of the Hungarian population is overweight or obese, one of the most obese people in Europe (Statista 2024), and this worrying situation is currently worsening. (Fodor 2015) The ability to tolerate heat is impaired by obesity.

c) Weakening physical performance: Studies conducted on children have shown a significant decrease in fitness in recent decades (Fodor 2015). The decrease in physical performance is associated with a decrease in fitness, which worsens the ability to tolerate heat.

d) Declining fitness and vitality: The shockingly low level of exercise and weakening physical performance reduce fitness and vitality, which are further destroyed by other bad habits. These include smoking, excessive caffeine consumption (coffee, “energy drinks”), consumption of sugary, heavily chilled (iced) drinks, and constant use of air-conditioning equipment (air conditioners). In 2019, more than one-fifth (22%) of adult Hungarian women and more than a quarter (27.3%) of men smoked on a daily basis (KSH 2021a). Children and young people consume energy drinks almost instead of water (Torontáli 2023). As a solution to the heat, most people drink supercooled liquids and spend days in supercooled rooms. All this reduces the body's ability to adapt to the environment and its tolerance to heat (Németh 2023). The exact opposite is needed: environmental adaptability, heat tolerance, and acclimatization.

e) Beach body fashion: In our time, appearance, a perfect and well-developed, shapely body is in fashion among both men and women, but a hardy and environmentally resistant body is not. The beach body trend specifically focuses on appearance and appearance, where the desired shape is mostly achieved with indoor training. Hiking, cycling and water-based touring sports are blooming again (reasons: technical development in the touring sports industry and business, government support), but often related to convenience (car approach), so their training value is much lower. The sporty (active) heat training nature of outdoor endurance sports (such as athletics, touring sports) appears precisely when we undertake the difficult sections on our own, with muscle strength. (However, beach-style training and comfortable hiking are also significantly more than lack of exercise.)

f) Spreading diseases: The health of Hungarians also deteriorated dramatically in the period 2000–2021: the number of asthmatics increased by 272%, the number of malignant tumor patients by 158%, the rate of diseases affecting the brain vessels by 147%, and the number of diabetics by 137% in two decades (Fintor 2022). These spreading diseases, affecting increasingly wider groups, can be considered a civilizational harm. The diseases impair the ability to tolerate heat. In poor health, even an average warm period can be a challenge!

g) Aging society: The domestic population is aging. In Hajdúböszörmény, the birth: death ratio is 3:4 (Table 1).

Cocktail effect: Several phenomena simultaneously exert their influence on the development of the urban climate and on people's everyday lives, quality of life, and tolerance as a “*cocktail effect*”; these effects reinforce each other. Their severity is revealed during heat waves (and other



environmental stress). **We are fighting the heat on a warming planet, where the heat islands of urban habits locally intensify heat waves; and a society that is sedentary, obese, weakening with decreasing fitness and vitality, concerned with external appearances, suffering from common diseases, and aging is less and less able to tolerate the heat.** The direction of technological development, the increasing need for comfort, and fashion that focuses on appearance all contribute to the weakening of people. The problem of heat is emphasized by the constantly panic-inducing media, while the frighteningly deteriorating public health is not a topic and is not in public awareness. **The Earth is becoming increasingly uninhabitable, and humans are becoming increasingly unlivable...**

2.3. A Health effects of extreme solar radiation

2.3.1. Effects of heat on the human body

2.3.1.1. Thermoregulation of the human body

The comfortable, optimal ambient temperature range for humans depends on several factors; approximately 22–36 degrees Celsius (room temperature 18–28 degrees C), which can vary from person to person and is significantly influenced by climate and culture. It is influenced by humidity, physical activity, clothing, body weight (fat layer), and the current physical and mental state. In order to maintain internal harmony and balance (homeostasis), our body ensures a uniform core temperature through thermoregulation. The core temperature of a person with a constant body temperature (homoiotherm) is ~37 degrees Celsius, which our body protects with thermal insulation, heat production and heat absorption, while they kept in dynamic balance with heat loss through thermoregulation (vegetative control mechanisms: thermoregulation). The processes of thermoregulation: thermal conductivity (conduction), thermal flow (convection), thermal radiation (radiation), vaporisation (evaporisation), other heat loss-heat absorption (inhalation, food and drink consumption).

We consider the ambient temperature pleasant, comfortable when the blood supply to the skin is at a moderate level, and we do not have to protect ourselves by “improving” thermal insulation (goosebumps), heat production (muscle work, shivering), or heat loss (sweating) to maintain our core temperature. We fight against environmental temperatures outside the comfort zone, which are perceived as too cold or too hot, by behaving in a way that restores internal harmony. We can protect ourselves against falling external temperatures primarily by increasing our clothing, but rising temperatures are increasingly difficult to handle, placing more strain on the body, which can lead to heat exhaustion.

The hotter it is, the greater the heat absorption, and the more the body’s heat loss is hindered. As body temperature rises, blood vessels in the skin dilate to help dissipate heat, increasing the amount of blood circulating on the body’s surface and raising the skin temperature. The mantle temperature

is higher, sweat glands begin to secrete sweat, the evaporation of which cools the body. Excess heat is released by the skin, which has an elevated temperature and evaporates sweat, as long as the ambient temperature is not higher and the humidity of the environment allows evaporation, and as long as there is sufficient salt and fluid intake to replenish it. The body's ability to regulate heat is influenced by many factors.

2.3.1.2. Conditions affecting thermoregulation: external factors

- duration of the heat wave (its increase has a negative effect on thermoregulation)
- number of consecutive hot nights (more hot nights are more burdensome)
- humidity (higher humidity has a negative effect on thermoregulation)
- a sudden heat wave (a sudden and unprepared heat wave has a negative effect on thermoregulation)

2.3.1.3. Conditions affecting thermoregulation: internal factors

- adaptation (acclimatization; lack of preparation of the body has a negative effect on thermoregulation)
- mental state (mental preparedness greatly helps the body to adapt the heat)
- population (race; those nations, who are living in hot climates and deserts, their bodies are better adapted to heat)
- fitness (condition, fitness; lack of training has a negative effect on thermoregulation)
- health status (many diseases are complicating conditions, and have a negative effect on thermoregulation)
- body weight (obesity has a negative effect on thermoregulation)
- age (thermoregulation deteriorates with age)
- nutrition (fatigue, heavy foods have a negative effect on thermoregulation)
- rest (fatigue and lack of sleep have a negative effect on thermoregulation)
- physical activity (intense physical activity has a negative effect on thermoregulation)

Increased physical activity can reduce blood circulation in the skin, thereby hindering heat loss. Repeated hot nights lead to a build-up of sleep deprivation, which further weakens the body and impairs heat tolerance. The heat protection habits of the Western lifestyle actually impair heat tolerance and make it more difficult to tolerate heat: overcooling rooms (which results in high humidity) and drinking cold liquids. The excess heat that is not dissipated accumulates in the body, thus increasing body temperature, causing heat exhaustion, negatively affecting our daily activities, and posing a health risk.

2.3.1.4. The effects of heat on our life activities

Heat rise: The effects of heat on our life activities when the body temperature rises by a few tenths of a degree above normal:

- Depression – bad mood
- Fatigue – reduced work efficiency and work motivation

- Dulled reflexes – risk of accidents, the number of accidents increases (traffic!)
- Headache
- Danger of dehydration – water loss can be up to twice the maximum amount of water that can be consumed
- Heat exhaustion – the body is no longer able to cool itself, the body becomes tired

45 °C: 45 degrees Celsius can be considered a critical temperature, because no one can survive an ambient temperature of 45 °C or higher in the long term. So 45 degrees Celsius is a critical temperature value, critical heat. (Silbernagl–Despopoulos 1994; Wikipedia 2024b)

50 °C: The upper limit of human tolerance to temperature is approximately 50 degrees Celsius, above which death sets in. (Silbernagl–Despopoulos 1994; Wikipedia 2024b) It is a glaring fact, that destructive heat exceeding 50 °C occurs in various populated areas and cities around the world, and according to forecasts, this will become more and more frequent – this is precisely the reason for the development of the **R4H (Ready4Heat)** project, the **HHAP (Heat and Health Action Plan)**, and this also urges the world to switch to a sustainable mode as soon as possible.

2.3.1.5. The harmful effects of heat

- Heatstroke, sunstroke, heatstroke (the body's thermoregulation is disrupted)
 - Symptoms of heating up: feeling hot, sweating
 - Symptoms of sunstroke: heavy sweating, feeling weak, rapid and shallow breathing, fast and weak pulse, warm to the touch skin, muscle cramps, paleness, dizziness, nausea, vomiting, fainting.
 - Symptoms of heatstroke: heat loss is insufficient and because of that the body cannot cool down by itself, body temperature quickly rises above 39 °C, sweating stops, the skin becomes pale and dry, fast but weak pulse, low blood pressure, excruciating headache, dizziness, nausea, vomiting, feeling confused, aggression, fainting and loss of consciousness, coma. Thickened blood due to dehydration causes circulatory problems, increasing the risk of thrombosis, stroke, and heart attack. Heat stroke can be fatal or cause permanent mental damage.
- In the case of existing diseases, the risk of death increases:
 - Diabetes mellitus and other metabolic diseases
 - Organic mental diseases: dementia, Alzheimer's disease
 - Mental and behavioral disorders due to psychoactive drugs and alcohol consumption
 - Schizophrenia and other psychiatric diseases
 - Extrapramidal diseases (and other movement disorders), e.g. Parkinson's disease
 - Cardiovascular diseases, e.g. cardiac arrhythmias, high blood pressure

- Respiratory diseases: (CALB, bronchitis) chronic bronchitis, bronchial asthma, emphysema
- Kidney diseases: renal failure, kidney stones.
- Groups of people at risk from heat: (Part 2.2)

2.3.2. Impact of extreme heat days on the numbers of morbidity and mortality

Rising temperatures can cause a higher incidence of several diseases: heat stress and heat stroke, malaise, cardiovascular diseases (e.g. high blood pressure), kidney failure, dehydration, diabetes, respiratory complaints, skin rashes, infections, etc. These are particularly dangerous for young children (under 5 years), the elderly (over 60 years), the chronically ill, residents with multiple disadvantages, summer workers and those, who spend extended periods of time outdoor. All this increases the use of health services, increases patient turnover at all levels, and may increase the burden on the health care system (Uzzoli 2015a, 2015b In Uzzoli et al. 2018).

According to climate health studies conducted in our country since 2000, the effect of temperature and extreme weather events can currently be considered the most significant health risk in the Carpathian Basin. Among environmental factors, temperature influences health status, and to a very significant extent. During heatwave days, daily mortality increases by approximately 15% on a national average. (Ministry of the Interior 2022b)

In 2021, there were six heat alerts. The number of national daily deaths increased by 8% during the 12 days of level II and by 12% during the 14 days of level III. During the season, 846 additional deaths were attributed to the heat (Figure 1). (Ministry of the Interior 2022b)

Temperature ° C

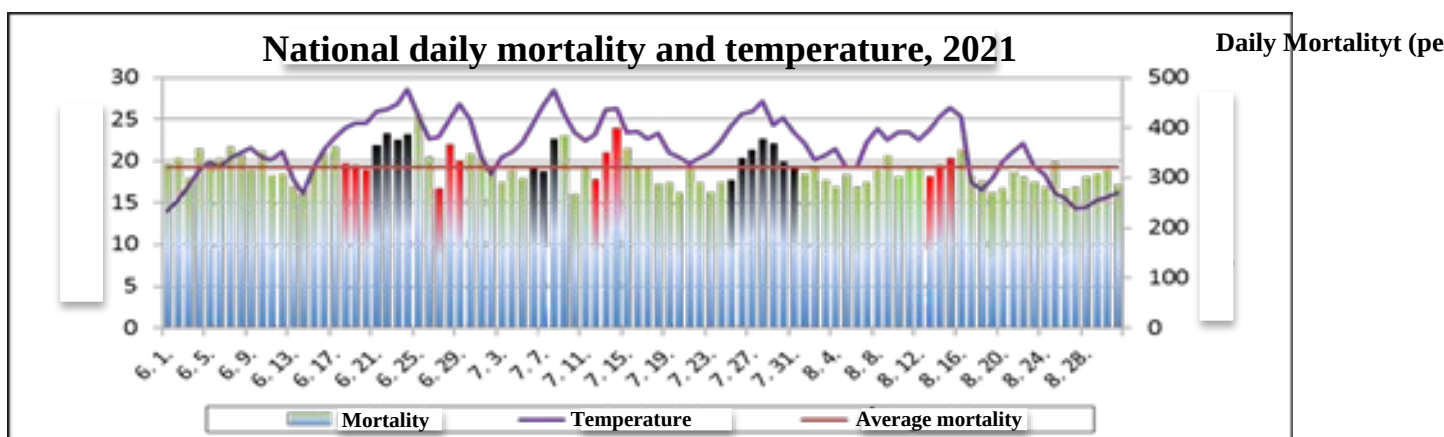


Table 1- National daily mortality and temperature, 2021. (Belügyminisztérium 2022b)

“During the development of the National Adaptation Geospatial System (NATÉR) established in 2014, the National Institute of Environmental Health, the legal predecessor of the NNK, conducted studies on excess mortality caused by heat waves. At the national level, between 2005-2014, the average annual excess mortality attributable to heat was approximately 780 cases, which is expected to increase to approximately 2000 cases between 2021-2050, assuming current vulnerability and an unchanged population. In the more distant future, between 2071-2100, due to the increase in the number and intensity of heat days, the annual excess mortality will increase to an average of approximately 5800 cases.” (Ministry of the Interior 2022b: page 1)

2.3.3. Effects of ultraviolet radiation on the human body

2.3.3.1. The nature of ultraviolet radiation

The energy of the Sun passes through the Earth's atmosphere and reaches the Earth, and living beings, including humans, on it, in the form of heat and light, as radiation. The electromagnetic radiation ranges coming from the Sun and not filtered by the atmosphere are perceived by our outer covering, skin and eyes. **Visible light**, or light, is the part of electromagnetic radiation between 400 and 750 nanometers in wavelength, which is perceived by the eye. Light with a longer wavelength is called the infrared range, where the “infra” indicator refers to a lower radiation frequency. After the violet color (rainbow) comes the ultraviolet part of the spectrum, which covers the part between 100 and 400 nm.

Infrared (IR) radiation is an electromagnetic radiation with a longer wavelength than visible light, but shorter than microwave radiation and radio waves. Compared to other wave ranges, it has a particularly high thermal capacity; humans perceive infrared radiation primarily as a thermal effect, which is why infrared radiation is treated as thermal radiation.

Ultraviolet (UV) radiation has a wavelength shorter than visible light (400–750 nm) but longer than X-rays (0.01–100 nm); it is an electromagnetic radiation in the 100–400 nanometer range. UV radiation is divided into three main parts:

- **UV-A radiation** (400–315 nm long wavelength, 98% of all UV radiation reaching the Earth's surface): the most common low-energy range closest to visible light, which is the least dangerous (toxic) to human health. [It has a beneficial effect on the body, promotes bone formation (vitamin D) and pigment formation (tanning).] It also penetrates window glass. UVA rays can cause long-term skin damage by releasing reactive oxygen free radicals (sun-induced skin aging, sun allergy, pigmentation disorders, skin tumors).
- **UV-B radiation** (medium wavelength 315–290 nm, 2% of all UV radiation reaching the Earth's surface): high-energy radiation, which is dangerous and harmful to human health. It reaches the Earth's surface, reaching its maximum intensity at a perpendicular angle of incidence, when its filtration is minimal. It does not penetrate window glass, but it does penetrate quartz glass and water. This wavelength is responsible for sunburn. Human skin

produces pigments in response to UV radiation, turning brown, thus protecting itself against harmful effects. However, a sudden and large amount of it reaching our body (due to the thinning of the corneal layer) can cause sunburn and skin cancer, damage our eyes (keratitis and conjunctivitis, cataracts) and weaken our immune system.

- **UV-C radiation** (short wavelength 290–180 nm, does not reach the Earth's surface): the strongest, most harmful and most dangerous radiation, but fortunately the ozone layer has so far completely filtered and absorbed it. It does not penetrate window glass. It is toxic to cells, has a bactericidal effect. It irritates the conjunctiva.
- UV radiation also has many beneficial physiological effects. It plays a role in the synthesis of vitamin D, optimizes the production of melatonin and serotonin, which is a condition for a restful night's sleep, and by increasing the level of beta-endorphins, it has a mood-improving effect, and is also beneficial in the prevention of obesity and type 2 diabetes. Excessive avoidance of sunlight can lead to low vitamin D levels (only dietary vitamin D supplementation is not sufficient), which is associated with mortality from high blood pressure, cardiovascular disease, and cancer. Spending time in nature is very important for maintaining our physical and mental health.

2.3.3.2. Harmful effects of ultraviolet radiation on the human body

- skin sunburn
- freckle staining
- premature aging of the skin
- skin cancer
- inflammation of the cornea and conjunctiva of the eye
- causes or accelerates the formation of cataracts
- weakens the immune system, which can increase the risk of infections and limit the effectiveness of disease defense. (Wikipedia 2024c)

2.3.3.3. UV-index

UV Index: Developed jointly by the World Health Organization (WHO) and the World Meteorological Organization (WMO), the UV Index expresses the measured or predicted amount/intensity of ultraviolet radiation from the sun at a given location on a given day. It divides the amount of UV radiation that is dangerous to our skin and vision into five groups according to how dangerous the given UV exposure is. In the case of extreme UV radiation (UV index 8–11), skin damage within 10 minutes is almost guaranteed. (Hungarian Dermatological Society (2022) This indicator shows the risk of sunburn much more accurately than the temperature forecast; in our country it is published by HungaroMet Hungarian Meteorological Service Nonprofit Zrt. The UV index provides a clear and simple way to know the strength of UV radiation and, accordingly, to easily decide on the type of precautions. (Table 3; Appendix 8.10)

The amount of UV radiation reaching the surface changes continuously:

- during the day: reaches its highest value around noon, (without cloud cover): between 10 am and 4 pm

- during the seasons: strongest in summer, weakest in winter
- depending on geographical latitude: decreases away from the Equator, increases closer to the Equator
- depending on altitude above sea level: increases by 8–15% per 1000 meters
- depending on the reflectivity of the earth's surface: the reflectivity of snow 80%, sand 25–30%, water 20–50% (water transmits 50–70% of UV-A and UV-B light up to a depth of 1 meter)
- depending on the weather: in the case of small cloud cover, UV radiation can be even more powerful due to the reflective effect, only very dark precipitation clouds are able to absorb it (up to 80%)

The UV index value ranges from 0 to 11, with a higher numerical value, some health damage may develop with a higher probability and in a shorter time due to UV radiation: skin or eye damage or injury (Table 3; Annex 8.5).

2.3.4. The impact of extreme ultraviolet radiation on diseases and deaths

2.3.4.1. Skin cancer

The most important and serious health consequence of extreme ultraviolet radiation is the risk of developing skin cancer, which can lead to death. Although skin cancer (melanoma) is not among the most common types of cancer and its mortality rate is not high, its continuous increase worldwide is worrying. According to the National Cancer Registry database, the number of new cases almost doubled between 2001 and 2019, which is in line with international trends. In contrast, according to the mortality database of the Central Statistical Office, the number of deaths did not change significantly during the indicated period, despite the increase in international data. The survival rate of skin cancer patients has therefore improved year by year, the reasons for which can be found in the strengthening of secondary prevention and the better effectiveness of newly introduced anti-cancer treatments. (Parrag et al. 2022)

2.3.4.2. Cataracts

While literature and research data show a clear correlation between skin cancer and exposure to sunlight, the correlations between clouding of the lens of the eye (cataracts) and UV-B radiation are controversial, and the domestic results require further investigation. (Páldy et al. 2004)

2.3.5. Advice for coping with extreme solar radiation, ultraviolet radiation and heat waves

2.3.5.1. Coping with heat waves – recommendations for the population, decision-makers and urban developers

It is relatively easy to protect against the UV radiation content of solar radiation with appropriate light-blocking, shading and light-filtering surfaces (Table 3). However, it is much more difficult to



prepare for the thermal radiation (IR radiation) and air temperature that warms our environment. Among heat waves (in Hungary, a heat wave is ≥ 30 °C on consecutive days), the critical heat of ≥ 45 °C can be considered extreme, because it directly endangers all human life (section 2.3.1).

If the body begins to heat up due to the external temperature and other conditions, it can gradually burden, overload, tire, and exhaust the body especially if the temperature and the duration of exposure continues to increase, further deteriorating the conditions. It is especially burdensome and risky in the case of vulnerable groups of people, where in extreme cases it can lead to health damage and even death. (2.2; section 2.3.1)

Indigenous heat protection: The technique of enduring heat waves can be learned best from people who are able to adapt to it, so we can consider the lifestyle, construction and behavior of indigenous people living sustainably in hot environments as an example:

- **Residents of the hot (tropical) climate zone (equatorial, savannah, tropical desert, tropical monsoon climates)**
- **Residents of the warm temperate climate zone (humid subtropical monsoon, dry subtropical Mediterranean climates)**
- **Endurance and extreme athletes exposed to high temperatures (Fülep 2021b)**

Endurance: The technique of surviving heat waves begins with enduring the heat. Physical adaptation and tolerance to environmental stresses (cold, heat, sunlight, wind, wildlife, etc.) are a fundamental part of vitality. Only natural man is able to live in complete harmony with his environment (indigenous and nomadic peoples), but a sufficient degree of tolerance is vital and is expected of everyone. Tolerance is developed through training. The body encounters heat stress, learns to deal with it properly, and remembers it during a heat wave – this tolerance decreases with age and illness. If the body does not encounter heat stress to a sufficient extent (for example, due to a lifestyle that constantly avoids heat: cooled buildings and vehicles; due to a complete lack of outdoor endurance sports activities), then the heat tolerance that is necessary for summers will not develop.

Heat training: With appropriate training, we can improve our acclimatization ability and tolerate summer heat and high temperatures much more easily. The human body is flexible and developable, with conscious work it is even capable of extreme performances. It all starts with consciousness: attitude and will – however, panic-like hype does a lot to ruin this. The first and inevitable step in heat protection is to develop a lifestyle that brings with it the development and improvement of heat tolerance.

- **Natural (everyday) heat training:** It trains the body against heat in a natural way, if we do not constantly hide from the heat and do not always try to stay “under the covers” in cooled (air-conditioned) places. If we are basically healthy and fit, a heat wave should not cause any problems.
- **Planned (passive) heat training:** We can train our body for heat in a planned way, for example with the Finnish sauna, steam bath, infrared sauna, where we stay at a controlled

temperature, humidity and time. With this simple and passive activity, we can easily learn about the effect of heat on our body. It is also a simple and pleasant way of heat training if we sometimes vacation in hot places.

- **Active heat training:** In outdoor endurance sports (e.g. athletics, hiking), the heat produced by the muscles is a significant factor, and the body thus encounters the burden of overheating. In the winter months, clothing can hinder the release of excess heat. In the summer months, high ambient temperatures make heat loss difficult or impossible. The examples of many athletes prove that extreme heat can be tolerated even during intense sports activities if the body has been prepared for it through training.

Heat protection techniques: The aim of all heat protection techniques is to keep the body temperature (coat temperature) low in order to prevent heat exhaustion and damage to the body. We must take all heat protection solutions into account, and in case of an emergency, anything may be needed. In the following, I will list and evaluate survival techniques for enduring heat waves, which accurately indicate the direction of development of heat protection.

Survival techniques for enduring heat waves, their evaluation, and development directions for heat protection (based on general knowledge and Fülep 2021b):

- **Cool building:** We should think about a building that can be kept cool during the summer period during the planning, construction, and home purchase stages.
Architectural protection for enduring heat waves:
 - orientation: planned use of the features of the northern sides, cool and shady northern walls, rooms
 - shading: shutters, blackout curtains, blinds (relux and strip curtains are not suitable for controlling heat gain), parasols, eaves, roofs, alleys, vegetation
 - thick walls, hollow, multi-layered walls
 - thermal insulation: natural thermal insulation materials (aluminum, superaluminum), thermal insulation layers (rock wool, nickel cell, shredded paper)
 - moderate window sizes
 - green environment, green roof, wall garden (vertical garden)
 - existence of constantly cool rooms (pantry, cellar)
 - green gardens: shade-giving trees, pavilions, pergolas, arbors, climbing plants
- **Building cooling:**
 - night ventilation
 - moderate use of heat-emitting devices use
 - use of solar chimneys: planned use of the cooling effect of natural heat flow, ancient architectural solution for air conditioning (Octogon é.n.)
 - use of windbreaks: directing the wind into the building, ancient architectural solution for air conditioning (Leveles é.n.)
 - use of water channels: use of the cooling effect of water evaporation, ancient architectural solution for air conditioning (Leveles é.n.)



- fans: circulation of air, useful up to 35 degrees Celsius
- air conditioning (energy-intensive, expensive, unsustainable): The internal temperature achieved by cooling the building should be 5–8, maximum 10 degrees Celsius lower than the external temperature (Belühyminisztérium 2022a)! If, after the too large difference, we are almost hit by a “heat shock” when we step outside, it significantly impairs our ability to acclimatize, and the sudden cold-hot effect is also harmful to the skeleton.
- **Acclimatization:** basically, we should strive for the best possible physical and mental health and fitness
 - physical acclimatization: getting used to the heat and overheating, avoiding overcooled places in the summer, occasionally doing intense sports activities in all seasons (warming up our bodies), sauna
 - mental acclimatization: avoiding panic, visiting hot places from time to time if possible, developing a healthy body awareness and self-confidence
- **Regular fluid intake and salt replacement:** Drinks to avoid: drinking cold, high sugar, alcohol and caffeine drinks, such as overly sweet fruit juices, soft drinks, coffee, energy drinks, chilled drinks. Proper nutrition and tea are the best ways to replace salt. Don't leave home without a bottle of water.
 - drink fluids every hour, preferably with a 2-3 deciliter glass at a time
 - sipping is not well utilized (drinking too little water in too small doses, over a long period of time)
 - drinking large amounts suddenly (drinking liters) puts a strain on the body and can be dangerous, causing water poisoning
 - water (cool, lukewarm, ambient temperature)
 - tea (boiled, hot or lukewarm)
 - our water loss can be twice our water absorption capacity, meaning that in certain situations dehydration is inevitable, which must be replaced immediately afterwards
- **Fully covering clothing:**
 - head covering with shading of the face and neck (sun visor, brimmed cap, hat, headscarf)
 - wearing light-colored, loose-fitting, airy clothing (summer fashion)
 - wearing light, breathable, preferably waterproof footwear (e.g. sandals, sports shoes; summer fashion)
 - wetting of clothing (feet, calves, forearms, neck and head)
- **Pay attention to our body's signals:** If our body indicates that it is becoming increasingly difficult to fight the heat, we should immediately seek rest and cooling opportunities, and if necessary, external help!
 - Continuously monitor our body temperature!
 - Do not let a rapid pulse develop!
 - Do not let a feeling of thirst develop!
- **Sufficient rest:** in a state of sleep and relaxation, the body handles stress better



- night sleep
- daytime rest: extra rest based on feeling, as needed
- afternoon siesta: the 4–7–8 breathing technique, deeply embedded in the culture of all heat-adapted peoples
- calms the mind and also helps with sleep
- Proper nutrition:
 - sufficient energy intake
 - light, less fatty and sweet foods
- Moderate exercise:
 - walking: light exercise definitely makes it easier to tolerate the heat
 - scooter: light exercise with a gentle breeze
 - cycling: in the optimal range between light driving with low torque and a pleasant breeze
- Restrained driving: slower reaction time (the reaction time of all traffic participants may slow down), deteriorating concentration (all traffic participants may be less attentive)
 - lower speed
 - greater following distances
- **Breathable places and activities:**
 - light outdoor work
 - postpone and move heavy outdoor work to early, late or night time, if possible
- **Visit wetlands:** the cooling, evaporative, temperature-balancing effect of water is beneficial; however, due to light reflection, we can expect greater light radiation; the beneficial thermal effect of paved-concreted, vegetation-free waters is lost
 - cool water showers even during the day, wet towels, foot soaks
 - lakeshores, ornamental lakes, boating lakes
 - fountains
 - springs, public wells, ornamental wells, drinking wells, water taps, bottle refill points
 - streams
 - swamps and other bodies of water
 - steam gates (fashionable visual solution)
 - water distribution (expensive and produces waste, not sustainable; solution: public wells)
 - beaches, baths, public baths (public baths), water playgrounds (NNGyK 2024)
 - (seashores: none in our country)
- **Visit wooded habitats:** tall vegetation provides excellent shade, evapotranspiration has a cooling effect
 - forests: groves or closed forests (urban forests and surrounding forests, mountains role)
 - public parks: groves, grass
 - tree plantings: variable in appearance



- tree rows: longitudinal, roadside
- green islands: under development, the fashion of the present, in place of former stone pavements
- **Reconsidering the use of medications:** consultation with the pharmacist-doctor in order to maintain fluid balance,
- **Keeping medications at the appropriate temperature:** many medications are heat-sensitive
- **Visiting cooled, air-conditioned public buildings: if necessary,** prior information about their location

Western heat protection: In the Western world, many common heat protection behaviors are known and have become public knowledge, but they are not always appropriate, sometimes unsustainable (for example, they can involve high energy consumption), and usually do not improve, but rather worsen people's physical fitness, condition, fitness, adaptability, and tolerance (decreased vitality). Ineffective and body-weakening heat protection practices are listed as contraindications.

Contraindications for heat waves (based on general knowledge and Fülep 2021b):

- It is not recommended to stay in cooled (air-conditioned), overcooled buildings for a long time (Kravčík et al. 2007) and to go in and out: which are $\cong 10-20$ °C colder than the outside temperature - this leads to damage to the joints, catching colds, and significantly worsens heat tolerance! – If possible, do not use mechanical cooling to keep the building cool, or use moderate cooling! To develop strong heat tolerance and a sustainable lifestyle, do not use artificial cooling at all, do not use air conditioning! (Due to your job, staying in overcooled places is unavoidable, for example, a poultry processing cold store: Keleti Industrial Park.)
- Do not drink cold, icy drinks! – Do not cool liquids too much! (Cold drinks can also cause a higher frequency of diseases related to blood clots.)
- Do not sip, but drink in glass-sized portions!
- Do not avoid exercise, especially in the period before summer!
- Do not listen to alarming panic news, do not consider a period of around 30 °C as a serious emergency! Summer is not a disaster, but one of the 4 temperate seasons. – Instead of shocking, let's create the conditions for livability and sustainability!
- Do not expose our skin to direct sunlight for the purpose of “ventilation”, and do not wear dark-colored, tight clothing! – Follow sporty and seasonal fashion whenever possible!
- Do not try to live the same way in winter and summer, ignoring the passage of the seasons.
- Do not forget that air conditioners and cars, in addition to their general pollution problems, further aggravate the heat island effect in cities!

2.3.5.2. Tolerating ultraviolet radiation – recommendations for the population, sunbathing rules

The HungaroMet Hungarian Meteorological Service Nonprofit Zrt. provides daily information about the expected temperature values in its daily weather forecast, and in all cases draws attention to upcoming heat waves and their severity. It also publishes and regularly updates the expected UV radiation levels at www.met.hu/idojaras/humanmeteorologia/uv-b/, and smartphone weather apps also display the current UV index. The UV index value indicates the correct behavior for sun protection (Table 3).

UV-index	UV radiation level	Outdore behaviours of those, who stayed outside for a longer time period	Recommended sunbathing time (minute)			
			really sensitive	sensitive	moderately sensitive	less sensitive
8,0<	extreme	Look for shade between 11am and 3pm; wear light clothing that covers the body well with a wide-brimmed hat; parasol and sunscreen recommended	10–15	15–20	25–30	30–40
7,0–7,9	really powerful	For uncovered parts of the body, a wide-brimmed hat, sunglasses, sunshade and sunscreen are recommended; avoid direct sunlight around noon	15–20	20–25	30–35	40–45
5,0–6,9	powerful	For uncovered parts of the body sunscreen is recommended with wide-brimmed hat, sunglasses and sunshade for sensitive people.	20–30	25–35	35–45	45–60
3,0–4,9	moderate	Wide-brimmed hat and sunglasses	30–45	35–60	45–80	60–100
0,1–2,9	weak	Precautions for people with particularly sensitive skin and infants only	45–60	60–75	80–90	100–120

Table 3: UV index description. (HungaroMet é.n.2; Magyar Dermatológiai Társaság 2022)

2.3.6. Emergency care for heatstroke

If heatstroke is suspected, call the National Ambulance Service at 104 or the central emergency number at 112! While waiting for the ambulance, do the following with the person in need of help (National Center for Public Health, n.a.):

- Take their body temperature!
- If possible, take them to a cooler place!
- Cool them down as quickly as possible, for example with a cold shower, water spraying, wrapping them in a wet sheet or creating an air current with a fan!
- If they are conscious, make them drink fluids!



- Do not give them aspirin or paracetamol!

2.4. Development process: R4HH Ready4Heat Hajdúböszörmény Project

2.4.1. Sustainable urban planning

Sustainable urban planning aims to create a livable settlement for its residents, while taking into account the natural values of the area, its role as a habitat, its ecological footprint, and all the basic principles of sustainability. Sustainable urban planning is done by rationally utilizing favorable conditions and making sustainable investments. True sustainability includes environmental, social, and economic sustainability.

Strengths and opportunities of Hajdúböszörmény in terms of sustainability (HBMFÜ–Kovács 2024) – these can be used and incorporated into developments:

- The area is exceptionally rich in natural and cultural values.
- On the outskirts of the city, afforestation and field protection forest belts.
- Excellent agricultural production conditions.
- Boating lake and other surface waters.
- Medicinal and thermal water.
- Green space development opportunities are available in the city's residential areas.
- Recreational areas designated for spending free time are mostly related to green spaces and water areas.
- Significant social activity, a large number of civil society organizations (NGOs), including those related to the environment. Impact: cooperation and attitude formation.

Weaknesses and threats of Hajdúböszörmény in terms of sustainability (HBMFÜ–Kovács 2024) – these should be resolved and improved during the developments:

- The forest areas under nature conservation protection in the area are for economic purposes. Impact: conflict with nature conservation.
- Areas at risk of inland water. Impact: land use difficulties.
- Senseless overcrowding of the outskirts with over-driven real estate developments. Impact: beginning of heat island formation.
- The extent and proportion of public green areas are few and unsatisfactory. Impact: formation of a heat island.
- The island-like green surface elements are not fully connected by green network elements (green corridors, ecological corridors). Impact: formation of a heat island, reduction of biodiversity.
- Sparse settlement network, long distances between settlements.
- The number of workers commuting to other settlements has increased significantly. Impact: increased vehicle traffic and road use.
- No relief bypass.
- Difficult rail access. Impact: less attractive and usable sustainable rail.
- Insufficient urban and inter-settlement cycle path network. Impact: less attractive and usable sustainable cycling for commuting and tourism.
- Contaminated groundwater. Impact: more limited and costly use.

Sustainable urban planning and urban land use planning measures also involve planning for thermal phenomena, meaning they provide solutions to both warming and heat waves. The city of Hajdúböszörmény initiated the experimental creation of 47 shading green islands in the Ready4Heat project, which were located in several points of the settlement, in public areas and in community and institutional areas by the end of June 2024 (Hajdúböszörmény Mayor's Office 2024e; 8.9. Shading green islands in Hajdúböszörmény (R4HH Project). The green islands basically consist of



2 wooden benches, surrounded by carefully selected species of soft and woody plants. The shading is enhanced by raised surfaces attached to the benches and vertical pergolas planted with specific herbaceous plants. The green islands are located at points used by local residents and everyone else, so they are expected to help reduce the impact of heat waves on the human body during summer heat waves and heatwave periods. The presence of (nature-based) green islands that utilize the natural effects of living plants also has a positive effect on the city climate, i.e. it helps prevent overheating of the settlement.

In my opinion, in the era of global environmental problems, the employment and active involvement of environmental and sustainability experts would be necessary in every settlement. Their task would be to steer the development and operation of the settlement in a sustainable direction. (Hajdúböszörmény currently has no sustainability expert.) At the dawn of the global afforestation era, horticultural experts would also be needed, since the vegetation planted in public areas requires continuous care and updating.

2.4.2. Climate adaptation research

The 47 green islands nature-based development is being implemented on an experimental basis, the effects of which are being researched during the project. We share our experiences at the domestic and international levels, thereby helping the work of other settlements and organizations dealing with climate adaptation.

In order to prepare the heat action plan in a practical, needs-oriented manner, we held target group-specific workshops between 21–29.02.2024. All operators, who have been involved in dealing with people exposed to heat were invited to attend the workshops, exchange ideas and, where possible, participate in the development of measures.

In this way, we were able to take into account the opinions and insights of stakeholders, which facilitated the development of communication channels and measures, as well as the establishment of a stable network. The following four working groups were established based on the scientific findings on the high level of exposure and vulnerability of certain population groups (section 2.2.2):

1. Chronic patients, local residents with health problems – patients who are particularly sensitive to the dangers posed by heat.
2. Elderly people – elderly people with health problems and living alone.
3. Expectant mothers, breastfeeding mothers, parents of young children and children themselves.
4. Workers working outdoors in the summer, even in the hot sun.

Taking into account the results of the workshops, we developed the current heat action plan, which enters the first implementation stage of the second phase of the “Ready4Heat Project in the pilot city of Hajdúböszörmény”. The entire project plan is shown in Figure 2.

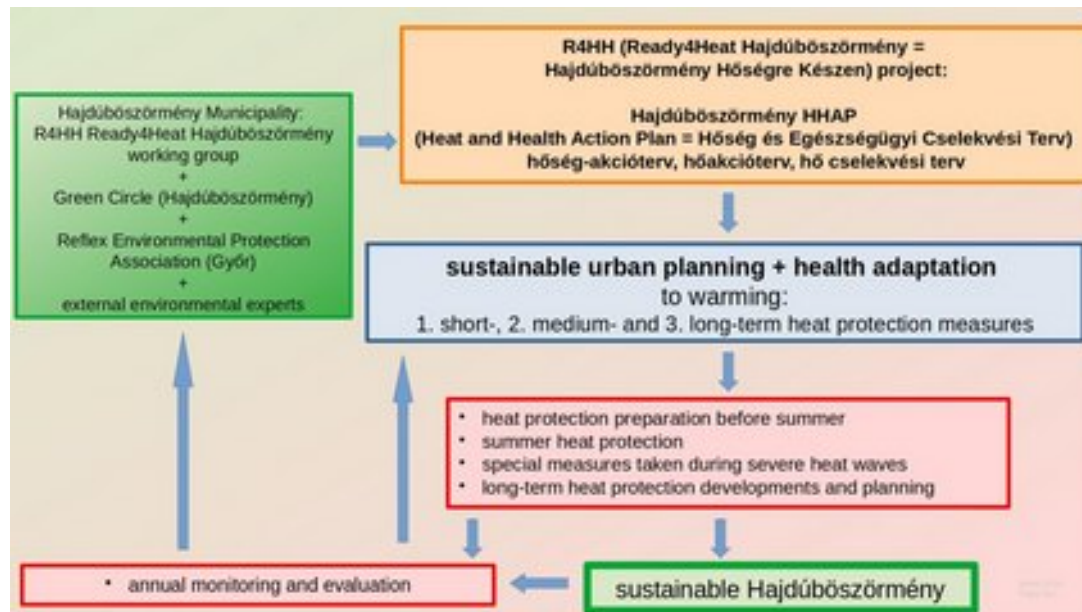


Figure 2: Structural diagram of the Hajdúböszörmény Heat and Health Action Plan (HHAP) (T. Fülep)

2.4.3. Preparation of a heat action plan

The structure of the Hajdúböszörmény HHAP (Heat and Health Action Plan) heat action plan, heat-related action plan (heat action plan):

- is based on the action proposals of the Hajdúböszörmény Municipality R4HH Ready4Heat Hajdúböszörmény working group,
- the Green Circle (Hajdúböszörmény) staff,
- the Reflex Environmental Protection Association (Győr) staff,
- the invited external environmental experts on the preparation of settlement heat-related action plans.

2.4.4. Organization of an expert heat protection working group

Listing, visiting and selecting environmental and sustainability experts in Hajdúböszörmény and its region. **Experts can be professionals with environmental or sustainability degrees, as well as professionals from recognized environmental and sustainability state and social organizations with relevant references.** (It is important that those who do not have relevant degrees and/or do not have recognized work do not end up in a decision-making position and do not mislead professional work.) Establishment of an office, a heat protection steering group (steering committee) and a heat protection working group consisting of experts and decision-makers.



2.4.5. Effective heat protection in Hajdúböszörmény

The expected result at the end of the development process of the R4HH Ready4Heat Hajdúböszörmény Project is effective heat protection of the city of Hajdúböszörmény, which ensures adequate protection against warming and heat waves.

Sustainable urban planning and health adaptation to the consequences of climate change with warming – includes short-, medium- and long-term heat protection measures:

- pre-summer heat protection preparation
- summer heat protection
- special measures taken during acute heat waves
- long-term heat protection developments and planning
- annual monitoring and evaluation

3. The timeliness of the issue of extreme heat in Hajdúböszörmény

3.1. Past, current and expected future climate status and processes [Sütő-Vásárhelyi Cs.]

3.1.1. Past and current climate conditions in the Hajdúböszörmény region

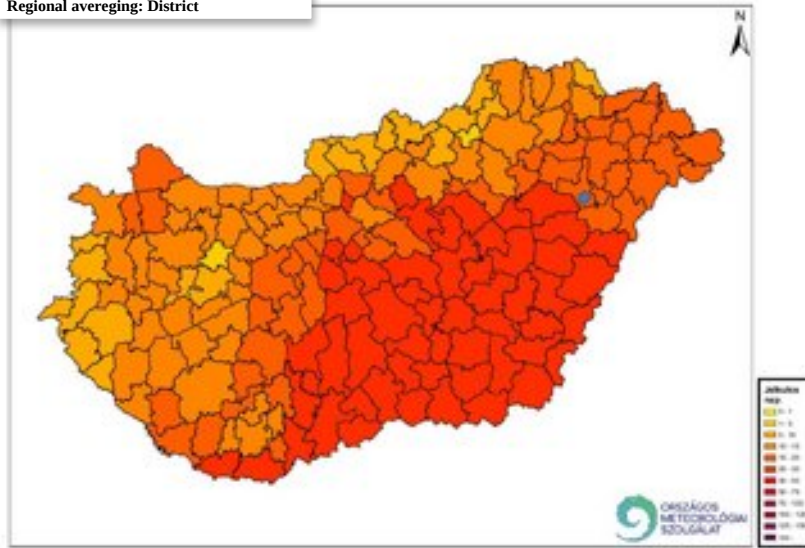
The city of Hajdúböszörmény is located in the central region of Hajdúság, within the Hajdúhát micro landscape. The climate of the microregion was moderately warm and dry based on the average for the period 1961–1990. During this period, the average annual temperature typically ranged between 9.7 and 10 °C (Dövényi 2010). In the period since then, the indicator has increased significantly, and the average for the 30-year period between 1991–2020 in the Hajdúböszörmény region was already 10.6 °C (KlimAdat 2016–2022).

In addition to the increase in the average temperature, the so-called warm temperature extremes have also increased significantly. The number of hot days (when the daily maximum temperature exceeds 30 °C) was 17.8 days on average in the period 1971–2000, which increased by more than one and a half times to 28.5 days in the period 1991–2020. The changes in district values in recent decades are illustrated in the following figures (3–5.).



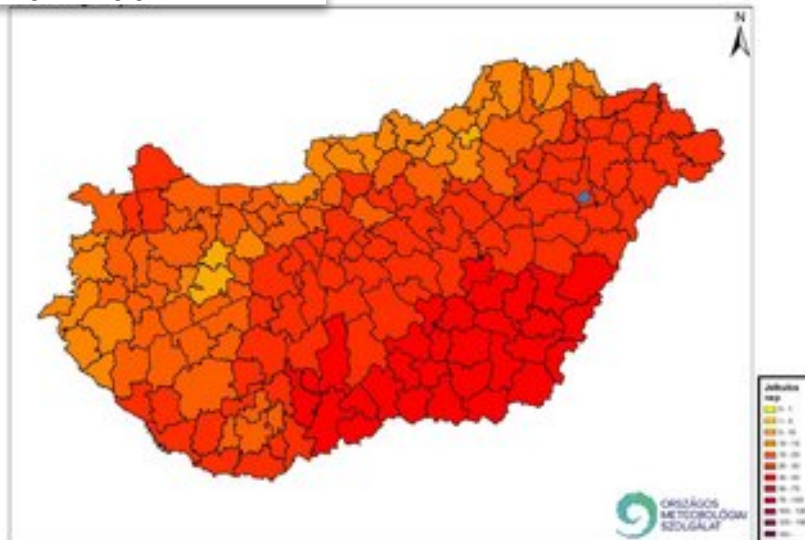
Működésének éves átlagos száma mérési adatok alapján
Average annual number of heat days based on measurements
Period:1971-2000
Regional avereging: District

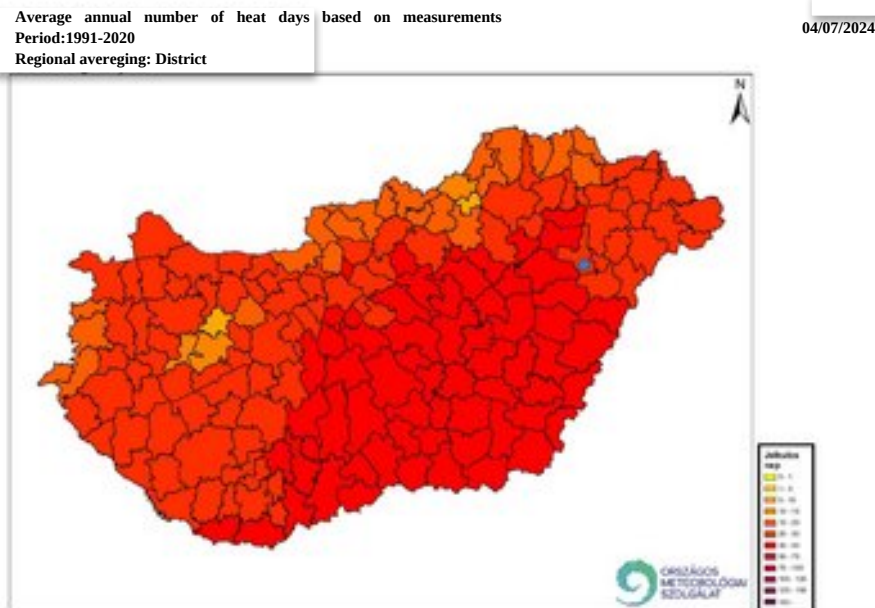
04/07/2024



Average annual number of heat days based on measurements
Period:1981-2010
Regional avereging: District

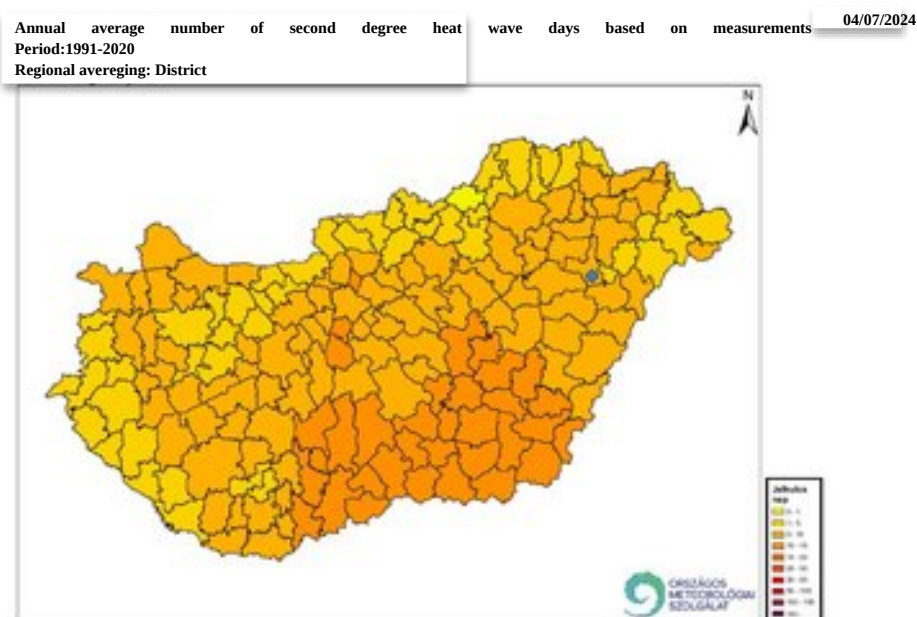
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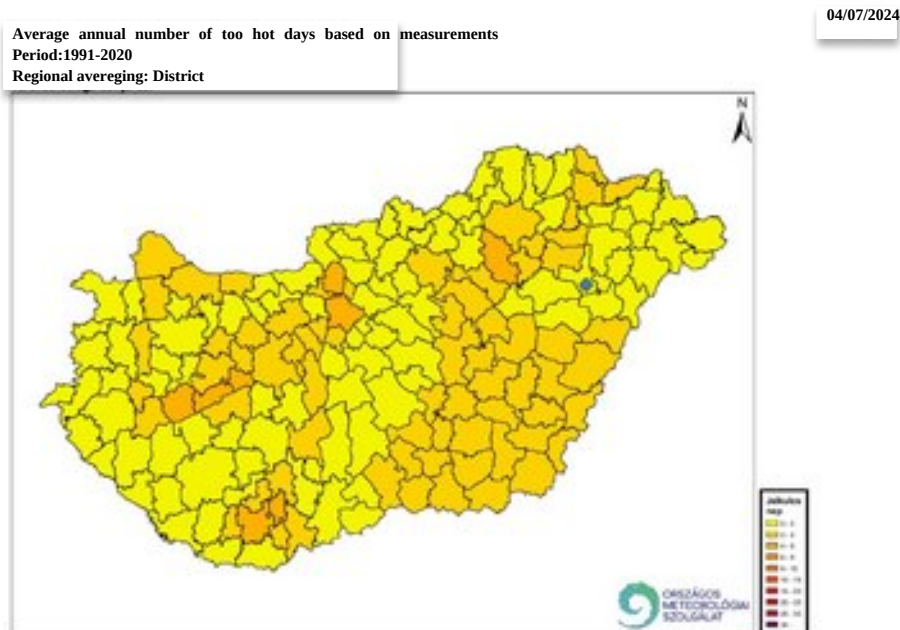
3–5. figures: Average number of heat days per year measured at the districts of Hungary (KlimAdat 2016–2022)

A similar trend is observed for secondary heat wave days (mean daily temperature reaching 25 °C for at least 3 days). During the periods examined, the number of such days increased from 3.2 to 6.8 days, i.e. more than doubled in the Hajdúböszörmény district (Figure 6). In the case of secondary heat wave days, the National Chief Medical Officer issues a secondary heat alert, which means warning the healthcare system and local governments and regularly informing the population during a heat wave (Section 5.2).



6. figure: Average annual number of measured days with second degree heat wave, average for the period 1991-2020 by districts (KlimAdat 2016–2022)

Another important parameter is the number of too warm nights, also known as tropical nights (Figure 7). This indicator indicates the days when the daily minimum temperature remains above 25 °C, which significantly burdens the human body. Its value in Hajdúböszörmény district was 1.5 days on average in the period 1991–2020.



7. figure: The number of too hot nights, average for the period 1991-2020 by districts (KlimAdat 2016–2022)

3.1.2. Presentation of the expected future climate change in the Hajdúböszörmény region

A further increase in average temperature can be expected due to climate change. Based on the climate model results available in the KlimAdat (2016–2022) database, the annual average temperature in the Hajdúböszörmény district is expected to increase by another 3 °C by the end of the century.

Based on the data available in the National Adaptation Geospatial Information System, the number of days with a second-degree heat alert may increase by another 30–35 days by the end of the century according to pessimistic scenarios (RCP8.5), which means that heat alerts may be in place for more than a month in summer. According to the moderately optimistic scenario (RCP4.5), the increase may be 10–15 days (Figure 8).

Change in the average number of second degree heat wave days per year for the period 2071–2100

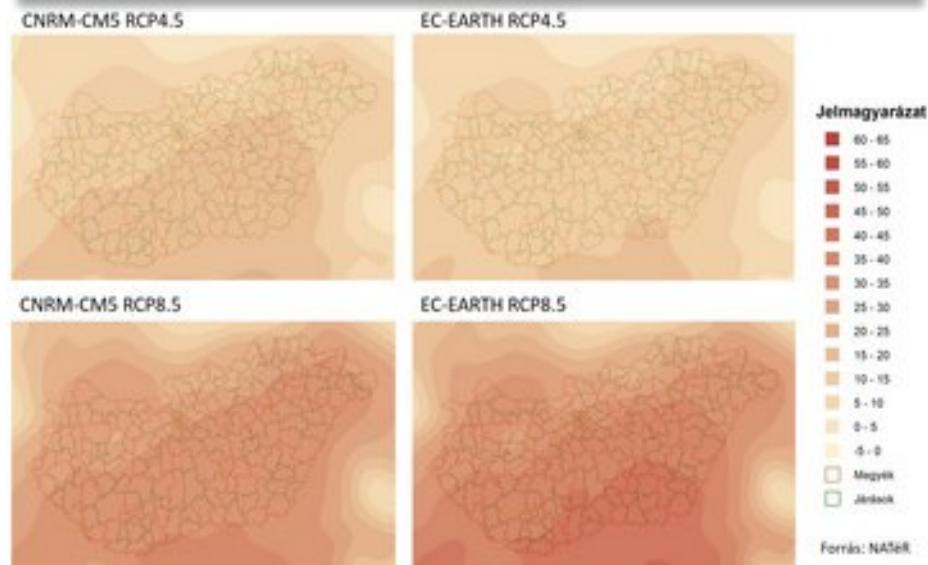


Figure 8: Expected change in the annual average number of secondary heat wave days for the period 2071–2100 based on various climate models according to moderately optimistic (above) and pessimistic (below) scenarios (NATÉR 2024)

3.2. Social structure of Hajdúböszörmény [Fülep T.]

Population of Hajdúböszörmény:

- 1900: 25070 people
- 1949: 30315 people
- 2001: 32208 people
- 2010: 31620 people
- 2023: 29574 people (Wikipedia 2024a) *or 29487 people (Table 1)

According to the censuses, the composition of the population is:

- 2001: 99% Hungarian, 1% Roma
- 2011: 85.8% Hungarian, 2.2% Roma, 0.2% German, 14.1% did not declare; (due to dual identities, the total may exceed 100%)
- 2022: 92.2% Hungarian, 3% Roma, 0.2% German, 0.1% Ukrainian, 0.1% Romanian, 2.2% other, non-domestic nationality, 7.7% did not declare; (due to dual identities, the total may exceed 100%). (Wikipedia 2024a)

Based on the available population data, it can be seen that the population of the city of Hajdúböszörmény is **~30,000 people**, which has been relatively stable since the mid-19th century,



but a **gradual and steady population decline has been observed since 2014**. In terms of age distribution, it can be stated that the number of young children aged 0–6 is increasing slightly, and the number of people over 65 is definitely increasing. The number of births is generally constant with minor fluctuations, while the number of deaths is slightly increasing. (Table 1)

The proportion of the indigenous Hungarian population, which is the overwhelming majority, has decreased somewhat in the 2000s, and the ethnic composition has become more diverse. The proportion of the Roma population is increasing slightly, and the appearance of German, Ukrainian, Romanian and other nationalities (Wikipedia 2024a) is probably the result of political and social changes in the world.

3.3. The identification of of Hajdúböszörmény's heat-sensitive areas [Sütő-Vásárhelyi Cs.]

During the 20th century, with the strengthening of urbanization and the growth of cities, the question of what the climate of a given city is, and within it, the city's districts, continuously become a priority. This phenomenon, as well as the impact of cities on the climate of their environment, is examined by urban climatology. Climatological processes occur at different scales. Large-scale processes shape the climate of a larger area or region. Within this, cities are considered to be medium-sized formations that affect the climate and weather of the city environment. Within cities, there are numerous small-scale phenomena and processes that interact in a complex way to determine the microclimatic characteristics of the settlement (Pongrácz–Bartholy 2013).

The urban heat island effect is a long-known microclimatic phenomenon, the essence of which is that the temperature of densely built-up urban areas is typically higher than that of the surrounding rural areas, or even less built-up areas within the city. The heat island phenomenon has become the focus of interest with the emergence and intensification of the effects of climate change, as extreme temperature events have become increasingly frequent and are expected to intensify in the future. Therefore, the urban population is significantly exposed to the negative effects of heat waves.

The strength of the heat island phenomenon can be defined as the difference between the urban and suburban temperatures. This requires either instrumental measurements, which can result in data series for built-up and unbuilt-up areas; or it is also possible to process satellite data. The intensity of the heat island depends on several factors (e.g. current weather, type of covering, degree of built-up, etc.). The largest temperature difference can occur in calm, clear weather, typically in the summer months. According to literature sources, the urban heat island determined from air temperature data is usually most intense 2–3 hours after sunset, so the difference between the temperature of the city and its surroundings is the largest at this time. If we look at the surface temperature, the intensity is highest around noon, when the greatest radiation reaches the surface (Dövényi 2010).

In order to identify areas that are sensitive to heat or are subject to the heat island effect, it is recommended to measure the city's air temperature and its surroundings. It is important to examine

the extent of built-up areas and paved surfaces as well, and now it is possible to examine surface temperatures, using satellite data. It is also important to examine where institutions (educational, health and social institutions) are located in the city that provide care to high-risk social groups (children, the elderly, people with cardiovascular diseases). It is also worth identifying key outdoor event venues and high-traffic urban areas (section 5.2.6).

The Ready4Heat project processed the results of the Landsat 8 and 9 earth observation satellites. These satellites are equipped with infrared radiation sensors that measure the temperature of the earth's surface. They can be used to produce high-resolution temperature maps and to examine temperature differences within cities and identify hot spots. During the preparation of the heat stress maps, hot days within the period 2013–2022 were selected and satellite images for these days were processed, as a result of which the degree of heat stress within the city and its region was determined (Figure 9). It is important to highlight that exceptionally high temperatures are observed in significant areas of the outskirts of the city, these are typically just ploughed or arable land with low vegetation cover, which are not the subject of this study. However, exceptionally high heat stress also occurs in industrial areas in addition to arable land.

Hőhullámokhoz való alkalmazkodást segítő eszközök és a magas kockázatú intézmények elhelyezkedése Hajdúböszörményben



Figure 9: Location of heat wave adaptation facilities and high-risk institutions and areas in the city of Hajdúböszörmény (Sütő-Vásárhelyi Cs.).



In Hajdúböszörmény city, 3 areas exposed to the heat island effect and several point-like locations can be identified.

- The heat island phenomenon is intensive in the **city center** due to the dense construction, the degree of heat stress is high in a significant area and in some points is especially high. The area around the Baltazár Dezső street department stores should be highlighted from this point of view, where the temperature is very high due to the high pavement, large parking lots and the lack of vegetation. This area is characterized by residential and institutional functions, and there are numerous health, educational and social institutions here, which are worth paying special attention to. There are drinking fountains, fountains in several places in the area, and steam traps are being placed on Bocskai István Square (main square), and there is also an air-conditioned room open to the public in the Mayor's Office building. Note (T. Fülep): The current main square is fully paved, which is helped by fountains and smaller trees and potted plants; while the old main square had many more trees and bushes, most of the public wells in the streets were dismantled by the service provider (Kathi I.).
- A continuously high heat island effect can be experienced in the commercial and **industrial zone located along the southern road 35**, and additional smaller, point-like locations can be identified in the wider area (**Kórház tér, artificial turf sports field along Széchenyi István utca, railway station**). There is a **nursing home** in this area, as a high-risk institution. The impact area also extends to residential areas, and we can assume that in the case of the department stores, the sports field, or the railway station, we can talk about high-traffic areas. We did not identify any adaptation aids in the area.
- In the **eastern industrial area between Kinizsi Pál Street and Külső-Hadházi Street**, the large halls and paved surfaces show very high or exceptionally high temperatures, the effect of which also affects residential areas to a lesser extent, and the **Csillagvár Kindergarten and Nursery School building**, as a high-risk institution.
- Among the hot spots that appear as points, **the Középkerti Elementary School** should be highlighted, which is located in a garden house zone characterized by a fundamentally low excess temperature, but at the same time, its surroundings heat up to a great extent due to the large building and paved surface, as well as the few green surfaces

3.4. Conclusions [Sütő-Vásárhelyi Cs.]

Overall, it can be stated that based on the available information, **3 larger hot areas and a few outstanding hot spots can be identified in the city**. The characteristics, functions and uses of the individual affected city districts differ significantly, thus requiring different management methods in each district.

- The dense urban fabric and intensive land use are inherent in the **downtown** area, and a smaller increase in green areas is possible. In addition, special attention should be paid to shading. Given that the vast majority of high-risk institutions are concentrated here, and a significant part of the population also lives here, it is advisable to focus primarily



on improving the adaptability of institutions and the population, and it is justified to further increase the number of adaptation tools in this area.

- In the **southern commercial and industrial areas**, it is advisable to emphasize the shading of parking lots and intensive greening of open areas, and it is recommended to establish a partnership with local companies in this regard. It is recommended to examine the building regulations related to the establishment of commercial units and department stores in order to reduce the number of continuous paved surfaces, and where this is not possible, to ensure the shading of a larger surface by planting trees or installing a shading structure. Note (Kathi I.): It is important not only to plant the appropriate number of trees, but also to ensure their maintenance and replacement; the species and variety of trees to be planted should be determined with the involvement of a specialist.
- In the **eastern industrial zone**, we recommend primarily establishing cooperation with the companies located there, and carrying out information and awareness-raising activities aimed at these. Local companies should be encouraged to green their sites and pay as much attention as possible to avoiding excessive heating of the sites. This can reduce the risk of workplace accidents and improve energy consumption. Moreover, these activities are also well connected to the ESG objectives.
- Among the **hot spots that appear in a point-by-point manner**, the Középkerti Elementary School and the artificial turf football field on Széchenyi István Street should be highlighted. Point-like hot surfaces also (Kathi I.): in the housing estate on Tizenhárom vértanú utca, the Bethlen Gábor Elementary School in Hajdúböszörmény (with its asphalt sports field and paved surfaces), next to it is also an artificial turf field, and behind it is a completely paved fitness park. In the case of elementary schools, it is recommended to examine the possibility of what technical solutions can be used to improve the microclimate and reduce the heating of the area. It is necessary to reduce the number of coverings, increase the green area, plant trees, and place shading structures (e.g. solar sails). In the case of the sports field, it is visible that the surface covered with artificial turf heats up to a much greater extent than the real grass field. We recommend examining what means can be used to reduce the heating of the surfaces at this location, and increased attention should be paid to the health of athletes in the event of a heat alert.



4. Framework conditions, organizations and operators [Fülep T.]

4.1. Framework conditions

The successful implementation of the **Hajdúböszörmény HHAP** heat action plan linked to the following prerequisites, as framework conditions:

- **Preparation of the Hajdúböszörmény HHAP:** Preparation, development, testing and publication of the Hajdúböszörmény HHAP Heat and Health Action Plan: Heat and Health Action Plan, heat-related action plan, heat action plan, heat action plan, heat action plan.
- **HHAP budget:** The financial framework allocated for short-, medium- and long-term municipal measures from the annual budget (investments, developments, salaries, wages).
- **HHAP staff:** Establishment of a heat protection office, a heat protection steering group (steering committee) and a heat protection working group consisting of experts and decision-makers. (Experts can be considered professionals with environmental or sustainability degrees, as well as professionals from recognized environmental and sustainability state and social organizations with relevant references.)
- **HHAP training:** Keeping the knowledge of HHAP staff participants up-to-date and shaping their attitudes.
- **Sustainable principles:** Harmonizing the environmental impacts of urban developments with thermal protection and long-term sustainability interests. (That is, future investments should not contradict the principles included in thermal protection.)
- **Social attitude formation:** Achieving social consensus and support, promoting the “sustainable and viable fashionable, cool (trendy)” attitude. Attracting and involving the widest possible social and expert stratum

4.2. Operators, stakeholders and responsibilities

The actors, stakeholders and their responsibilities of the Hajdúböszörmény HHAP are summarized in Table 4.

Actors, stakeholders	Responsibilities
The Municipality of Hajdúböszörmény	R4H Ready4Heat Hajdúböszörmény working group organization, involvement of environmental and sustainability experts
R4H Ready4Heat Hajdúböszörmény working group	The Hajdúböszörmény HHAP Heat and Health Action Plan: Heat and Health Action Plan, heat-related action plan, heat action plan, heat action plan, heat action plan



	preparation, development, testing and publication
Green Circle (Hajdúszabolcs)	Initiating role and active participation, visiting and involving external environmental and sustainability experts in the processes of the Hajdúszabolcs HHAP Heat and Health Action Plan: Heat and Health Action Plan
Reflex Environmental Protection Association (Győr)	Professional supervision of the Hajdúszabolcs HHAP Heat and Health Action Plan and the domestic representation of the international processes to be followed
External environmental experts	High-level development of professional subtasks.
Urban development of Hajdúszabolcs	Sustainable urban development of the city of Hajdúszabolcs, where the objectives of the Hajdúszabolcs HHAP Heat and Health Action Plan are achieved
Healthcare workers in Hajdúszabolcs	Effective management of the health consequences of heat
Hajdúszabolcs educational staff	Spreading knowledge about heat
Residents of Hajdúszabolcs	Acceptance of the proposals formulated by the R4H Ready4Heat Hajdúszabolcs working group

Table 4: Operators, stakeholders and responsibilities.

The task of the Heat Action Plan Coordination is to initiate and manage the measures of the Heat Action Plan. This includes:

- preparation for the summer,
- coordination measures of the summer,
- and post-summer evaluation,
- coordination of the heat protection steering group (steering committee),
- coordination of the relevant heat protection working groups.

The aim is to continuously adapt, develop and expand the Heat Action Plan.



The scope of responsibility includes:

- establishing new structures,
- establishing new collaborations,
- *maintaining and expanding the network with all actors involved in the implementation,*
- *holding regular meetings, and*
- *organising training opportunities and information events.*

Since coordination requires human resources, this must be taken into account when scheduling work hours!

4.3. Organisational structure: HHAP coordination and heat protection steering group

The heat protection steering group (steering committee) consists of key municipal stakeholders (Table 5) who meet at regular intervals to implement, adjust and further develop the heat action plan. The heat protection steering committee is therefore responsible for coordinating and implementing the HHAP in the different areas. In practice, this means:

- Developing, discussing and prioritising measures.
- Initiating and coordinating the sequential implementation of the measures set out in the HHAP
- Setting up working groups on specific topics (e.g. creating and opening cooling points) with other stakeholders as necessary.
- Quality assurance: evaluating and adjusting measures and introducing new measures.
- Evaluating and necessary improvements to the heat warning system (heat alert levels, communication chains)
- Evaluating and necessary changes to the composition of the heat protection steering committee. The steering group can be expanded at any time if necessary and other actors or areas can be involved depending on the topic.

The heat action plan is coordinated through an annual meeting.



The members of the heat protection steering committee are municipal representatives from different sectors who, through their function, have access to the groups of people included in the heat action plan: the general population, with a special focus on heat-sensitive target groups (section 2.2.2).

The full composition of the relevant actors is important for the implementation of the heat action plan, as the plan covers a wide range of activities (as is already clear from the division into short-, medium- and long-term measures; section 6.2).

Since it is planned to create separate working groups for long-term heat protection measures, the heat protection steering group itself should initially consist of actors who are mainly involved in the implementation of short- and medium-term measures.

Organisation	Function
Mayor's Office: Mayor's Cabinet: Head of Urban Development and Technical Department 4220 Hajdúszörmény, Bocskai István square 1.	Leader
Government Office of Hajdú-Bihar County 4220 Hajdúszörmény, Bocskai István square 2. 52/229-587	Member
Media, Preass and PR-work	Member
Hajdúszörmény Disaster Management Office: Chief: Zoltán Harsányi firefighter captain 4220 Hajdúszörmény, Kert street 24. 52/561-068 ors.hajduboszormeny@katved.gov.hu	Member
Educational Institutions: directors	Member
Gábor Fazekas Home for the Elderly: Director: Ágnes Csohány Dr. Tóthné 4220 Hajdúszörmény Dorogi street 91. 52/561-227 fgio@t-online.hu	Member
Emmaus Home for the Elderly - Baptist House of Love 4220 Hajdúszörmény, Külső Hadházi street 1. 52/561-160	Member
House of Caring- Home for the Elderly 4220 Batthyány Lajos street 30-32. 52/561-250	Member
Kastélykert Nursing Home 4220 Hajdúszörmény, Újvárosi street 24. 52/220-106	Member
John Calvin Reformed Social Service Centre 4220 Hajdúszörmény, Budai Nagy Antal street 82. 52/561-056	Member



Club of the Elders 4220 Hajdúböszörmény, Petőfi Sándor street 31. 52/228-115	Member
“Hajdúböszörmény ESZ-V” Kft. rendelőintézet: vezető: 4220, Hajdúböszörmény, Kálvin square 7-9. 52/560-130 titkarsag@hboszormenyrendelo.hu	Member
North Hungarian Regional Waterworks Ltd. (ÉRV. Zrt.): Chief Executive Officer: Ákos Lőrinc	Member

Table 5: Members of the Hajdúböszörmény thermal protection steering group (steering committee)



5. Heat wave warning system (heat warning and UV warning plan)

5.1. Warning system of the national weather channel [T. Fülep]

In 1868, the Hungarian Academy of Sciences discussed the proposal to establish an independent Hungarian geophysical institute, thus the “**Hungarian Royal Central Institute of Meteorology and Geophysical Institute**” was established, from 1894 as the “**Hungarian Royal Central Institute of Meteorology and Geomagnetism**”. In 1950, it was transferred to the Ministry of Defense and its name was changed to the “**OMI National Meteorological Institute**”. In 1970, the institute was renamed the “**OMSZ National Meteorological Service**”, and it was discontinued in 2023. Its tasks were taken over by **HungaroMet Hungarian Meteorological Service Nonprofit Zrt.** from 2024. HungaroMet Zrt. tasks (HungaroMet é.n. 1.):

- meteorological data, information collection and analysis organization
- meteorological information service organization
- operates a synoptic measuring and detection network in the territory of Hungary, provides upper atmosphere radiosonde measurements, operates the meteorological radar network and the lightning localization system
- ensures the collection, control, processing of meteorological information, maintenance and continuous uploading of the meteorological database
- **carries out weather analysis and forecasting activities**
- maintains and develops the Hungarian section of the telecommunications channels coordinated by the World Meteorological Organization (WMO) and the International Civil Aviation Organization (ICAO) by exchanging information
- ensures the submission of domestic meteorological data to the international telecommunications system
- ensures the collection and processing of international data concerning our country
- **carries out research and development activities**
- **carries out life and property protection activities: weather disaster forecasting (storm warning for Lake Balaton, Lake Venice and Lake Tisza), forecasting the spread of chemical and nuclear contamination**
- **ensures meteorological services for certain state administrative institutions and organizations and activities supervised by the state (civil aviation, water affairs, disaster management)**
- **supporting weather-dependent renewable energies and facilitating the effective management of weather phenomena resulting from global warming, other environmental protection tasks**

Meteorological services supporting heat protection are marked in bold.



5.2. The legal background, process and stages of issuing a heat alert [Sütő-Vásárhelyi Cs.]

5.2.1. Legal background

Numerous EU and domestic legislation contain points that are worth knowing as a broader professional framework for the protocols to be followed in the event of heat alerts. We will briefly review these below.

- Numerous EU and domestic legislation contain points that are worth knowing as a broader professional framework for the protocols to be followed in the event of heat alerts. We will briefly review these below. Both the **European Commission's Green Paper ("Adapting to Climate Change in Europe")** from June 2007, the **EU's 2013 Adaptation Strategy and its revised version from 2021** refer to increasing the resilience of healthcare among vulnerable sectors.
- The National Climate Change Strategy (NÉS) was developed under the authority of **Act LX of 2007 on the Implementation Framework of the United Nations Framework Convention on Climate Change and its Kyoto Protocol**. According to **Resolution 23/2018. (X. 31.) OGY on the adoption of the Strategy and the document itself**, the adaptation action directions aimed at human health include preparing for heat waves, obliging (social, educational) institutions serving larger groups to compile an "action plan" for dealing with heat waves, developing a central system of criteria for this, and introducing regulations that effectively regulate working conditions in indoor and outdoor workplaces in order to ensure that rising temperatures do not endanger health;
- **The precise tasks of local governments are set out in the Local Government Act (Mötv.)**, and these include services aimed at supporting primary health care and a healthy lifestyle, and environmental health tasks related to the topic.
- This is confirmed by the **Health Act (Eütv.)**, which explicitly stipulates that the local government must continuously monitor the development of the environmental health situation of the settlement and, in the event of a possible deterioration, take action within its own competence, or initiate the adoption of the necessary measures by the competent authority, within its capabilities.
- **Act XI of 1991 on health authority and administrative activities** lists the establishment and implementation of climate health measures and the operation of the national heat alert system among the environmental and settlement health tasks of the health state administrative body. According to Section 4 (1) 1) of the Act: "*The environmental and settlement health task of the health state administrative body is (...) 1) the implementation of climate health measures and the operation of the national heat alert system.*"



- **Act XXXVII of 1996 Act on Civil Protection** provides for the alert duties of the county's General Assembly chairmen, mayors and mayors in civil protection matters;
- According to **Government Decree 333/2023. (VII. 20.) on the National Public Health and Pharmaceutical Center (NNGyK)**: "2. Section (1) The NNGYK is headed by the national chief medical officer."
- According to the **relevant provisions of Government Decree 385/2016. (XII. 2.) on the performance of public health tasks of the capital and county government offices and the district (capital district) offices, and on the designation of the health state administration body**: "8. Section (1) The Government designates the NNGYK as the health state administration body a) Act XI of 1991 on health authority and administrative activity Act (hereinafter referred to as: Ehi.) aa) Section 4 (1) points k), l) and o) and Section 4/A. Section (1) to carry out the tasks set out in this Act. In view of these legal provisions, the national heat alert system is operated by the NNGYK and the heat alert is ordered by the national chief medical officer. According to the decree, the capital and county government offices acting within the scope of public health functions shall operate in connection with the public health functions of the minister responsible for health (hereinafter referred to as: minister) and the national chief medical officer who supports him and heads the NNGyK in the professional preparation of decisions necessary for the exercise of the minister's powers. Within the framework of the professional guidance of the Minister, the government offices and the district (capital district) offices of the government office acting within the scope of public health tasks (hereinafter referred to as: district office) implement the official inspection plans issued by the Minister, inform the Minister directly about their completed tasks, while simultaneously informing the national chief medical officer - in the case of the district office, through the governor -, collect data in order to develop and maintain national databases, keep records, perform the tasks within their competence through the professional IT systems of the national chief medical officer, and perform tasks related to the operation of rapid alert systems. In the area of Hajdúböszörmény, the county government office and the Hajdúböszörmény District Office are competent according to the area of competence of the district offices performing public health tasks designated in Annex 2 of the Government Decree.
- **Government Resolution 1384/2014. (VII. 17.) on the report on the Hungarian national disaster risk assessment methodology and its results** also names heat waves among the risks expected in the coming decades. According to the models, the increase in the annual average temperature and the persistent heat waves (when the average temperature is above 27 °C for at least 3 days) indicate a significant increase (7-21 days/decade) by the middle of the 21st century. The changes in the two indicators show a similar spatial distribution: the most intensive increase is expected in the south-southeast of the country, while the smaller one is expected in the northern (mountainous) areas.
- **Act CXXVIII of 2011 on disaster protection and the amendment of certain related acts focuses** more on those activities that are carried out on the territory of Hungary and



are disaster-prone. Its purpose is to prevent extensive damage events, and in the event of their occurrence, to combat damage, and to protect Hungary against the damaging effects of disasters. It also prescribes alert obligations and tasks. It declares that the central body of the professional disaster protection body manages the operation and professional activities of the regional and local bodies of the professional disaster protection body, developing the professional principles and requirements for planning, organization, and preparation related to disaster protection, performing planning and organizational tasks related to the rescue of the population, and managing the activities of subordinate bodies aimed at eliminating the consequences of the events that have occurred. It participates in the planning for the prevention and elimination of the expected consequences of disasters, is responsible for the establishment of a central civil protection organization based on the civil protection obligation and for the preparation of the central hazard prevention plan. It should be noted that these only indirectly affect the activities required during a heat alert.

5.2.2. National warning system

During heat waves and heat alerts, events and professional responses take place according to a predefined protocol. According to the National Heat and Safety Commission, the heat alert system has been operating continuously in our country since 2005. In view of the provisions presented in the legal framework chapter, the national heat alert system is operated by the National Heat and Safety Commission and the heat alert is ordered by the national chief medical officer. The purpose of this national alert is to draw the attention of the healthcare system, local governments and cooperating organizations to take the necessary measures, and to inform the population about the current situation and the necessary actions.

Different alert levels are known, the criteria for which are based on environmental health analyses. The three-stage Hungarian system was introduced in 2005, based on the forecasts of HungaroMet (then the National Meteorological Service), to prepare the healthcare system for the expected additional tasks, calling on local governments, the defense administration and cooperating organizations to take the necessary measures and to inform the population in a timely manner about the increase in temperature in order to reduce and prevent the harmful effects of heat waves. The average daily threshold temperature for the alert is 25°C and any period when the average daily temperature exceeds this threshold for at least three consecutive days is considered a heat wave. Among the environmental factors, temperature has a very significant impact on health: during heat wave days, for example, an average increase of approximately 15% can be registered in daily mortality nationwide.

The levels are assigned as follows:

- **Level 1** is a warning for indoor use when the average daily temperature is 25°C or higher;
- **Level 2** is issued when the average daily temperature is expected to reach (or exceed) 25°C for at least three consecutive days.



- **Level 3** is issued when the average daily temperature is expected to reach (or exceed) 27°C for at least three consecutive days.

The necessary background for the proper functioning of the national heat alert system is provided by the Public Health Department of the National Health Service, in cooperation with experts from the Public Health Laboratory and Methodology Department, responsible for the professional justification of decisions establishing the heat alert, for issuing the heat alert, continuously monitoring the development of daily temperature conditions, and for the hazard warning service of HungaroMet. Heat alerts are always issued based on the national plan for handling health crises. The heat alert, its level, the date of entry into force and its expected duration are determined and announced accordingly (taking into account the professional recommendation of the National Health Service) by the national chief medical officer, by means of legal authorization, at the same time informing the heads of the county government offices, and through them the district offices and the healthcare service providers operating in their area of competence.

If necessary (when forecast data changes), an extension or a change in level may also be made. The assessment of the effects of the heat wave on other areas (health sector, infrastructure, electricity and water supply, transport, etc.) and the taking of the necessary measures fall within the competence of different ministries, therefore the affected organizations and local governments will also be informed. The NNGYK permanently communicates about the heat alert through written, electronic and social media channels (Chief Medical Officer Facebook page, <https://www.nngyk.gov.hu>). From 2023, information related to the ordering of the heat alert will also be communicated through the VÉSZ application of the National Directorate General of Disaster Management of the Ministry of the Interior (an emergency notification service developed for smartphones and tablets).

5.2.3. Heat alert levels

The levels of the heat alert are given by level. **A total of 3 levels (alert levels) are distinguished:**

5.2.3.1. Heat alert level 1: information level

The criterion for **level 1 (information level)** is that the daily average temperature is predicted to exceed 25 °C for at least 1 day (which makes the associated mortality rate likely to increase by up to 15%). The information level is primarily a task for the public health administrative body of the county government office, which provides information to regional and district institutions through its internal system. The local government of Hajdúböszörmény may decide to inform the population on its own social media platform, cable TV, in newspapers, and on notices posted in busy locations (*“warning sign for internal use”*).

5.2.3.2. Heat alert level 2: alert level

Level 2 is the alert phase, the criterion of which is the forecast indicating that the daily average temperature has exceeded 25 °C for at least 3 days. As an additional condition, the daily average



temperature must reach 27 °C for at least one day (thereby causing an increase in daily mortality of approximately 30 %). This is the “readiness signal – public alert” phase. The national chief medical officer sends the alert to the government offices of the capital and the counties, and through them to the healthcare providers operating in their area of competence (health institutions, ambulance services, family doctors) about the extent and duration of the heat alert. The Hajdú-Bihar County Protection Committee notifies the county Disaster Management Directorate and the mayor of Hajdúböszörmény about these and about the heat alert itself. The county government office notifies the OMSZ Northern Great Plain Regional Rescue Organization, the county Dialysis Centers (located in Debrecen) and all hospitals in the county.

The first and second stages mainly affect the healthcare system, the specific local government tasks in these stages focus on the rapid execution of alarm and notification tasks (to public institutions and the population), warning the population and preparing protection against heat-related harm, as well as carefully monitoring the development of the situation and detecting and evaluating its possible deterioration in time, in preparation for possible further stages. In addition to these, local governments can take smaller-scale measures within their own competence, such as increased watering of public areas, distributing water to passers-by, opening cooler/air-conditioned places for the population, etc.

5.2.3.3. Heat alert level 3: Emergency alarm

Level 3, the emergency alarm phase, comes into effect when the daily average temperature exceeds 27 °C for at least 3 days according to the forecasts. At this time, the national chief medical officer notifies healthcare institutions, ambulance services, family doctors, and local governments, including the Hajdúböszörmény municipality, through the county government office, of the extent and duration of the heat alert. At this time, in addition to the tasks to be performed during a second-degree heat alert, it is also mandatory to inform the population through the media about the expected weather extremes and the methods of preventing related health hazards.

5.2.4. Heat alert chain

The alert chain refers to the logical sequence of information communication within the framework of which the mayor's office warns the relevant institutions and the population of the importance of taking preventive and reactive measures affecting health. However, the chain also has an upper stage, from the national level to the mayor's office. In this, (1.) based on HungaroMet's own forecast data (taking into account the professional recommendation of the National Health Service), (2.) the National Chief Medical Officer issues the heat alert, notifying (3.) the Public Health Department of the Hajdú-Bihar County Government Office, Hajdúböszörmény District Office. The Hajdúböszörmény District Office of the Hajdú-Bihar County Government Office, acting within its public health and protection administrative responsibilities, notifies (4.) the mayors, (5.) the primary healthcare providers (family doctors, central emergency services, nurse services and institutions of specialized social care, residential social institutions) of the degree and duration of the heat alert. After that, the Hajdúböszörmény Mayor's Office notifies the (6.) institutions involved in the alert chain and requests their cooperation in complying with the provisions specified in the heat alert plan, warning (7.) the population to take preventive measures affecting health. The Hajdú-Bihar

County Protection Committee notifies the (8.) County Disaster Management Directorate and the (9.) county district and local protection committees of the heat alert. As previously indicated, the Public Health Department of the County Government Office notifies the (10.) OMSZ Northern Great Plain Regional Rescue Organization, (11.) the County Dialysis Stations and (12.) the county hospitals.

In the lower half of the alert chain, the affected components of the chain include (13.) Hajdúböszörmény social institutions, (13.) educational institutions, (14.) childcare institutions, (15.) institutions performing health functions, (15.) leisure and sports institutions, (16.) municipally owned companies, (17.) settlement cultural institutions, (18.) other institutions and (19.) the municipality's own events. The mayor or the person designated by him, or the Hajdúböszörmény Local Operational Team to be established for heat alert situations, contacts the heads/representatives of the institutions concerned from the listed types before the third-degree heat alert, and starts implementing the indicated measures based on the previously approved heat alert plan. As part of the heat alert plan, the municipality prepares and updates the contact address list every year by May 31. The complete alarm chain is illustrated in Figure 10.

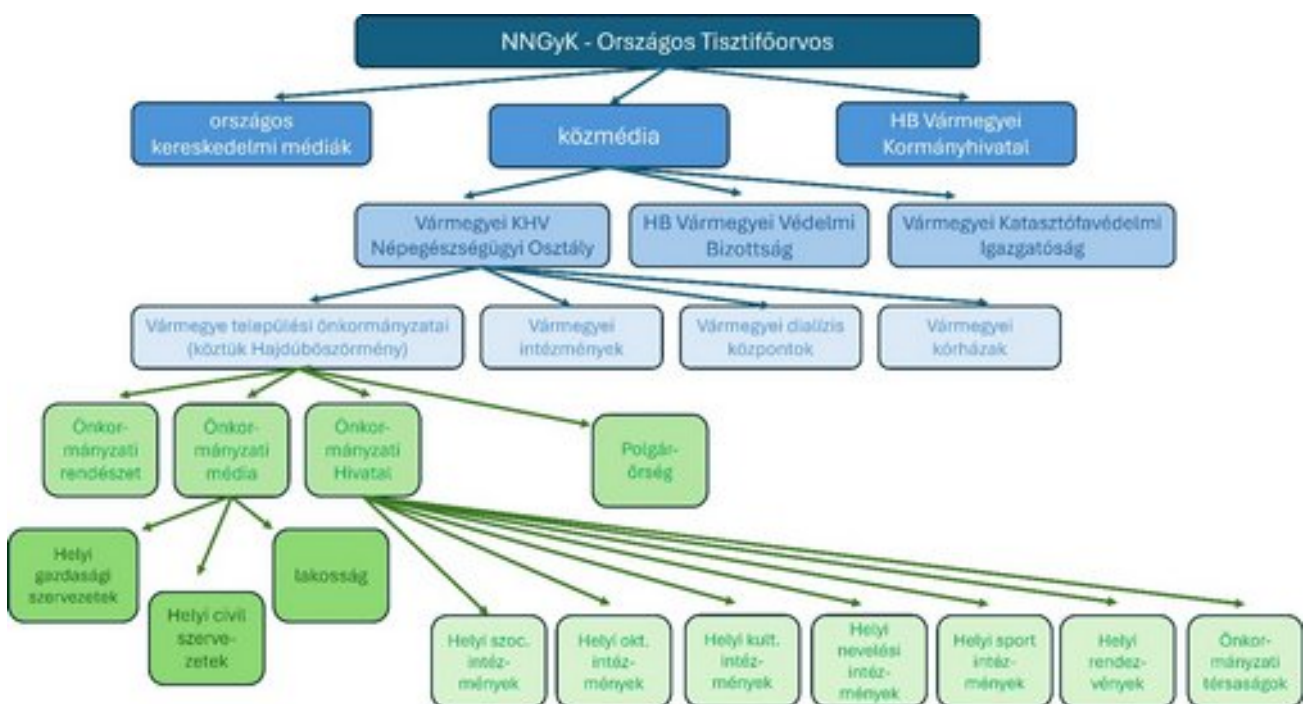


Figure 10: Indicative national and local alert chain in the event of a heat alert for Hajdú-Bihar County and Hajdúböszörmény (Sütő-Vásárhelyi Cs.).

In the event of a special legal order, the local government is placed under the so-called central protection administration, in which it participates as an invited party – in such cases, the County Protection Committee is authorized to carry out alarm tasks. Whether it is a general legal order or a special legal order, it is worth placing the alarm chain with the names of the persons to be notified



in a clearly visible, central place in the institutions concerned, ensuring the fastest and most effective response in the event of a heat alarm.

After the heat alarm is issued, the local governments implement the settlement heat plan and activate the persons included in the alarm chain. They take the necessary measures in social care institutions, home care services, public education and health institutions, and at outdoor events. They ensure the availability of drinking water and the removal of dust from public areas. Note: The local government cannot ensure the uninterrupted supply of electricity (Kathi I.).

5.2.5. Communication channels

In relation to heat alerts and in general to preparing for the entire challenge, the role of appropriate information flow and communication to support this is outstanding on hot days and in the periods preceding them. The local government has a key role in informing the population of potentially vulnerable social groups (11) and settlement areas about the dangers of heat, exposure to heat during indoor and outdoor stays, and signs of heat-related health damage (17), but the advance warning of the local government's own – primarily social care – institutional system about expected heat waves and their length according to the national forecast is also a neuralgic point. Part of the information is the continuous information of the target group about state, central and county measures. Regarding local response measures:

1. Publication and continuous updating of the list of available air-conditioned rooms, public institutions (90), drinking fountains, steam gates, fountains and water distribution points opened for cooling purposes (86).
2. It is also important to share toll-free numbers and emergency hotlines to ensure that people at risk report.
3. Road users should be informed about the increasing risk of accidents caused by heat stress.
 - on the municipality's own website or heat alert subpage,
 - on the municipality's official social media pages (Facebook)
 - at the customer service office and
 - in the local newspaper (Szabadhajdú Weekly, Hajdúböszörmény Szuperinfó Újság)
 - SMS notifications for people with disabilities and the deaf (there is a cost involved!)
 - on Hajdúböszörményi Városi Televízió (HBTv)
 - on city billboards

It is recommended to disseminate this information on the aforementioned web addresses, in newspapers and local media, and on social media, together with various health protection recommendations and sharing of specialist materials.



5.3. Tasks of local governments [Sütő-Vásárhelyi Cs.]

The activities of local governments during heat waves or specific heat alerts can be basically divided into two distinct groups. Some of the activities are for prevention and preparation purposes, and they should be carried out at any time of the year, helping to make long-term, conscious preparations for coping with heat waves. The other group of measures includes (reactive) interventions to be carried out specifically during heat waves. The following two sub-chapters present the typical activities of these two groups.

5.3.1. Preliminary measures

The responses to heat waves do not begin with the tasks to be carried out during the heat alert; it is advisable to prepare for the expected effects in advance, following the principles of conscious climate adaptation. Before the arrival of heat waves, before the onset of the “season” of heat alerts, there are many steps that can be taken to help prepare.

It is worth publishing health protection recommendations and suggestions among the population and local government bodies (targeting the groups of nurseries, kindergarten teachers, primary and secondary school teachers, social institution employees, social workers, etc.) before the heat periods. Making municipally produced or central professional materials available to these groups and young people or older age groups, detailing the preliminary steps to take before the heat alert and heat period. It is also recommended to directly involve nursery and kindergarten institutions, as well as primary and secondary schools, in the preparation, making the related professional materials available to them and strengthening their awareness and information regarding the challenge. In institutions, it is recommended to map out in advance the deficiencies in ventilation and shading, the available or missing cool spaces, and permanently artificially heated or cooled rooms (kitchen, shower, operating room), which may aggravate or mitigate the heat effect. Among the options for mitigating and eliminating the heat hazard in institutions, it is worth considering, in addition to technical solutions, organizational measures (review of work organization and schedules) or the intensification of basic activities (more vigorous medical monitoring) in addition to improving the conditions of local health care. In order to ensure appropriate social and health care for the most vulnerable social groups, it is necessary to establish long-term strategic professional cooperation between local social and health care providers.

Another such activity that helps in preparation could be the identification of locations and settlement areas that are critical in terms of heat waves and are at risk of heat islands by local governments. In the case of Hajdúböszörmény, these areas potentially affected by extreme heat stress, based on the situational maps, are, on the one hand, arable land, saline areas, and protected steppe areas located in the outskirts - in their case, the population is not affected by the negative climate impact. In the inner area, on the one hand, the central parts of the former two-block inner boulevard with multiple walls can be mentioned (most notably the strip between Benedek János Street and Kassai Street, the strip bordered by Hajdúkerület and Mester Streets, and strongly along Gönczy, Káplár Miklós, Madách, Szondi, Koporna, Mester Streets), on the other hand, from the area between the two boulevards, along Baltazár Dezső Street, the long artificial surface of Bácság



Square, abundantly equipped with parking lots, the artificial grass sports field along Széchenyi Street and Kórház Square, the area at the end of Kolozsvár Street, next to main road number 35 (an old filled-in adobe pit, locally known as a frog pond), which is currently fallow and bare, but will soon be developed into a residential park, but also the Keleti Ipartelep, a settlement area prone to a strong heat island effect. Likewise, it is worth identifying the most vulnerable social groups (with the help of health workers, social workers, home visiting nurses, family doctors, institutional nurses).

It is also worth conducting a preliminary survey of the communication channels, including local and national media partners, potential cooperating actors in the private and civil sectors and the methods of cooperation. The definition of the participants in the alert chain itself (presented earlier in the material) (institutions providing care for children: nurseries, kindergartens, on-call kindergartens and day camps, primary and secondary schools, elderly care workers, workers working with disadvantaged populations, local civil society organizations, local businesses, employers) and the continuous review/updating of the developed chain and member list can also be mentioned here. The forward-looking development of the heat alert mobile phone information system is also important, ensuring that in an emergency, registered users receive information about the current situation via email, SMS, or other message sent to their mobile phones. It is worth considering in advance the creation of a local government website subpage in order to increase the efficiency of information (where the availability of relevant settlement information is continuously ensured).

Encouraging public institutions to develop and implement their own heat plans is also among the preliminary activities, similarly to the development of an alert plan for the local government (this document serves precisely this purpose). In response to heat alert situations, it is also possible to think in advance about establishing a Hajdúböszörmény Local Operational Team.

Preparation is assisted by the modification/further development of settlement development and planning and zoning plan documents, ensuring that they respond to the heat island effect by maintaining and expanding green areas, creating green roofs and green facades, and ensuring settlement ventilation. This also includes the related modification of building design and construction regulations, encouraging the selection of appropriate building materials, the use of heat-reflecting paints and thermal insulation solutions, the appropriate orientation of newly constructed buildings that reduces daytime radiation, and external shading.

Ensuring the appropriate cooling capacity of local government and other public institutions, the creation of air-conditioned resting places for the population also contribute to adaptation, as does the creation of shaded resting places for the population. It is advisable to conduct a preliminary assessment of the capacity of air-conditioned spaces that can be opened to the population, in consultation with the operators of the premises, and to continuously update and publish the list on the local government website or its designated subpage.

It is worthwhile to involve local businesses and employers in planning and action, consulting with them about the possibilities of participation and cooperation in protecting against heat waves.



5.3.2. Hőségriadó idején szükséges önkormányzati teendők

In order to fulfill the obligations set out in the Mötvt and Eütv (see the legal background chapter), a number of types of measures are outlined that must be implemented during heat waves and disaster situations. These are basically disaster protection tasks, but the doctors, nurses, and social care network staff of the healthcare and social institutions operated by the local government are also in constant contact with vulnerable groups (the elderly, children, chronically ill), so the local government has an important role in informing the population through them and through them, as well as in forwarding information from the national institutions described earlier.

5.3.3. Information level

During the information level, the National Chief Medical Officer warns the Hajdúböszörmény District Office of the Hajdú-Bihar County Government Office, and the latter notifies the Hajdúböszörmény Mayor's Office based on the data sent. The latter calls the attention of the population, especially the sick, children under 14 years of age and the elderly, to avoid being outdoors and physical activity, to stay in the shade if possible, or in cool/air-conditioned rooms until further information. The local government also makes health protection recommendations for the population and healthcare and social care staff.

5.3.4. Alert level

During this second level, the National Chief Medical Officer issues the heat alert based on the HungaroMet weather forecast data, taking into account the professional recommendations of the NNGyK, and notifies the Public Health Department of the Hajdúböszörmény District Office of the Hajdú-Bihar County Government Office. The Hajdúböszörmény District Office of the County Government Office, acting within its public health and protection administrative duties, notifies the mayors, including the head of this settlement, of the duration and degree of the heat alert; primary health care providers, including the family doctors, central emergency services, nurse services and specialized social care settlement institutions of this settlement, residential social institutions, persons with care needs, requiring home assistance and the homeless, drawing attention to the care. The local government specifically warns the affected public institutions and the population, including the chronically ill and elderly people, as well as institutions dealing with children under 14, to avoid staying and working outdoors, and to prefer staying in the shade/cool/air-conditioned rooms. In order to ensure uninterrupted electricity supply and drinking water supply of adequate quality, continuous contact is necessary with the relevant service providers and organizations, drawing attention to the need to take the listed measures. Water use may also be restricted as necessary (e.g. ban on watering and swimming pool use). The municipality publishes a list of fountains, drinking fountains and air-conditioned rooms in the city's public areas on its website or a related subpage (currently, a fountain is operating in the center of Pród, which is further from the city center, and also in the center on Bocskai Square, Korpona, Árpád and Karap Ferenc Streets; a drinking fountain is available at the intersection of Korpona and Piac Streets, on Korpona Street at the Post Office, at the playground on Hajdúkerület Street, on Árpád Street, in the fitness park on



Szabad Hajdú Street and at the playground on Fördőkert. The steam door is currently only operating in Bocskai Square; the Mayor's Office opens its air-conditioned room to the public in the event of a heat wave). Traffic management measures to prevent "summer smog" are defined.

5.3.5. Alert level

Similar to the previous level, the local government warns the affected public institutions and the population, especially vulnerable groups, to avoid staying/working outdoors and to prefer staying in the shade, cool/air-conditioned rooms. It informs the target groups about the dangers of heat, the possibilities of reducing indoor and outdoor exposure to heat, and the symptoms of heat-related health problems. The placement of shading sun sails and steam vents that can be set up in public areas is planned and implemented, the location of drinking water dispensers is designated and set up, fountains and water fountains that can be used for cooling purposes are designated, and the necessary equipment is purchased. During the designation, the local government must take into account the possible risk of infection or other public hygiene issues (Selmeczy J. P.). Drinking water should be provided to homeless people and other groups without adequate drinking water. Asphalt and parks should be watered more frequently in the evening. Beach and swimming pool operators can be asked to extend their opening hours.

Health protection recommendations, advice and information will continue to be published on the municipal website or sub-website, together with a list of public fountains, drinking fountains and air-conditioned rooms (see the list in the previous stage). In order to ensure uninterrupted electricity supply and drinking water supply of appropriate quality, continuous cooperation is taking place with the relevant service providers and organizations, drawing attention to the need to take the listed measures. Similar to the previous stage, water use may be restricted again if necessary (e.g. ban on watering and swimming pool use). It is recommended to encourage visitors and athletes, organizers of upcoming outdoor events and other relevant service providers, organizations and collaborators to take the listed measures. Where possible, postponement of outdoor and sports activities should be considered during the heat of the day.

In social and healthcare institutions (family doctors, nurse practitioners, home care services, clinics, etc.), in the case of heat alarm levels 2 and 3, in addition to checking and replenishing the emergency medicine kit, increased fluid and salt replacement due to increased sweating, and monitoring the fluid consumption of the cared-for are key considerations. Patients should be made aware of the symptoms of fainting that accompany heat and that they need to drink fluids even if the cared-for does not feel thirsty. Placing related information on the noticeboard of the given institution can also be helpful. It is important to closely monitor chronic patients (patients with blood pressure problems, chronic kidney and liver patients, diabetics, etc.), contacting them by phone or in person, asking them about their condition, and informing them about the behaviors to follow. In the case of bedridden patients, more frequent bed linen changes are also necessary. It may be necessary to visit home-based care recipients more frequently, provide them with assistance in shopping, replacing medication, and, if necessary, seek medical care. The potential change in the effects of medications used due to heat deserves special attention in the case of beta-blockers, antihistamines, and antidepressants, and frequent consultation with the treating physician is necessary - the attention of those affected should also be drawn to this. In institutions, it is



necessary to continuously monitor the temperature of the rooms and the body temperature of the care recipients, keeping the latter low by showering and compresses. Early morning and night ventilation, the use of mobile fans, increasing cooling capacity, and early darkening of south-facing windows can help. It is recommended to distribute protective drinks to nursing staff and patients. Technical support should be provided in case of failure of continuously operating air conditioners. Light foods containing a lot of liquid should be preferred in the current diet. In social and healthcare institutions, rational organization of work schedules is particularly important during and before heat waves, in order to ensure the availability of a sufficient number of employees and their rest. In addition to the above, institutions can also take additional measures within their own competence (e.g. increased watering, water distribution, opening cooler/air-conditioned areas for the public, etc.). Childcare and educational institutions must monitor children closely, by repeatedly checking their body temperature and keeping it low, and by ensuring regular and abundant fluid intake. Continuous measurement of the temperature of the rooms and ensuring adequate shading and cooling options are also important here (by providing air conditioning, fans, ventilation, shading, etc.). Staying outdoors and jobs requiring a lot of movement should be avoided. Comments (Selmeczy J. P.): Many educational institutions operate camps with on-call staff during the summer, and education also lasts until mid-June. Heat waves can occur in both June and September. (Kathi I.): The thermometers used during the Covid pandemic are also suitable for measuring body temperature.

The local operational team in Hajdúböszörmény continuously monitors and reviews the effects of the interventions during the heat alert period, then evaluates what happened after the heat alert has been sounded and, if necessary, changes the protocol for the next heat period. During the heat alert, the institutions concerned immediately notify the operational team if they encounter obstacles in carrying out the tasks assigned to them - and the team takes action on the necessary intervention by indicating the possible sources. After the heat alert(s) have been sounded, once a year, by a designated autumn date, each person concerned evaluates in a short note how successful they consider the performance of the assigned tasks to be, what obstacles they encountered, and what suggestions they have regarding the modification of the plan, even formulating comments and suggestions for other areas beyond their own field of expertise. The operational team evaluates the opinions received, if necessary, coordinating with the people concerned and modifying the heat alert plan.

5.3.6. Potential local government responses, good practices

The increasing presence of heat waves and the related urban heat island phenomenon in European and Hungarian cities has induced a number of response measures in recent decades, several of which can be presented as good practices to follow. The following subsection collects these, offering adaptation response interventions and models for Hajdúböszörmény as well.

One of the most obvious and direct local government response options is to ensure an appropriate, climate-resilient settlement environment in general and especially during heat wave periods. As part



of this, the energy renovation of local government buildings and the encouragement of the renovation of residential buildings can be recommended, thus ensuring the availability of (cool) rooms that maintain the appropriate temperature during heat waves.

During urban rehabilitation and settlement development interventions, it is similarly important to take adaptation aspects into account, such as maintaining and developing green spaces, preferring to plant tree and shrub species that are more resistant to climate effects, and reflecting these aspects in local regulations (e.g. local building regulations, Settlement Image Manual). It is equally important to provide adequate comfort in public areas by installing shading, sunshades, and sun sails in busy areas; installing vapor barriers during the summer, on hot days, providing drinking water quality in public areas, e.g. by organizing bottled or bagged water distribution; building and regularly maintaining drinking fountains, temporarily converting fire hydrants into drinking fountains during heat waves; creating air-conditioned community rooms that offer both hospitality and relaxation, and creating experience elements that mitigate microclimatic effects, e.g. by creating sunken fountains.

Recommendations of the National Center for Public Health and Pharmacy (NNGyK) on the development of public spaces

"The issues of the operation and development of public spaces are becoming increasingly important in modern urban policy. The users of public spaces (local residents, commuters, businesses) have daily contact with public spaces, and their condition is crucial for assessing the quality of a given settlement. The relevant local governments (...) have ownership rights in public spaces, in contrast to privately owned construction sites, where they can apply regulatory tools. The importance of developing public spaces can be supported by the following:

- they have an identity-forming role: the appearance, character, and uniqueness of public spaces are characteristic of a given settlement, making it easier for visitors to identify the area, and are decisive for the strengthening of the connection to the area for the people living there;
- they ensure the attractiveness of the settlement for developments with a quality environment: not only the development of historical cities, but also the urban development practice of recent years has repeatedly proven that the functional and quality development of public spaces increases the value and prestige of the settlement, and stimulates real estate developments. It is no coincidence that larger real estate development projects also pay special attention to the sophisticated design of open spaces;
- transport areas: they provide a location for individual (pedestrian, bicycle, car) traffic and public transport; they improve their usability, give way to new functions: well-designed open spaces provide opportunities for a variety of activities, for the establishment of new recreational services required by the population, which above all serve the operation and community life of the settlement;
- they improve the quality of living space: the usability, image and orderliness of public spaces determine the public opinion of the area, influencing the well-being of users;



- improve the tourist appeal of the settlement: the attractiveness of public spaces in areas frequented by tourism is an attraction for tourism, so tourism can become a strong element of the settlement's economy;
- increase the diversity of the biosphere: green spaces can form a biologically active network, increasing the species and variety diversity of the vegetation of settlement areas;
- provide climate comfort: properly designed public spaces, especially green spaces, mitigate extreme climatic effects, giving preference to gentle mobility reduces the CO₂ load on the environment, reduces energy consumption for transport. Due to the shading and evaporation effect of vegetation, they also act as natural air conditioners;
- contribute to the preservation of the health of residents: quality public spaces that encourage physical activity and enable recreation help preserve and improve mental and physical health;
- improve public safety: the proper design of public spaces can in itself increase public safety and a sense of security;
- stimulate productivity: inspiring, unique public space design enhances creativity and promotes more efficient work.”

(National Center for Public Health, n.d.)

Participation in various regional, national and international cooperations between settlements (Green City, Covenant of Mayors networks, Climate-Friendly Settlements Association, Hungarian Climate Protection Association, etc.) can help in obtaining international climate adaptation project funding, learning from each other: studying practical solutions of other settlements that have been struggling with heatwave problems for a long time and then adapting them to their own conditions. A lot of related information can be obtained from international (UKCIP, UAST) and domestic platforms (NATÉR) on good practices, planning methods, and vulnerability databases.

This includes preliminary studies to help prepare for the increasing frequency/intensity of heatwaves, conducting vulnerability and risk assessments, and implementing adaptation to changes and its regular reassessment. Specific risks affecting the given city should be explored at the settlement level. In Hungary, exposure, sensitivity, adaptability and vulnerability information related to heat waves can be obtained from the NATÉR map information set and databases, and analyses can be prepared that treat these indicators in a complex and integrated manner, comparing different regions. Using the SURFEX models of HungaroMet and the University of Szeged, and the heat stress maps prepared in the Ready4Heat Project, we can also obtain important points for studying the urban heat island phenomenon.

We have already drawn attention to several points in relation to raising awareness in the context of local government tasks. Here, it is once again important to draw the attention of the population to the general tasks: cooling the home, ventilation at night, air conditioning if necessary (taking into account that its increased use further heats the external environment!), monitoring body



temperature and keeping it low by frequent showers, drinking plenty of fluids and regularly (if possible, water, unsweetened tea instead of soft drinks, caffeinated carbonated and alcoholic drinks), wearing light and airy clothing, and preferring cooled, air-conditioned public buildings or shady places instead of staying and working outdoors. The publication of health protection recommendations, advice, and information (e.g., a list of air-conditioned public institutions and public places that can be visited by the public, a list of drinking fountains, steam gates, water distribution sites, toll-free numbers and emergency lines where reports of endangered persons can be made) among the public and health/social care personnel, and possibly the organizers of outdoor events currently taking place in the settlement, through various channels (municipal website, municipal newspaper, cable TV radio, social media) is also a critical point; in the case of chronic patients, the awareness raising should also include consultation with the treating physician regarding maintaining fluid balance and keeping medications at the appropriate temperature). It is recommended that transport participants (drivers, passengers) be informed through the above channels about the risks of accidents caused by heat stress and the feeling of fatigue often caused by sudden heat (which we do not anticipate in advance, especially among the older age group). In the case of vehicles with inflated tires (cars, trucks, buses, bicycles), it is important to check the tire pressure more frequently. When setting off on a long journey, it is important to ensure an adequate amount of (preferably chilled) fluids. Even minimal consumption of alcoholic beverages in the summer heat worsens driving ability even more seriously. The high heat also puts a lot of strain on the drivers' bodies, reflexes become dull, and drivers become even more impatient and irritable. Before setting off on a long journey, it is worth planning a break at least every two to three hours and sticking to it. Warnings can also be shared regarding beaching (avoiding irresponsible and reckless behavior on the beach; avoiding bathing immediately after eating and under the influence of alcohol/intoxicants; the need to cool the body down with a shower or other method between sunbathing and bathing; prohibiting people with cardiovascular, respiratory, or musculoskeletal diseases from bathing alone).

A good solution is to strengthen public area patrols: identifying people in a state of danger and, if necessary, notifying the appropriate agency (doctor, ambulance service). The civil guard can also be involved in the above tasks.

The regulation of working and rest times in municipally owned companies and organizations can be done in cooperation with the labor protection inspectorates and in order to reduce the heat load of employees exposed to high heat (e.g. public workers), as well as to ensure that they have appropriate work clothes, water, rest time and opportunities to relax (the latter can preferably take place in a cool room).

Regarding local animal welfare, it is recommended to place bird, dog and cat drinkers in municipal institutions. A related point is to draw the attention of the public to the proper care of pets, to the prohibition of leaving them in the sun, in closed cars, and to place drinking bowls at events.



5.3.7. Proposal for a measure (example of a measure)

Presentation of a specific measure, with a description of the specific sub-tasks, time schedule, description of the partners responsible for the task and to be involved, planned outcome, target group, financial background, estimated cost, and planned impacts:

Designation of areas potentially endangered by the urban heat island effect and formulation of an action plan for these

Justification: Among the expected impacts of climate change, the more densely built-up parts of urban settlements characterized by a higher proportion of artificial surface cover are particularly affected during heat waves. Although Hajdúböszörmény is not among the most densely built-up cities in Hungary, the population is therefore exposed to a higher heat load in the inner area. Taking into account the settlement structure of the settlement, which was originally a cluster village with two inner areas, these critical points with a more densely built-up/high artificial surface cover ratio can be identified in the inner city (within the outer ring road) parts and partly in the eastern industrial area. By choosing the right amount, type and colour of the paving material for roads and buildings; by increasing the extent of green areas and by developing blue and green infrastructure elements, these indicated heat loads and microclimatic conditions can be improved.

Subtasks: Preparation of background material based on a survey to designate the necessary interventions in the parts of the city most affected by heat loads, identified in the heat alert plan. [The affected parts of the settlement are expected to be: the parts of the city centre /within the inner ring road/, between the inner and outer ring roads and the artificial turf sports field along Baltazár Dezső Street, the Railway Station and Hospital Square, the southern commercial and industrial areas, the eastern industrial area and the Középkert Primary School]. Based on this, determining the list of operational interventions, and then developing specific small-scale adaptation interventions. The latter (designation of new steam gates and drinking fountains or water distribution sites, planting trees, development of green areas) should particularly affect the areas between the two boulevards, especially the strip between Benedek János and Kassai streets, the area between Hajdúkerület and Mester streets, and around the inner and outer boulevards along Baltazár Dezső street, along Bácság square, the area around the artificial grass sports field on Széchenyi István street, the surroundings of the Railway Station and the Hospital.

Affected climate policy pillar: adaptation, attitude formation

Schedule: 2024-25

Responsible for implementation: Local government, Intermediary(s)

Planned impact: implemented developments, tenders to be developed, increasing intervention activity

Target group: population of affected settlement areas, economic organizations



Possible source: Cost requirement: none, Cost center: within own local government tasks

Output: Developed background material and settlement-specific package of measures, submitted TOP Plusz tender

5.4. Tasks of institutions, technical implementation [T. Fülep]

Tasks of the Public Health Department of the Hajdú-Bihar County Government Office Hajdúböszörmény District Office in the event of a heat alert:

5.4.1. Pre-season preparation tasks

- **Survey:** Assessing the increasing needs and the frameworks and opportunities to meet them, as well as the justification and methods for introducing any restrictions.
- **Dissemination of knowledge:** Publishing heat protection health recommendations and advice to the population, care staff, nursery staff, kindergarten teachers, primary and secondary school teachers, and care staff of social institutions.
- **Education:** Draw the attention of educational institutions to the specialist materials in order to protect young people.

National Ambulance Service tasks in preparation for a heat alert:

- Blind alert: Preparing for an increase in the number of unjustified calls and alerts.
- Replenishment of emergency medicine supplies.

Hajdúböszörmény GP and health visitor services tasks in preparation for a heat alert:

- Increased monitoring of vulnerable population groups.
- Replenishment of emergency medicine supplies.
- Storage of medicines in warehouses and refrigerators.
- Possible prevention of side effects of medications.
- Providing the population with advice and information.
- Raising awareness of the need for regular dermatological screening.

Tasks of the social care institutions in Hajdúböszörmény in preparation for a heat alert:

- Mapping the heat-hazardous areas of the institution (where dangerous levels of heat are highly likely to develop): poorly ventilated, poorly shaded, artificially heated rooms even in the heat (kitchen, shower, etc.).



- Taking stock of the options for managing heat hazards in the institution: technical and organizational solutions, other measures (e.g. increased medical supervision).

The tasks of the Northern Hungarian Regional Water Works Co. (ÉRV. Co.) in preparation for a heat alert:

- Check the status of urban drinking wells, expand, repair or replace them if necessary.
- Review the water consumption of the past period and the possibility of meeting increased demands.
- Review the need for water restrictions: what area would be affected, for how long, the possibilities for solving the additional water supply.
- Review the number and readiness of available devices in the event of a possible failure of the water supply system.
- Review the security of water supply to livestock farms.
- Planning the possibility of water distribution: providing for people who do not have access to drinking water in extraordinary situations. (For example, drivers who form a traffic jam, stuck in a traffic jam following a traffic accident.)

5.4.2. In case of heat alert levels

The HungaroMet Hungarian Meteorological Service Nonprofit Co. Based on the weather forecast, taking into account the professional recommendations of the National Public Health Center, the National Chief Medical Officer issues the heat alert, which he notifies the Public Health Department of the Hajdú-Bihar County Government Office, Hajdúböszörmény District Office. The Hajdúböszörmény District Office of the Hajdú-Bihar County Government Office, acting within its public health and protection administrative responsibilities, notifies the mayors and primary health care providers of the duration and degree of the heat alert:

- family doctors,
- central medical on-call services,
- nursing services,
- social specialized care institutions,
- residential social institutions.

During a heat alert, increased attention must be paid to the care of people with care needs, those requiring home help and the homeless!



5.4.2.1. Heat alert level 1: in case of information level

Tasks of the Hajdúböszörmény Mayor's Office in case of a heat alert level 1:

Based on the weather forecast of HungaroMet Hungarian Meteorological Service Nonprofit Zrt., the National Chief Medical Officer warns the Hajdúböszörmény District Office of the Hajdú-Bihar County Government Office, which notifies the Hajdúböszörmény Mayor's Office based on the data sent.

5.4.2.2. Heat alert level 2: in case of alarm level

Tasks of the Hajdúböszörmény Mayor's Office in case of a heat alert level 2:

- Informing the population about the effects of heat waves on human health (section 2.3.1).
- Publishing heat-related health protection recommendations among the population and healthcare personnel (section 2.3.5.1).
- Mechanical watering of the road surface of densely populated areas (sprinkler truck).
- Installation of a steam gate at the highest pedestrian traffic point in the city center.
- Publication of a list of operating public wells, drinking fountains, fountains and steam gates in the public areas of Hajdúböszörmény (Annex 8.7)
- Publication of a list of cooled, air-conditioned premises accessible to the public in the administrative area of Hajdúböszörmény (Annex 8.8)

Tasks of the Northern Hungarian Regional Water Works Co. (ÉRV. Zrt.) in the event of a level 2 heat alarm:

- In the event of a level 2 heat alarm, the Northern Hungarian Regional Water Works Co. provides drinking water supply using a special system mounted on a fire hydrant. The quality of the drinking water at the water supply points is checked in the accredited Central Laboratory of the Northern Hungarian Regional Water Works Co. based on the relevant legislation. The test results are sent to the Public Health Department of the Hajdú-Bihar County Government Office of the Hajdúböszörmény District Office.

5.4.2.3. Heat alert level 3: in case of an alert

Tasks of the Hajdúböszörmény Mayor's Office in case of a heat alert level 3:

- Informing the population about the effects of heat waves on human health (section 2.3.1).
- Publishing heat-related health protection recommendations among the population and care personnel (section 2.3.5.1).
- Mechanical watering of the road surface of densely populated areas (sprinkler truck).
- Placing a vapor barrier at the highest pedestrian traffic point in the city center.



- Publication of the list of public wells, drinking fountains, fountains and steam traps in the public areas of Hajdúböszörmény (Annex 8.7)
- Publication of the list of cooled, air-conditioned premises accessible to the public in the administrative area of Hajdúböszörmény (Annex 8.8)
- Warns the affected public institutions and the public, especially the highly vulnerable, endangered population groups (section 2.2.2), to avoid staying and working outdoors during the day as much as possible, and to stay in the shade or in cool, cooled (air-conditioned) premises as much as possible.
- Informing the organizers of outdoor events, tourists and athletes.
- Drawing the attention of all affected service providers, organizations and collaborators to the need to take the listed measures.

The tasks of the social care institutions in Hajdúböszörmény in the event of heat alert levels 2 and 3:

- Increased fluid and salt replacement due to increased sweating, monitoring the fluid consumption of the residents; (increased attention should be drawn to the fact that they drink despite the lack of thirst).
- Monitoring the air temperature of the rooms where the residents are staying (temperature measurement).
- Monitoring the body temperature of the residents (fever measurement).
- Keeping the body temperature of the residents low (showering, compresses if necessary).
- Changing bed linen more frequently in the case of bedridden residents.
- Providing and monitoring light, juicy foods containing a lot of fluid.
- Drawing the attention of patients and staff to the symptoms of fainting that accompany heat.
- Increased monitoring of people with chronic diseases (high blood pressure, chronic kidney and liver disease, diabetes, etc.).
- Monitoring the effects of medications used in certain diseases due to heat (e.g. beta blockers, antihistamines, antidepressants) - frequent consultation with the attending physician.
- Reasonable organization of work schedules, avoidance of excessive strain: ensuring adequate rest for employees.
- Early ventilation, adjustment of fans, early darkening on the southern and western sides.
- Distribution of an adequate amount of protective drink among nursing staff and patients.
- Increasing cooling capacity (putting into operation of backup coolers).
- Strengthening technical on-call service in case of possible failure of continuously operating air conditioners.



5.5. UV alert levels and tasks [Fülep T.]

5.5.1. UV alert levels

Meteorological Service Nonprofit Zrt.:

- National UV index forecast:
https://www.met.hu/idojaras/humanmeteorologia/uv-b/orszagos_elojelzes/
- UV radiation warning:
<https://www.met.hu/idojaras/humanmeteorologia/uv-b/figyelmeztetes/>

5.5.1.1. UV warning

HungaroMet issues a UV warning for very strong ultraviolet radiation if the forecast UV index reaches 7.0 in at least 50% of the area of a given region. (OMSz é.n.)

5.5.1.2. UV alert, UV warning

HungaroMet issues an extreme UV alert if the forecast UV index reaches 8.0 in at least 50% of the area of a given region. (OMSz é.n.)

5.5.2. Issuance and tasks of UV warnings and alerts

Issuance of UV warnings: From 2021, HungaroMet will provide the highest, lowest and average values of the maximum UV index forecast for the next day for the 7 statistical regions of Hungary (Western Transdanubia, Central Transdanubia, Southern Transdanubia, Pest and Budapest, Northern Hungary, Northern Great Plain, Southern Great Plain).

- At the same time, a UV warning is issued if the forecast UV index reaches 7.0 in at least 50% of the area of a given region – in this case, a warning of very strong UV radiation is issued.
- If this value reaches 8.0 – an extreme alert is issued: UV alert, UV alert. (OMSz é.n.)

Based on the UV index values available from HungaroMet Hungarian Meteorological Service Nonprofit Zrt. (<https://met.hu>), the Hajdúböszörmény Mayor's Office warns the public and informs them about the rules for safe outdoor activities and sunbathing (8.10. Rules for sunbathing).

5.6. Office triggering the alert and interested parties [Fülep T.]

In Hajdúböszörmény, the heat and UV alert is triggered by the Hajdúböszörmény Municipality:

- Public information on the issuance of an information or alert level heat alert (Annex 8.4).
- Public information on the issuance of an information or alert level UV alert (Annex 8.5).

Actors, stakeholders and responsibilities (4.2. Actors, stakeholders and responsibilities).



Projekt kedvezményezett:
Hajdúböszörmény Város Önkormányzata

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6. Thermal protection measures in the short, medium and long term [Fülep T.]

6.1. Overview TABLE of measures

Target group	Measure	Code
Short-term (acute) heat protection measures (accidental heat wave treatment)		R
population	Communicating the heat alert by disseminating recommendations	R1
population	Tracking illnesses and deaths	R2
population	Opening of cool and refrigerated buildings, provision of drinking water, steam doors	R3
people living alone	Supporting organizations that work with people in need living alone	R4
pregnant women and babies	Expanding early intervention services	R5
Medium-term heat protection measures (heat wave avoidance strategies)		K
population	Developing health awareness and spreading knowledge widely	K1
outpatient care	Heat protection education for those working with vulnerable groups	K2
population	Provision of drinking water in public areas, operation of steam doors	K3
outdoor workers	Networking and consulting services for outdoor workers	K4
population	Information campaign on the possibilities of building with good thermal properties	K5
Long-term thermal protection measures (sustainability against climate change)		H
population	Afforestation, care of urban trees, tree planting, landscaping	H1
population	Supplementing the building regulations with architectural solutions with good thermal properties	H2
urban developers	Analysis and design of urban climate (city climate) with green elements	H3
urban developers	Development of sustainable transport sectors and multimodal transport	H4
population	Promoting an active lifestyle and increasing the fitness of the population	H5
educational institutions	Shading and air conditioning of educational institutions	H6
houses with gardens	Support for the placement of garden rainwater tanks at home	H7

6.2. Heat action plan (= heat action plan) TABLES

6.2.1. Short-term (acute) heat protection measures (accidental heat wave management)

Short-term measures (acute measures + acute plan): Measures that provide immediate support to groups of the population that are particularly sensitive, vulnerable and at risk in relation to heat waves. For them, heat waves pose an increased risk and they are unable to adequately support themselves during heat waves. During acute heat waves, a heat alert is issued and short-term measures (acute measures + acute plan) must be implemented. The heat warning system is responsible for the heat alert, which is based on meteorological forecasts and the heat warning levels of the Drinking Water Directive. Activities are triggered by specific responsible parties according to the heat alert level. **Objective: to prevent the serious consequences of a heat wave, accidental heat wave management.**

S1	Short-term action: immediate acute extreme heatwave action plan
	Communicate the heat alert with recommendations
<p>Destination: Informing the public about the expected extent, arrival and duration of the heatwave. Provide recommendations to the public for successfully surviving heatwaves. Active actors receive target-group-specific information. Community interest sites (multipliers) provide heat alerts and behavioural recommendations to their target groups.</p> <p>Target groups: The entire population of Hajdúböszörmény</p> <p>Short description: The heat alarm system is activated according to the heat alert levels (stage 1, 2 or 3) via information and communication channels. At Stage 1 (information stage), the mean daily temperature is projected to exceed 25 °C for at least 1 day. First of all, the county government office is a public health administrative body, which provides information to regional and district institutions through its internal system. The Stage 2 of the alarm phase forecast a daily mean temperature exceeding 25 °C for at least 3 days and a daily mean temperature of 27 °C for at least one day. This "Alert – Public alert" phase. The National Chief Medical Officer sends the alert to the government offices of the capital and counties, and through them to health care providers (health institutions, ambulance services, general practitioners) operating in their area of competence about the extent and duration of the heat alert. The Stage 3, the alarm signal phase the average daily temperature is forecast to exceed 27 °C for at least 3 days. At this time, the National Chief Medical Officer notifies health institutions, ambulance services, general practitioners and local governments, including the municipality of Hajdúböszörmény, about the extent and duration of the heat alert through the county government office. At this time, in addition to the tasks to be performed during the second-stage heat alert, it is mandatory to inform the public through the media about the expected weather extremity and the ways of preventing related health damages. (2.3.5. Advice on withstanding extreme solar radiation, ultraviolet radiation and heat wave 21)</p> <p>As heat waves are usually accompanied by high levels of UV radiation, be sure to include them in the information. (5.5. Stages and tasks of UV alarm 66; 8.10. Sunbathing rules 94)</p> <p>Responsible: Clerk (Hajdúböszörmény Mayor's Office)</p> <p>Possible steps to act:</p> <p>(5.2.4. Heat alert chain 50)</p> <p>(5.2.5. Communication channels 52)</p> <p>(5.3.2. Local government actions during heat alarms 55)</p> <p>(5.3.3. Information step 55)</p> <p>(5.3.4. Alert level 55)</p> <p>(5.4.2. For heat alert stages 63)</p>	



(5.6. Alert office and interested parties 66)

Planning (season): summer

S2

Short-term action: immediate acute extreme heatwave action plan

Monitoring morbidity and mortality

Destination: Medical institutions of Hajdúszörmény

Target groups: The entire population of Hajdúszörmény

Short description: Unfortunately, during heatwaves, the number of cases and deaths increases. (2.3.2. Impact of extreme heat days on morbidity and death 18) Knowledge of temperature data and health data can point to areas for improvement, but this requires research. For this research, statistics on health institutions are needed.

Responsible: Responsible for data collection at the health institutions of Hajdúszörmény and the Mayor's Office of Hajdúszörmény

Possible steps for action: 1. Appointment of data collection officers. 2. Development of data collection methodology. 3. Data processing and evaluation. 4. Using the lessons learned from research results in heat protection.

Planning (season): summer

S3

Short-term action: immediate acute extreme heatwave action plan

Opening and communicating cool and chilled buildings, provision of drinking water, vapour gates

Destination: Public buildings in Hajdúszörmény

Target groups: The entire population of Hajdúszörmény

Short description: During heat waves, an immediate, quick step to alleviate the health consequences of heat is to free up shelters from the heat, which cool and cooled buildings are suitable for. (8.8. Refrigerated, air-conditioned rooms in Hajdúszörmény Hiba: A hivatkozás forrása nem található)

- Public air-conditioned room in Hajdúszörmény: Mayor's Office, 1st floor, Báthory Hall (Hajdúszörmény Mayor's Office 2024c).
- Other air-conditioned premises in Hajdúszörmény: shops, post office, customer service offices, etc.

A short-term solution for heat emergency (costly, waste-generating, unsustainable) is water distribution, where for some reason there is no public well or drinking water tap. (Medium-term solution: operation of public wells and drinking water taps.)

Part of a heat emergency solution may be to install additional vapor gates. (8.7.4. Vapor gates in Hajdúszörmény 90)

Responsible: Mayor (Hajdúszörmény Mayor's Office)

Possible steps to act: 1. Publish the names of cool and cooled buildings during heat alerts. 2. Organization of water distribution and publication of its places. 3. Encourage hospitality venues to allow residents and visitors to fill their drinking bottles with water on heat days. (5.2.5. Communication channels 52)

Planning (season): summer

S4

Short-term action: immediate acute extreme heatwave action plan

Support for organisations working with deprived people living alone



<p>Destination: Social Service Center</p> <p>Target groups: deprived persons living alone (2.2.2. Population groups that are particularly vulnerable and at risk during heatwaves 11)</p> <p>Short description: People in need living alone are primarily dealt with by the Social Service Centre, so it is important to support this organisation.</p> <p>Responsible: Head of Social Service Centre (Hajdúböszörmény Mayor's Office)</p> <p>Possible steps for action: 1. Plan the manner and extent of support. 2. Identify and establish sources of support. 3. Delivery of aid.</p> <p>Planning (season): summer</p>

S5	Short-term action: immediate acute extreme heatwave action plan
	Extending early assistance services
<p>Destination: Health visitors – Hajdúböszörmény</p> <p>Target groups: premature babies, newborns, infants, young children; pregnant women and nursing mothers (2.2.2. Population groups that are particularly vulnerable and at risk during heatwaves 11)</p> <p>Short description: Preterm babies, newborns, infants, young children; pregnant mothers and breastfeeding mothers are highly vulnerable, vulnerable population groups that may need preventive and first-round early assistance during heatwaves. These population groups are dealt with by health visitors, so it is necessary to extend and strengthen their assistance services.</p> <p>Responsible: Health visitors – Head of Hajdúböszörmény</p> <p>Possible steps of action: 1. Assessment of the condition of the Health Visitors – Hajdúböszörmény organization. 2. Planning the extension and strengthening of Health Visitors – Hajdúböszörmény services by exploring the resources. 3. Organization and implementation of the extension and reinforcement of services.</p> <p>Planning (season): summer</p>	

6.2.2. Medium-term thermal protection measures (heatwave avoidance strategies)

Medium-term measures (preparation, preparation, conditioning): Preparatory actions, raising awareness among the population and support systems and actors in the health system. Preparation measures for the health consequences of heat, appropriate prevention strategies and good behaviour. Conditioning, improving the general health and tolerance of the population. Preparatory, and conditioning measures should be taken, reviewed or started before each summer. **The goal: to ease the heat island effect in the city, to avoid dangerous heatwaves, and to make everyone ready to endure heat waves.**

M1	Medium-term action: strategic action plan for heat emergency prevention (preparedness and awareness)
	Health awareness development and widespread dissemination
<p>Destination: Public education, public media, events</p> <p>Target groups: The entire population of Hajdúböszörmény</p> <p>Short description: Health awareness related to heat and sustainability (climate change, environmental problems and</p>	



opportunities for action) should be included among the tasks of public education. Public media (TV, radio, websites, newspapers, posters) and events (appearances at cultural events, posters, banners, leaflets) are designed for all ages. 2.2. Groups at risk of heat 10; 2.3. Health effects of extreme solar radiation 15; 8.10. Rules of sunbathing 94

Responsible: Hajdúböszörmény Health Promotion Office (EFI) <https://efi.eszv.hu/>; Sillye Gábor Cultural Centre and Community House, Szabadhajdú urban policy weekly, Hajdúböszörmény City Television (HBTV)

Possible steps of action: 1. Preparation of health awareness materials. 2. Organisation of awareness-raising.

Planning (season): continuous, especially summer

M2

Medium-term action: strategic action plan for heat emergency prevention (preparedness and awareness)

Thermal protection education for vulnerable focus group workers

Destination: Social Service Center

Target groups: vulnerable target groups (2.2.2. Population groups that are particularly vulnerable and at risk during heatwaves 11)

Short description: Social workers working in the Social Service Centre primarily deal with vulnerable population groups during the heatwave, therefore heat protection training preparing them for heat management is particularly important for them.

Responsible: Head of Social Service Centre (Hajdúböszörmény Mayor's Office)

Possible steps of action: 1. Organization of thermal protection education for social workers. 2. Conducting heat protection trainings for social workers.

Planning (season): continuous

M3

Medium-term action: strategic action plan for heat emergency prevention (preparedness and awareness)

Providing drinking water in public areas, operation of vapor gates

Destination: Public areas of Hajdúböszörmény

Target groups: The entire population of Hajdúböszörmény

Short description: In the summer heat, especially during heat waves, it is extremely important to consume enough drinking water. The easiest way is to have accessible and working sources, public wells, ornamental wells, drinking fountains, water taps or refill points in reasonably designed places. Water intake is necessary primarily in places used for longer stays: squares, parks, stations, pedestrian streets, shops, sports grounds, leisure parks (recreational areas). First of all, drinking water should be provided at Bocskai Square and the bus station, then drinking fountains should also be installed in other busier places: Szent István square, Korpona street – Kálvin square roundabout, Újváros street, city market.

The vapor gate currently operates in one place (2 pieces on Bocskai Square: 8.7.4. Vapor gates in Hajdúböszörmény 90). It is recommended to operate steam gates in some other areas with high pedestrian traffic: in the public area in front of the post office (Korpona Street), at the intersection of Szent István Square – Kossuth Street and in the area of the city market.

Responsible: Hajdúböszörmény Mayor's Office

Possible steps to act: 1. Review and rethink the situation of public wells and drinking fountains and vapor gates. (8.7.



Public wells, drinking wells, fountains and vapor gates in Hajdúböszörmény 86) 2. Repair and restart of many closed or possibly non-functioning public wells and drinking fountains. 3. Installation of niche drinking fountains and steam gates

Planning (season): continuous, from the beginning of spring to the end of autumn

M4

Medium-term action: strategic action plan for heat emergency prevention (preparedness and awareness)

Network and consulting services for outdoor workers

Destination: Hajdúböszörmény employers employing outdoor employees

Target groups: outdoor workers

Short description: Outdoor workers are directly exposed to heat and heat waves during their working life, supported by network and advisory services.

Responsible: occupational safety

Possible steps for action: 1. Preparation and training of health and safety officers and professionals on heat and outdoor working. 2. During the annual occupational safety trainings, prepare employees for the heat situation. 3. Presence or monitoring of occupational safety professionals during heat waves.

Planning (season): continuous

M5

Medium-term action: strategic action plan for heat emergency prevention (preparedness and awareness)

Information campaign on the possibilities of building with good thermal properties

Destination: The entire population of Hajdúböszörmény

Target groups: The entire population of Hajdúböszörmény

Short description: The thermal properties of architectural solutions of buildings determine energy consumption and heat properties from the outset. (Thin walls without thermal insulation, large windows and glass surfaces, bituminous flat roofs, paved courtyards, etc. lead to significant warming of the building in summer.) It is worth promoting increasing the proportion of green space in courtyards, modern possibilities of shading and thermal insulation, sustainable architectural solutions for roof design, ingenious engineering ideas of the past forgotten and pointing to the present, because they prevent the development of heat problems. Through information campaigns, knowledge of these sustainable building options can be disseminated and hopefully brought into fashion over time. All solutions that reduce energy use, provide shading and increase biomass can be recommended and supported. Within the framework of the information campaign, presentations, competitions, exhibitions, conferences, event desks, posters, educational films, infographics, websites, etc. can be designed and organized. (2.3.5.1. Coping with heat waves – recommendations for the population, decision-makers, urban developers 21; 8.11. Reducing the urban heat island effect with biologically active green spaces 96)

Responsible: Sillye Gábor Community Centre and Community Centre

Possible steps for action: 1. Choice of technical implementation of the information campaign. 2. Creating costs for the information campaign and integrating them into other projects. 3. Organisation and conduct of the information campaign.



Planning (season): occasional

6.2.3. Long-term thermal protection measures (sustainability against climate change)

Long-term measures (sustainability): Measures related to urban development activities, measures related to urban buildings and the way of life of the population. Town planning and urban land use planning measures with thermal event planning. Creation of natural air ducts (chimney effect, draught effect), damped areas (shading, greening, seal reduction, etc.), cold air production sites (air conditioning). Architectural and construction design; Measures relating to buildings and real estate mainly concern the combination of technical-structural measures aimed at reducing the heat of buildings and the climate modernisation of existing and planned outdoor facilities. Promoting an active lifestyle to increase fitness. **Goal: to increase the resilience of cities and people to heat in the long term through sustainable measures, and to curb climate change with sustainability.**

L1	Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)
	Afforestation, care of urban trees, tree planting, landscaping
<p>Destination: Public areas of Hajdúböszörmény (streets, squares, roads, suburbs)</p> <p>Target groups: The entire population of Hajdúböszörmény and those staying in the city</p> <p>Short Description: Urban trees, with their presence, greatly reduce the extreme warming of summer days and the formation of heat islands. They provide shade and act as natural vapor barriers, their habitat role is also significant, they also act as ecological corridors. They greatly improve the tolerability of urban climate (urban climate) and act against climate change (global warming). (Photo attachments 11, 12, 13; 107)</p> <p>With landscape architect and gardening experts, it must be determined in a planned manner where it is possible to plant new trees, rows of trees and groups of trees in the public areas of the city and in the institutional courtyards maintained by the municipality; locations in priority order.</p> <p>When determining tree sites, it is necessary to take into account:</p> <ul style="list-style-type: none"> • public utility developments planned in connection with existing and possible future investments, so that trees can develop properly and do not need to be cut down prematurely; • the characteristics of the site, which influence the optimal species and varieties for the given tree location (crown width and shape, maximum height, light demand, etc.). <p>The choice of species and varieties is supported by the annually updated list of city-tolerant trees suitable for road and street wooding, published by the Association of Hungarian Ornamental Gardeners (List of Row Trees in Public Areas). A sustainability aspect is to give preference to native tree species.</p> <p>Where possible, it is recommended to plant saplings using the Stockholm Tree Planting System, which ensures longer lifespan and optimal development conditions for woody vegetation in urban environments (https://www.gardenfutura.hu/stockholm-faultetesi-rendszer).</p> <p>For planting trees in public areas, it is recommended to observe the standard "Planting ornamental trees and ornamental shrubs in public areas of settlements, MSZ 12172:2019".</p> <p>Regular care and tree care greatly contributes to maintaining the good health of trees and increasing their lifespan, so this must be integrated into the local green space management system and tasks.</p> <p>Responsible: the municipality's company performing city management tasks</p> <p>Possible steps for action: 1. Assess the situation of current urban trees. 2. Annual review and care of current urban trees. 3. Designate a place to plant additional trees. 4. Creating material conditions for tree planting. 5. Selection of suitable tree species and varieties. 6. Purchase of seedlings to plant. 7. Tree planting with the involvement of civil society organisations and the general public. 8. Care for planted trees.</p> <p>Planning (season): Caring for trees is a year-round task, the time for planting trees is autumn.</p>	



<h1>L2</h1>	Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)
	Supplementing the building ordinance with architectural solutions with good thermal properties
<p>Destination: Buildings in Hajdúszabolcs</p> <p>Target groups: The entire population of Hajdúszabolcs</p> <p>Short description: The thermal properties of architectural solutions of buildings determine energy consumption and heat properties from the outset. (Thin walls without thermal insulation, large windows and glass surfaces, bituminous flat roofs, paved courtyards, etc. lead to significant warming of the building in summer.) If sustainability building rules apply to the green area-stone surface ratio of yards, shading, thermal insulation, glass surface ratio and roof design, this will prevent heat problems. All solutions that reduce energy use, shield and increase biomass can be recommended and supported. (2.3.5.1. Coping with heat waves – recommendations for the population, decision-makers, urban developers 21; 8.11. Reducing the urban heat island effect with biologically active green spaces 96) Green Card</p> <p>Responsible: Chief Architect (Hajdúszabolcs Mayor's Office)</p> <p>Possible steps for action: With the involvement of the city administration and the chief architect, as well as eminent architectural and sustainability experts, regulations can be drafted that reduce unsustainable solutions and promote sustainable, high-thermal architectural design.</p> <p>Planning (season): continuous</p>	

<h1>L3</h1>	Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)
	Analysis and planning of urban climate (urban climate) with green elements
<p>Destination: Public areas of Hajdúszabolcs</p> <p>Target groups: urban developers</p> <p>Short description: The study of the urban climate of Hajdúszabolcs has shown the right directions for development. (3.3. Identification of heat-sensitive areas of Hajdúszabolcs 36; 3.4. Conclusions 38) In addition to wooding (H1), several other green elements are needed to reduce the heat island effect of the settlement:</p> <ul style="list-style-type: none"> • Application of solar sails (parasols): Installation of solar sails on playgrounds, under which benches can also be installed, a natural shaded playground can be quickly created, simultaneously lowering the air temperature, improving people's well-being and helping to avoid sunstroke. Supplement solar sails with tree planting, which grows slowly and provides shade as a long-term solution. • Planting vineyards: Planting resistant vineyards, which can be run on racks to quickly create a natural shaded resting place, even with benches, simultaneously increasing the green area, reducing the air temperature, and improving urban air quality by trapping dust. • stone paving: Elimination of high tub plants (~1m³) and "regreening" of the area covered by them (Bocskai Square – the main square of the city). The ~1m² removal of the paved surface and foundation of the site, and then filling its place with topsoil and planting a tree species that tolerates living in this concrete heap. The care of these plants – after rooting – requires significantly less work than that of current tub plants (moving, planting, regular watering – for almost zero shade). The resulting green space itself provides heat and UV shielding for those occupying the square. To enhance this, trees growing canopy could later be surrounded by benches, thus providing them with physical protection from possible damage, and creating a "cooling point" around them. The trees placed in the right distribution can also provide a pleasant and enjoyable venue for regular events on the square. A containerized or ground ball tree planting method can significantly accelerate their growth. (Photo Appendix 8.12: Photos 12-13; 107) 	



- Water permeable pavements: Application of water-permeable pavements in public spaces.
- concrete demolition: demolition and plantation of unused concreted, asphalted surfaces and islands (perennials, shrubs, trees)
- installation of green roofs, green facades, rain gardens, etc. (8.11. Reducing the urban heat island effect with biologically active green spaces 96)
- fountains, water fountains, ornamental ponds, boating ponds: installation, operation, maintenance
- Establishment of water playgrounds: Water playgrounds are playgrounds containing water-operated adventure elements, such as steam gates, gargoyles and tipping toys, typically intended for children, and are classified as type 3 public baths. Their placement in public spaces is a freely accessible heat seating point that can also have an impact on the urban climate.
- development of private gardens: encouraging and supporting garden owners to plant (perennial, shrub and tree division action)

(8.9. Shading green islands in Hajdúböszörmény (R4HH Project) 90; 2.4.1. Sustainable urban planning 28)

Responsible: Head of Urban Development Department (Hajdúböszörmény Mayor's Office)

Possible steps of action: 1. Spring: installation of solar sails (parasols); installation of vineyard running racks, planting of plants. 2. Summer: maintenance of solar sails (parasols), care of vineyards. 3. Autumn: collecting and storing solar sails (parasols), paving stones and planting trees.

Planning (season): continuous

L4

Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)

Development of sustainable transport sectors and multimodal transport

Destination: Roads in Hajdúböszörmény

Target groups: urban developers

Short description: Car-centred urban development and everyday transport (supporting cars and crowding out other transport sectors) have significantly contributed to the spread of asphalt pavement and the reduction of the fitness of the population. However, in a mixed (multimodal) transport system, motorists do not crowd out other, mostly sustainable transport sectors, i.e. bicycle, walking, micromobility and public transport are on an equal footing with car transport. Another advantage is that the reduction of car lanes and car parks contributes to the increase of green spaces. Those who travel actively and muscularly (e.g. commuting to work, school, shopping) will be significantly fitter, less susceptible to the strain caused by the heat wave and various urbanization diseases. (2.2.3. Concomitant factors that exacerbate the effects of heat waves (cocktail effect) 12)

Responsible: Head of Urban Development Department (Hajdúböszörmény Mayor's Office)

Possible steps for action: 1. Assess routes suitable for cycling commuting and tourism. 2. Creation of cycle paths on routes suitable for cycling commuting and tourism. 3. Establishment of adequate bicycle parking and bicycle storage facilities in public buildings, shops, parks, squares and tourist destinations. 4. Creating the conditions for cyclists to work and school by creating adequate institutional bicycle parking and bicycle storage, washing and dressing conditions. 5. A decree that can only support car commuting to work in exceptionally justified cases, instead subsidizing public transport passes. 6. Review of sidewalks and footpaths. 7. The ultimate aim is to achieve a mixed, multimodal transport system in all directions as possible (equal opportunities for all transport sectors). 8. In parallel with multimodal developments, gradual reduction of car parking areas.

Planning (season): continuous



L5	Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)
	Promoting an active lifestyle and increasing the fitness of the population
<p>Destination: Hajdúböszörmény, its suburbs and surrounding area</p> <p>Target groups: The entire population of Hajdúböszörmény</p> <p>Short description: Urbanization habits distanced people from nature and naturalness in Hajdúböszörmény as well. One consequence of this is the appearance of neighborhoods suitable for the formation of heat islands, and another consequence is that people become increasingly ill and their fitness decreases. (2.2.3. Concomitant factors that exacerbate the effects of heat waves (cocktail effect) 12) The lifestyle of the population can be changed by influencing everyday and leisure activities, which depends to a large extent on the level of development (infrastructure).</p> <ul style="list-style-type: none"> • multimodal transport (L4) • development and support of walking and cycling to school, work and shop (L4) • construction of outdoor fitness parks • development of active tourism (e.g. around Boating Lake (Csónakázótó), towards Bodaszőlő and Hortobágy) • support and organization of outdoor sports events <p>Responsible: Mayor (Mayor's Office of Hajdúböszörmény), with recommendations</p> <p>Possible steps of action: 1. Finding tender opportunities for outdoor fitness parks, then planning and implementation. 2. Assessing the possibilities of active tourism, finding the necessary financial resources, then planning and implementation</p> <p>Planning (season): continuous</p>	

L6	Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)
	Shading and air-conditioning of educational institutions
<p>Destination: Educational institutions and public buildings of Hajdúböszörmény</p> <p>Target groups: children (kindergarten children, schoolchildren) and their educators in Hajdúböszörmény</p> <p>Short description: Unfortunately, several educational institutions have certain rooms that are unsuitable for their functions during hot days. In this case, these rooms become so hot and hot that educational work cannot continue in them with sufficient efficiency. Therefore, efforts should be made to ensure that adequate shading and, as a last resort, mechanical air conditioning of these rooms are solved as soon as possible. Possible solutions for shading and air conditioning: sun sails (giant umbrellas/parasols), tree planting, rainwater collection containers, vapor gates, garden showers.</p> <p>Responsible: Mayor (Mayor's Office of Hajdúböszörmény), formulating and forwarding recommendations to the maintainers of the given institutions</p> <p>Possible steps to act: 1. Survey of the institutions: needs assessment for the installation of shading and air-conditioning systems; and preparation of construction plans and designs. 2. Source exploration to finance the task. 3. Implementation in order of priority, depending on available resources.</p> <p>Planning (season): summer</p>	



L7	Long-term action: Sustainable Living Action Plan for Climate Protection and Liveability (urban development and lifestyle)
	Support for home placement of garden rainwater collection pots
<p>Destination: Residential communities of Hajdúböszörmény, owners of houses with garden</p> <p>Target groups: The entire population of Hajdúböszörmény</p> <p>Short description: An important abandonment of climate adaptation is water retention and collection, which needs to be encouraged at municipal level. Partly because of finite drinking water resources, clean and healthy water is a great treasure. Partly because irrigation with rainwater is better for garden crops (due to the chemistry of the water). Therefore, helping to improve the material conditions of domestic rainwater collection, raising awareness and education related to it is a voluntary task of local governments.</p> <p>Responsible: Head of Urban Development Department (Hajdúböszörmény Mayor's Office)</p> <p>Possible steps for action: 1. Needs assessment for rainwater collection (among owners of houses with gardens). 2. Source exploration to finance the task. 3. Purchase and distribution of rainwater collection vessels.</p> <p>Planning (season): continuous</p>	

6.3. Concept and strategies for implementing the heat protection measure

1. Establish a local heat protection steering group and a technical working group: Hajdúböszörmény Municipality R4HH Ready4Heat Hajdúböszörmény working group.
2. Assess the vulnerability to heat.
3. Draft heat and health plan based on the analysis.
4. Hajdúböszörmény HHAP Heat and Health Action Plan: Hajdúböszörmény Heat and Health Action Plan, heat-related action plan, heat action plan, heat action plan, heat action plan: Consultation on the first version.
5. Hajdúböszörmény HHAP Heat and Health Action Plan: Hajdúböszörmény Heat and Health Action Plan, heat-related action plan, heat action plan, heat action plan, heat action plan: Consultation before the final version.
6. Request for ministerial permission for the preliminary testing of the Hajdúböszörmény Heat and Health Action Plan.
7. Testing of the Hajdúböszörmény Heat and Health Action Plan.
8. Evaluation of the test, use of the results to improve the Hajdúböszörmény Heat and Health Action Plan.
9. Definition of the Hajdúböszörmény Heat and Health Action Plan implementation process.



10. Obtaining ministerial approval for and implementing the final Hajdúböszörmény Heat and Health Action Plan.

7. Monitoring and documentation

Hajdúböszörmény built 47 shading green islands in the Ready4Heat project. The 47 green islands nature-based development will be implemented on an experimental basis, the effects of which will be researched during the project. We will share the experiences at the national and international level, thereby helping the work of other settlements and organizations dealing with climate adaptation.

- tomorrow news and articles
- knowledge dissemination articles
- knowledge dissemination short films
- blog articles
- conferences



8. Annexes

8.1. Glossary: list of key terms [Fülep T.]

- **constant body temperature:** constant body temperature independent of the environment (homoiothermal), in humans ~37 °C
- **internal harmony:** balance of the internal environment (homeostasis)
- **HHAP Heat and Health Action Plan:** Heat and Health Action Plan, heat-related action plan, heat action plan, heat action plan, heat action plan (result of R4H)
- **heat training:** We can tolerate the summer heat and high temperatures much more easily if we adapt to the heat with heat training and develop and expand our heat tolerance. Heat training can be natural (everyday), planned (passive) or sports-like (active).
- **heat wave (in Hungary):** a period in which the temperature is 30 °C or higher for several consecutive days
- **thermal regulation:** vegetative regulatory mechanism (thermoregulation)
- **heat island (urban heat island):** a microclimatic phenomenon occurring in large cities; in built-up urban areas the temperature is definitely higher than in the suburban and rural areas surrounding the city, taking a toll on the body of urban people in summer; the reason is that concrete, panels, bricks, bitumen, in contrast to natural surfaces (e.g. green areas), absorb solar radiation much better than they would reflect and retain heat, and the heat generation from the cooling and heating of buildings, industry, vehicles, etc., the emission of greenhouse gases and other air pollutants is concentrated; the difference in maximum temperatures can be 5–10 °C.
- **thermal tolerance limit:** 50 °C, above which death occurs
- **thermal protection:** similar to “flood protection”, “fire protection”, etc., simplified term (Fülep)
- **mantle temperature:** The temperature of the extremities and the surface of the body, which fluctuates much more than the core temperature.
- **environmental expert, sustainability expert:** a professional with a degree or reference in environmental protection or sustainability
- **critical temperature:** 45 °C, which no one can survive in the long term (critical heat)
- **core temperature:** The internal temperature of the body (head and torso), rounded to an average of 37 °C ± 0.5 °C, with little fluctuation.



- **UV index:** expresses the measured or predicted amount and intensity of ultraviolet radiation (UV radiation) from the sun at a certain location on a certain day, with a value ranging from 0 to 11
- **R4H Ready4Heat:** Ready for Heat Project, Hőségre Készen Projekt
- **R4HH Ready4Heat Hajdúböszörmény:** Ready for Heat Hajdúböszörmény Project, Hajdúböszörmény Hősezér Készen Projekt
- **room temperature:** 22–36 degrees Celsius (human comfort zone)
- **green island:** shading points in cities consisting of 2 benches, raised with vertical pergolas, planted with plants and surrounded by other plants

8.2. When a heat alert ~ UV alert is issued ~ when it is cancelled, the following shall be notified:

- mayors
- family doctors
- central duty service
- midwife service
- social specialized care institutions
- residential social institutions
- population
- Hajdú-Bihar County Protection Committee
- Hajdú County Disaster Management Directorate
- county district and local protection committees
- county Government Office Public Health Department
- OMSZ Northern Great Plain Regional Rescue Organization
- County Dialysis Stations
- county hospitals
- Hajdú Bösörmény social institutions
- educational institutions
- childcare institutions
- institutions performing health functions
- leisure and sports institutions



- municipal-owned companies
- settlement cultural institutions
- other institutions
- municipal events

8.3. Contact details of participants in heat warning protection

Northern Hungarian Regional Water Works Ltd. (ÉRV. Ltd.): CEO: Ákos Lőrinc

Northern Hungarian
Regional Water Works Ltd.
(ÉRV. Ltd.): CEO: Ákos
Lőrinc

8.4. Public information on the issuance of an information or alert level heat alert

Public information

Attention, attention!

We inform the population of Hajdúszabolcs-Szatmárcsaba and those staying in the city that, according to the information of the Public Health Department of the Hajdú-Bihar County Government Office, the National Chief Medical Officer, taking into account the forecast of HungaroMet Hungarian Meteorological Service Nonprofit Zrt. and the professional recommendation of the National Public Health Center, has issued a heat alert of

.....level of heat
alarm!

I ask the public, especially the sick, children aged 0–14 and the elderly, to avoid prolonged stay and work outdoors, and to stay in the shade or cool (air-conditioned) rooms as much as possible until further notice.

In order to reduce the adverse effects of the heat wave, we are taking the following measures:

- publication of health recommendations among the public and care staff



- publication of a list of freely usable public fountains, drinking fountains, and drinking water collection facilities
- publication of a list of air-conditioned rooms
- mechanical watering of busy road surfaces
- using a special system mounted on a fire hydrant. (The quality of drinking water at the water intake points is checked in the accredited Central Laboratory of the Northern Hungary Regional Water Works Co. Ltd. based on the relevant legislation. The test results received are sent to the Public Health Department of the Hajdú-Bihar County Government Office, Hajdúböszörmény District Office.)

I suggest that in addition to the ordered measures, the health protection (heat protection) recommendations must be strictly followed in order to protect your health!

We will inform the Dear Residents about the changes immediately through the local media!

Thank you in advance for your cooperation!

Hajdúböszörmény, 202X. year..... month.... day

Sincerely:

XXXXXXXXXX

Mayor

8.5. Citizen information on the ordering of the UV alarm with information or alarm level

Citizen information

Attention, attention!

We inform the population of Hajdúböszörmény and those staying in the city that the UV index in Hajdúböszörmény has reached a very strong value of 7–7.9 (8+ extreme), which is harmful to health. Therefore, I am ordering a UV information (UV alert, UV alert) for the city area.

The start of the exceedance is, expected duration is

Physiological effects of a high UV index value: sunburn, skin cancer, cataracts, weakening of the immune system

I ask the population, especially the sick, children aged 0–14 and the elderly, as well as those working in the sun, to stay in the shade or in a covered place between 11 a.m. and 3 p.m. if possible, cover their skin, wear a shirt, sunglasses, a hat, and use sunscreen until further notice!



In order to reduce the effects of the high UV index, we are taking the following measures:

- publication of health and safe outdoor stay recommendations
- publication of sunbathing recommendations and advice

among the population and care staff.

Please make sure to follow these recommendations in order to preserve your health!

We will immediately inform the Dear Residents about the expected changes through the local media!

Thank you in advance for your cooperation!

Hajdúböszörmény, 202X. year..... month.... day

Sincerely:

XXXXXX

Mayor

8.6. Recommendations for managers of social institutions in the event of a heat alarm

Excerpt from the work of the National Center for Public Health (é.n.a):

- Keep the temperature of the institution as low as possible.
- Activate plans to maintain the continuity of operations – including possible increased needs.
- Ensure and increase external shading – outdoor watering to cool the air (avoid slipping hazards, check local drought-related water restrictions before watering).
- Keep curtains closed and windows closed as long as the outdoor temperature is higher than the indoor temperature.
- Open windows if the outdoor temperature drops below the indoor temperature (late evening or early morning).
- Regularly record the indoor temperature in the rooms where the residents are staying.
- Train staff to help and advise residents.
- Ensure that the building is ventilated at a cooler temperature at night.
- Reduce the internal temperature by switching off unnecessary lights and electrical equipment.
- Shift visiting hours to the morning and evening to reduce the afternoon heat due to increased crowds.
- Provide an adequate number of refrigerators for both staff and residents.
- Ensure continuous monitoring of residents and patients: – Check body temperature, heart and respiratory rate, blood pressure and fluid intake.
- “Drink plenty of fluids”: increase fluid intake by the amount necessary to compensate for fluid loss (losses through urine and sweat). This is approximately a 150% increase in



intake. During heat and heat waves, people should drink even when they do not feel thirsty. This is especially true for the elderly, who have a reduced sense of thirst. However, excessive water consumption without electrolyte replacement can lead to severe sodium loss, which can lead to complications, brain swelling, brain damage, coma, and death. Adding sodium chloride and other soluble substances to the drink consumed (20-50 mmol/l) reduces water loss in urine and helps restore fluid balance. All elderly people or patients should be given personalized fluid intake advice depending on their health status. – Monitoring the patient's behavior (any changes, especially excessive sleepiness). – Monitoring the patient's complaints (complaints of headache, unusual fatigue, weakness, dizziness, disorientation, or sleep disturbances). Encourage patients/patients to stay in the coolest parts of the building possible. Ensure that residents are properly housed: everyone spends time in a cool room/area (below 26°C), give priority to residents who are at high risk or showing signs of distress (including elevated body temperature), and also to residents who cannot be moved or whose movement would increase disorientation, Provide cooling (e.g. fluids, cool wipes) and increase supervision. Monitor residents' fluid intake, especially if residents cannot always drink unaided, increase fluid intake during heatwaves. Provide oral rehydration salts for those taking diuretics. Provide bananas, orange juice and occasional salty snacks, oilseeds to replace salts lost through sweating.

- Instructing the patient to avoid caffeine-containing (coffee, tea, cola) and excessively sugary drinks.
- Instructing the patient to wear light, loose cotton clothing that absorbs sweat, thereby preventing skin rashes caused by sweat.
- The patient should regularly cool their exposed body parts with cold water, spray, and place a wet cloth or towel on the back of their neck, which helps regulate temperature. Providing the possibility of showering or bathing with lukewarm water!

For the staff of social institutions:

- Reasonable organization of the work schedule, ensuring adequate rest for employees to avoid excessive strain.
- Reasonable interruption of working hours and work processes, and multiple relaxation periods.
- Distribution of an adequate amount of protective drink among the staff, provision of chilled lemonade, tea, and mineral water as financial means are provided to replace fluids.
- Strengthening technical duty, in case of failure of continuously operating air conditioners.
- Provision of appropriate, comfortable, natural-based, airy summer work clothes.

(Nemzeti Népegészségügyi Központ é.n.a.)



8.7. Public wells, drinking wells, fountains and vapor gates in Hajdúböszörmény

8.7.1. Public wells in Hajdúböszörmény

By 2024, 109 public wells had been established in Hajdúböszörmény, of which 59 were closed, **45 were operational, and 5 were in operation** (Hajdúböszörményi Polgármesteri Hivatal 2024d).

1. Külső-Hadházi Street – Szittyta Street intersection: closed
2. Turán Street 8: closed
3. **Géza Fejedelem Street – Csángó Street intersection: open**
4. Géza Fejedelem Street – Jászkun Street intersection: closed
5. **Géza Fejedelem Street – Erdély Street intersection: open**
6. **Pusztaszer Street 14: open**
7. Koppány Street 1: closed
8. **Táltos Street 20: open**
9. Székely Street 13: closed, upper part missing
10. Erdély Street 108: closed
11. **Erdély Street 96: open**
12. **Erdély Street 84: open**
13. **Erdély Street 2: open**
14. Pálnagy Zsigmond Street 14: closed
15. **Külső-Hadházi Street 1–3: operating**
16. Budai Nagy Antal Street 54: closed
17. Hétvezér Street 21: closed
18. Hétvezér Street 51: closed
19. Avar Street 29: closed
20. **Középkert Street 27: operating**
21. **Hargita Street 78: operating**
22. **Kinizsi Pál Street 30: operating**
23. Kinizsi Pál – Dobó István Street intersection: closed
24. **Dobó István Street 111: operating**
25. **Dobó István Street 91: operating**



- 26. **Dobó István Street 37: operating**
- 27. **Dobó István Street 69: operating**
- 28. Apafi Mihály Street 125: closed
- 29. Perczel Mór Street 55: closed
- 30. Perczel Mór Street – Kövi Miklós Street intersection: closed
- 31. **Téglási Street 16/a: active**
- 32. Újfehértói Street 32.: closed
- 33. **Csokonai Street 9.: active**
- 34. **Vitéz Street 38.: active**
- 35. **Kuruc Street 19.: active**
- 36. **Fazekas Gábor Boulevard 6.: active**
- 37. **Fazekas Gábor Boulevard 24.: active**
- 38. Cserna Street 13.: closed
- 39. Bethlen Gábor Street 8.: closed
- 40. Benedek Street 16.: closed
- 41. Polgári Street 5.: closed
- 42. Káplár Miklós Street 16.: closed
- 43. **Eötvös József Street – Bajcsy-Zsilinszky Endre Street intersection: active**
- 44. **Bem József Street – Bajcsy-Zsilinszky Endre Street intersection: active**
- 45. **Újvárosi Street 64.: active**
- 46. **Báthori Gábor Boulevard – Szilassy János Street baptism: active**
- 47. Dózsa György Boulevard – Polgári Street intersection: closed
- 48. Cemető Square – Lorántffy Zsuzsanna intersection: closed
- 49. Lorántffy Street 14/a.: closed
- 50. **Szilassy János Street 5.: active**
- 51. Nagy Sándor József Street 34.: closed
- 52. Kálvineum Street 1.: closed
- 53. Enyingi Török Bálint Street 8.: closed
- 54. **Harmat Street 32.: active**



- 55. Külső-Dorogi Street garbage dump: closed
- 56. Dorogi Street 102.: active**
- 57. Nemzetőr Street 18.: active**
- 58. Harmat Street – Fürdő Street intersection: closed
- 59. Fürdő Street 21/A.: active**
- 60. Hunyadi János Boulevard 62.: active**
- 61. Kemény János Boulevard 66.: active**
- 62. Kemény János Boulevard 40.: active**
- 63. Batthyány Lajos Street 15.: active**
- 64. Eötvös József Street 1.: active**
- 65. Kolozsvár Street 51.: closed
- 66. Kolozsvár Street 27.: active**
- 67. Kolozsvár – Maros Street intersection: active**
- 68. Baltazár Dezső Street 50.: active**
- 69. Tessedik Sámuel Street 13.: active**
- 70. Görgey Artúr Street 15.: closed
- 71. Görgey Artúr Street 42.: active**
- 72. Görgey Artúr Street 58.: active**
- 73. Katona József Street 23.: closed
- 74. Móricz Zsigmond Street – Katona József intersection: closed
- 75. Móricz Zsigmond Street 14: closed
- 76. Esze Tamás Street 18: closed
- 77. Mészáros Lőrinc Street 15: closed
- 78. Porcsalmy Gyula Street 13: closed
- 79. Puskás Tivadar – Madarász Viktor Street 1: closed
- 80. Kőrösi Csoma Sándor Street 11: closed
- 81. Kodály Zoltán Street – Bartók Béla intersection: closed
- 82. Bartók Béla – Bíró Lajos Street intersection: closed
- 83. Martinovics Ignác Street 2: closed
- 84. Bíró Lajos Street – Martinovics Ignác Street intersection: open**



85. Balassi Bálint Street 10: closed

86. Fazekas Mihály Street 4: open

87. Balassi Bálint Street 28: closed

88. Szabó Antal Street 20: closed

89. Erkel Ferenc Street 11: closed

90. Semmelweis Ignác Street – Erkel Ferenc 11 intersection: open

91. Móra Ferenc Street 36: open

92. Móra Ferenc Street 14: closed

93. Bíró Péter Street 43: open

94. Debreceni Street 42: closed

95. Külső-Debreceni Street 8: closed

96. Külső-Debreceni Street – Zrínyi Miklós Street intersection: closed

97. Lehel Street 12: closed

98. Széchenyi István Street 17: open

99. Stromfeld Aurél Street 17: closed

100. H. Fekete Péter Street 9: closed

101. Doktor Molnár István Street 20: closed

102. Doktor Molnár István Street 52: closed

103. Doktor Molnár István Street 79: closed

104. Corvin János Boulevard 18: open

105. Corvin János Boulevard 46: closed

106. Bercsényi Miklós Street 15: closed

107. Arany János Street 16: open

108. Jókai Mór – Hadházi Street intersection: closed

109. Királyhágó Street 24: open

110. Apafi Mihály Street 31: operating

111. Apafi Mihály Street 69: operating



8.7.2. Drinking fountains in Hajdúböszörmény

There are 7 drinking fountains in Hajdúböszörmény in 2024 (Hajdúböszörményi Polgármesteri Hivatal 2024d).

- 1–3. Korpona Street Market: 2 pcs, Post Office: 1 pc
4. Hajdúkerület Street Playground: 1 pc
5. Árpád Street Next to the Fountain: 1 pc
6. Szabadhajdú Street Fitness Park: 1 pc
7. Bürdőkerti Playground: 1 pc

8.7.3. Fountains in Hajdúböszörmény

There are 4 fountains in Hajdúböszörmény in 2024 (Hajdúböszörményi Polgármesteri Hivatal 2024d).

1. Bocskai Square
2. Korpona Street
3. Árpád Street
4. Karap Ferenc Street

8.7.4. Vapor gates in Hajdúböszörmény

Bocskai István Square: vapor gates (steam doors)

8.8. Cooled, air-conditioned premises in the area of Hajdúböszörmény

- Public air-conditioned premises in Hajdúböszörmény: Mayor's Office, 1st floor, Báthory Hall (Hajdúböszörmény Mayor's Office 2024c).
- Other air-conditioned premises in Hajdúböszörmény: shops, post office, customer service offices, etc.

8.9. Shading green islands in Hajdúböszörmény (R4HH Project)

The city of Hajdúböszörmény initiated the creation of 47 shading green islands in the Ready4Heat Hajdúböszörmény Project, which were located in several points of the settlement, public areas and community and institutional areas by the end of June 2024 (Hajdúböszörmény Mayor's Office 2024e).

1. KARAP FERENC STREET RESIDENTIAL ESTATE IS COMPLETED



1-2. Number of islands: 2 pcs

Address:

Around the rest area in the green area next to the parking lot behind the Penny store (1 pc),

The beginning of Désány István Street, the green area next to the playground (1 pc)

2. CSILLAVÁR KINDERGARTEN AND CHILDREN'S SCHOOL (KÖLCSEY STREET SITE) IS COMPLETED

3. Number of islands: 1 piece

Address: Kölcsey Ferenc Street 1.

3. BOCSKAI SQUARE IS COMPLETED

4-5. Number of islands: 2 pieces

Address: Bocskai Square 3. Public area adjacent to the property (next to the brick building)

4. BOCSKAI BEACH AND SPA, COMMUNITY SPACE (PLAYING SPACE) IS COMPLETED

6-7. Number of islands: 2 pieces

Address: Uzsok Square 1.

5. HAJDÚBÖSZÖRMÉNY THERMAL CAMPING AND APARTMENT IS READY

8-9. Number of islands: 2 pieces

Address: Nagy András Street

6. KÖZÉPKERTI HUNGARIAN-GERMAN BILINGUAL GENERAL SCHOOL, COURTYARD IS READY

10-11. Number of islands: 2 pieces

Address: Erdélyi Street 37.

7. FÜRDŐKERT LEISURE CENTER, COURTYARD IS READY

12-15. Number of islands: 4 pieces

Address: Vásár Square 3. (on the E side of the accommodation building and at the two corners of the new water block)

8. GÁBOR FAZEKAS ELDERLY HOME, COURTYARD IS READY



16-17. Number of islands: 2 pieces

Address: Dorogi Street 91.

9. NORTHERN ASZC SZÉCHENYI ISTVÁN AGRICULTURAL AND FOOD INDUSTRY TECHNICAL SCHOOL, VOCATIONAL SCHOOL AND DORMITORY IS COMPLETED

18-19. Number of islands: 2 pieces

Address: Radnóti Miklós Street 3.

10. CSILLAGVÁR KINDERGARTEN AND GARDEN, YUDVARA IS COMPLETED

20-21. Number of islands: 2 pieces Kindergarten

22. Number of islands: 1 piece Nursery

Address: Dobó István Street 70-72.

11. CSILLAGÁR KINDERGARTEN AND SCHOOL (SEVEN VEZÉR STREET SITE), YARD IS READY

23. Number of islands: 1 piece

Address: Hét vézer Street 58.

12. NAPSUGÁR KINDERGARTEN (POLGÁRI STREET SITE), YARD IS READY

24-25. Number of islands: 2 pieces

Address: Polgári Street 48-50.

13. MEDICAL CLINIC, PUBLIC AREA IS READY

26. Number of islands: 1 piece

Address: Balassi Bálint Street 17. (in front of the entrance, next to the bicycle storage on the street)

14. THIRTEEN VÉRTANÚ STREET, PLAYGROUND AND COMMUNITY SPACE (PUBLIC AREA) IS READY

27-28. Number of islands: 2 pieces

Address: Thirteen Martyrs/Szabadhajdú Street

15. ÁRPÁD STREET FOUNTAIN, PUBLIC AREA IS COMPLETE

29-30. Number of islands: 2 pieces

Address: Árpád Street



16. PRÓDI LEISURE PARK, PUBLIC AREA IS COMPLETE

31-33. Number of islands: 3 pieces

Address: Hajdúböszörmény-Pród, at the intersection of Bagota Street and Rókahát Street

17. LOCAL BUS STOP, PUBLIC AREA IN FRONT OF BODOGÁN ABC (ON THE OTHER SIDE OF THE STREET) IS COMPLETE

34. Number of islands: 1 piece

Address: Erdély Street 78. (next to the local bus stop)

18. LOCAL BUS STOP, PUBLIC AREA IN FRONT OF THE BAPTISTA OLDER HOME IS COMPLETE

35. Number of islands: 1 piece

Address: Külső-Hadházi Street (train station intercity bus stop)

19. BOCSKAI BEACH AND THERMAL SPA, BEACH AREA IS COMPLETE

36-38. Number of islands: 3 pieces

Address: Hajdúböszörmény, Uzsok Square 1.

20. NAPSUGÁR KINDERGARTEN – BODASZŐLŐI MEMBER SCHOOL COMPLETED

39-40. Number of islands: 2 pieces

Address: Hajdúböszörmény-Bodaszőlő, Vincellér Street 16.

21. ZELEMÉRY LÁSZLÓ GENERAL SCHOOL COMPLETED

41-43. Number of islands: 3 pieces

Address: Hajdúböszörmény-Bodaszőlő, Vákáncsos Street 43.

22. DR. MOLNÁR ISTVÁN UNIFIED SPECIAL EDUCATIONAL METHODOLOGICAL INSTITUTE, KINDERGARTEN, PRIMARY AND SKILLS DEVELOPMENT SCHOOL, DORMITORY COMPLETED

44-45. Number of islands: 2

Address: Hajdúböszörmény, Radnóti Miklós Street 5. yard

23. PLAYGROUND PETŐFI-WESZPRÉMI STREET COMPLETED

46-47. Number of islands: 2



Address: Section between Petőfi Street and Weszprémi Street (from the garage row)

8.10. Rules for sunbathing [Fülep T.]

I have compiled the rules for sunbathing based on the announcement of the Ministry of the Interior (2022a).

8.10.1. In case of weak radiation (UV index 0–2.9)

Weak UV radiation of 0–2.9 does not pose a danger to a healthy average person, except for infants and those with very sensitive skin.

Sunbathing: sunbathe for a maximum of 60 minutes, even less for those with more sensitive skin and young children. 120 minutes before 11 a.m. and after 3 p.m. is also safe.

Recommendations: Wear sunglasses in bright weather. In winter, light reflected from fresh snow doubles the strength of UV radiation. If you are prone to sunburn, cover as much skin as possible and use sunscreen.

8.10.2. In case of moderate radiation (UV index 3–4.9)

Moderate UV radiation of 3–4.9 is of low risk for the average healthy person, but can be dangerous for those with sensitive skin and young children.

Sunbathing: A maximum of 30–45 minutes is recommended, and even less for those with sensitive skin and young children. You can spend 60–90 minutes in the sun before 11 a.m. and after 3 p.m.

Recommendations: Try to cover as much skin as possible when outdoors. Wear sunglasses with UV protection and use sunscreen.

8.10.3. In case of strong radiation (UV index 5–6.9)

Strong UV radiation of 5–6.9 poses a greater risk to unprotected skin, and people with sensitive skin can get sunburned in just 20–30 minutes.

Sunbathing: A maximum of 20 minutes, even less for people with more sensitive skin and young children. Before 11 a.m. and 40 minutes after 3 p.m.

Recommendations: Spend as little time in the sun as possible between 11 a.m. and 3 p.m. Protect exposed parts of the body with a sunscreen with at least factor 15. Wear a wide-brimmed hat and protect your eyes with UV-blocking sunglasses.

8.10.4. Very strong radiation (UV index 7.0–7.9)

Very strong UV radiation of 7.0–7.9 poses a high risk to unprotected skin. The burn time in this case is 15–20 minutes.



Sunbathing: Spend no more than 20 minutes in the sun before 11 a.m. and after 3 p.m.

Recommendations: Stay in the shade or in a covered area between 11 a.m. and 3 p.m. if possible.

Be sure to wear a wide-brimmed hat, strong, UV-filtering sunglasses, or an umbrella. Uncovered parts of the body must be covered with sunscreen with at least factor 15, which must be reapplied every two hours.

8.10.5. Extreme radiation (UV index above 8.0)

Extremely strong UV index above 8.00 poses a particularly high risk!

Sunbathing: Sunbathing is not recommended at all between 11 am and 3 pm, the skin can burn in 10 minutes at this time.

Recommendations: If possible, avoid going out in the sun between 11 am and 3 pm, stay in the shade, protect yourself with long clothing, wear a wide-brimmed hat and strong, UV-filtering sunglasses. Use a sunscreen with at least factor 15, apply it thickly to your skin and repeat every two hours.

8.10.6. UV radiation: frequently asked questions (UV-FAQ)

8.10.6.1. How much do snow and water increase the UV risk?

Since snow and water surfaces reflect the sun's rays, they significantly increase the UV risk (winter sports, water sports). Reflected UV radiation also reaches our body from below, so we can get sunburned better, faster and in places where we usually don't. Protect your skin with clothing, UV-blocking sunglasses and a sunscreen with at least SPF 15, and apply it to the chin and under the nose.

8.10.6.2. How do you use UV sunscreen?

Apply a generous amount to your skin and reapply after sweating or swimming. If used incorrectly, it increases the risk of skin cancer, especially because those who use sunscreen incorrectly develop a false sense of security, so they stay out in the sun longer and use less protection than those who do not use sunscreen. Since the long-term effects of various sunscreens are less well known and pollute the water, sun-protective clothing is always a better solution.

8.10.6.3. How can we be most safe from UV radiation?

Our primary tool for UV protection is avoiding excessive exposure to sunlight, our secondary tool is sun-protective clothing (with a hat, sunglasses!), and only our tertiary tool should be sunscreen. Know your skin type, gradually accustom yourself to sunlight, and always think about UV risk, not just at the beach, for example!



8.11. Reducing the urban heat island effect with biologically active green spaces [Lajtmann Cs.]

8.11.1. Urban trees

Trees – and green spaces and green spaces in general – significantly cool the microclimate through their evaporation and effectively help to make the critical period of heat waves and heat waves more bearable. According to experts, a single young tree can replace up to 10 air conditioning units operating for 10 hours (Kravčík et al. 2007). That is why, in the spirit of adapting to climate change, it is of paramount importance to plant as many trees as possible in cities – in private gardens, institutions, and public spaces.

Tree rows, groups of trees planted in a grove-like manner, and Miyawaki mini forests not only reduce the temperature of their surroundings through evaporation, but also provide shade for those walking by. Where possible, it is worth planting trees on roads and squares with heavy pedestrian traffic in such a way that they enable a network of more extensive shady routes throughout the city. In contrast to sun sails and other artificial shading devices, green vegetation cools its environment more efficiently and provides a higher sense of comfort through evaporation.

The tempering effect of trees can also be exploited in the case of buildings. Deciduous trees planted on the south side of houses shade them in summer, thus keeping the walls cooler, while in winter the sun's rays penetrating through the bare branches can heat them.

When planting woody vegetation, professional considerations must always be taken into account; In addition to regular maintenance work, this can guarantee a long-lasting, quality green investment (choosing city-tolerant varieties that are suitable for local climatic conditions, professional planting, choosing the right location, compatibility with public utilities, applying the Stockholm tree planting method, etc.).

With conscious planning, planting trees based on a strategy developed by professional actors – and by caring for and nurturing trees in the interest of a healthy population – the temperature of the built environment and the urban heat island effect can be effectively reduced.

Recommended professional materials:

- Protection of tree spaces and green belts along urban roads
https://archiv.budapest.hu/Documents/V%C3%A1ros%C3%A9p%C3%ADt%C3%A9si%20F%C5%91oszt%C3%A1ly/ZOLDINFRASTRUKTURA_FUZETEK_6_online%20verzio.pdf
- The relationship between urban trees and utilities
https://archiv.budapest.hu/Documents/V%C3%A1ros%C3%A9p%C3%ADt%C3%A9si%20F%C5%91oszt%C3%A1ly/ZI_FUZETEK_fak_online.pdf
- The Stockholm Method
<https://tajepiteszek.hu/blog/a-stockholm-modszer>



Saint Stephen Park, Dublin.

(Photo: [https://fr.wikipedia.org/wiki/Fichier:Park_in_Dublin_St_Stephen%27s_Green_aerial_\(21951006350\).jpg](https://fr.wikipedia.org/wiki/Fichier:Park_in_Dublin_St_Stephen%27s_Green_aerial_(21951006350).jpg))



A young row of trees developing into a shady corridor.

(Photo: <https://www.ebben.nl/en/range/trees/avenue-trees/>)

8.11.2. Green roof – extensive, intensive

Green roofs are flat roofs or slabs covered with vegetation, where the various insulating layers and plants are organically connected. Green roofs can be classified into two main groups: extensive and intensive green roofs. In the former, the planting medium is shallower, in which drought-tolerant, primarily succulent plant species are planted; in the latter, various perennials, but even smaller trees and shrubs, are planted in a thicker soil layer.

One of the great advantages of green roofs is that they insulate the roofs of buildings, thus regulating their thermal management; they heat the houses in winter and cool them in summer. Roofs without vegetation are much warmer in summer than green roofs. Thanks to the insulating capacity of green roofs, the energy demand for thermal regulation of buildings is reduced, and consequently the operating costs associated with cooling and heating the houses are also reduced.

Another benefit of green roofs is that they reduce the amount of precipitation that runs off the roof, thus alleviating extreme sewer loads during storms; they store most of the rainwater and return it to the natural cycle through evaporation, thus cooling the microclimate; they provide a habitat for many species, increasing urban biodiversity; they bind fine dust, purify the air; they protect the insulation from harmful UV radiation and winter-summer temperature fluctuations, thus increasing the lifespan of the structure.

Green roofs – with an attitude-forming and demonstration purpose – can be created on the roofs of bus stops, public pavilions, bicycle racks, garbage bins, etc.



Green roof healthcare facility in Augsburg.

(Photo: <https://una.city/nbs/augsburg/roof-garden-diakonissen-klinik/>)



Green roof school in Chicago.

(Photo: <https://engworksglobal.com/project/william-b-ogden-public-school/>)

8.11.3. Green facade

Green facades can be implemented on almost any surface; on building facades, firewalls, partition walls, etc. They play a key role in urban adaptation and local tempering in areas of settlement – e.g. inner city districts, old town areas – where alternative solutions are needed instead of traditional green surface elements due to dense construction.

Like green roofs, green facades also offer numerous advantages, including alleviating the heat load of buildings, reducing the energy demand for cooling and heating within buildings, reducing noise, improving the quality of polluted urban air, and providing ecological services. They protect the building from dominant winds, UV rays, and driving rain.

Facades can be vegetated using a variety of technological solutions. Depending on the characteristics of the buildings, you can choose from running, suspended, pocket, and modular systems.

In the case of green facades created with running or climbing plants, the plants cling directly to the wall or some kind of support structure, or they can also be grown in planting pots placed on the facade to form a hanging, green curtain. In vertical root zone systems, the root zone forms a vertically continuous surface in front of the facade, into which the plants are planted, planted from the front (felt or cassette systems). In some areas, the walls are shaded with so-called shape trees; these are aesthetic solutions, but require high maintenance: fruit trees planted next to the wall, regularly pruned, and shaped into a “two-dimensional” shape.

Recommended professional material:

- Green Facades – Technical and horticultural guide to the design and construction of vertical green spaces https://archiv.budapest.hu/Documents/V%C3%A1ros%C3%A9p%C3%ADt%C3%A9si%20F%C5%91oszt%C3%A1ly/Zoldhomlokzatok_2017.pdf



Benefits of green spaces on buildings.

(Figure: Based on the Leitfaden Fassadenbegrünung – In: https://archiv.budapest.hu/Documents/V%C3%A1ros%C3%A9p%C3%ADt%C3%A9si%20F%C5%91oszt%C3%A1ly/Zoldhomlokzatok_2017.pdf)



Building shaded with a wire running system

(Photo: https://www.archdaily.com/search/products/categories/construction-materials_facade-systems_green-facades)



Office building facade, Munich.

(Photo: <https://una.city/nbs/munich/greening-office-citizens>)

8.11.4. Green shading – facades and pergolas

One of the cost-effective ways to shade and cool spaces and buildings is to build a pergola with vegetation. They can be structurally placed separately from buildings or attached to a wall or facade; their size and design can be easily adjusted to the given surface, shape, and space. They are a cost-effective, durable, and aesthetic solution; they can be made of wood or metal.

This solution, which is very widespread in Mediterranean countries and has been used since ancient times, allows you to create green areas that provide shade relatively quickly, in an island-like manner – or even in a corridor-like manner, even in places where planting woody vegetation is not an optimal solution or is not feasible in some way.

Compared to sun sails, awnings, and modern pergolas – shaded with slats or canvas – the fundamental advantage and very important feature of traditional, plant-covered versions is that they remove heat from their environment through evaporation, thus not only reducing the air temperature, but also effectively increasing its humidity, meaning they are useful in two ways – cooling and humidifying. Artificial shading cannot do this; green shading solutions definitely provide a more pleasant feeling of warmth and comfort.



Green corridor – streets shaded by arbors, Jerez de la Frontera.
(Photo: <https://www.turismojerez.com/en/detail-tab/bodegas-tio-pepe>)



Where a tree is not suitable, a pergola lined with plants can be an alternative.
(Photo: laforetjardin.fr – In: <https://jardinierconseil.wordpress.com/2015/07/21/3-raisons-dinstaller-une-pergola-au-jardin/>)



8.11.5. "Sky-high", biodiverse green spaces

One effective antidote to the urban heat island effect is the maintenance and development of biologically active surfaces covered with vegetation. Heat can be protected not only with trees, but also with climate-adaptive lawns, which do not mean frequently mowed lawns with high maintenance costs.

The currently accepted, general lawn management method is no longer sustainable, neither in public areas nor in private gardens. Unnecessarily frequent mowing is problematic in several respects. Grass cut short dries out regularly and even for longer periods in summer (especially if it is mowed during hot days). In this state, it does not evaporate intensively, it is not suitable for tempering its environment and helping to reduce the urban heat island effect.

The soil under short grass also dries out more and compacts, thus forming a water-tight layer. Compacted soil is unable to absorb enough water, meaning that a significant portion of precipitation runs off and ends up in the canals in urban environments, instead of replenishing groundwater reserves. Urban lawns, which are mowed every few weeks, act as a kind of ecological desert, not offering a suitable habitat for various animal and plant species. Since grasses and any established wildflowers do not have the opportunity to mature seeds due to the dense mowing, they cannot reseed and thus regularly renew the area. Maintaining such areas is a costly, labor- and energy-intensive task.

Adapting to the challenges of climate change requires a new approach to green space management. The more diverse and species-rich the lawn, the more resistant it will be to environmental factors. If the lawn is left higher during green space care – wherever possible – the soil dries out less; the blades of grass retain dew and precipitation better; biodiversity increases; the tempering effect of the area is effective; the additional costs of maintenance are reduced. Hungarian cities such as Veszprém, Székesfehérvár, Budapest, Szeged, Vác, Debrecen have also moved in this direction; but there are many examples abroad.

Recommended professional materials:

- Climate-adaptive grassland management in the city
<https://www.vkszrt.hu/media/kiadvany/files/KlimaadaptivvarosigyepgazdalkodaskiadvanyVeszprem.pdf>
- Pollinator Operation 2.0 Research and Results
https://drive.google.com/file/d/1Ien3eueWN6uh6vSwry4_r-w1F4K1uaZV/view



Urban lawn area, Győr.
(Photo: Hungarian Climate Protection Association)



High grassed area in a city park, Bergamo.
(Photo: Verde sostenibile Facebook page <https://www.facebook.com/photo/?fbid=902504525013223&set=pb.100057610503112.-2207520000>)

8.11.6. Rain Garden

The excessive proportion of paved surfaces is becoming an increasingly serious problem in cities. Solid surfaces – in addition to increasing the urban heat island effect when heated – prevent

precipitation from seeping into the ground, so that the sewer system has to handle too much water; and the drained water is missing from the local water cycle; urban soil is becoming drier and more compact, and the groundwater layer is not receiving sufficient replenishment.

One quick and cost-effective solution to the problem is to create urban rain gardens. These are plant beds with a special soil structure created in a depression that act as a sponge: they absorb precipitation during sudden, heavy rains, so that the collected rainwater has time to seep into the ground, i.e. it stays in place and is utilized locally. Thanks to drainage, the load on the urban sewer system is also reduced. The diverse flora of rain gardens provides habitat for animal species, cools the environment and provides an aesthetic, fresh splash of color.

It is not negligible that their construction and maintenance require orders of magnitude fewer resources than the construction, expansion and maintenance of storm drains. They can be established almost anywhere within the city – along roads, in parks, courtyards, etc. Several domestic – e.g. Kecskemét, Budapest – and international examples can already be found.

Recommended professional material:

- Rain Garden
<https://www.esokert.hu/>



Kecskeméti lakótelep esőkertje.

(Fotó: Esőkert Facebook oldal <https://www.facebook.com/esokert>)



8.11.7. Sponge City

Suddenly falling rain in large quantities poses a problem for settlements. According to common practice, precipitation should be drained out of the inhabited area as quickly as possible. A significant portion of the rainwater from buildings and impermeable surfaces ends up in canals or surface watercourses, where it runs off and is not utilized locally. As a result, the urban environment becomes drier and no water reserves are formed, which would be useful in times of drought. However, if this water is retained in settlements as much as possible through various solutions – but above all by being stored in deeper layers of the soil – it cools the environment through evaporation and also helps the survival of vegetation.

The “sponge city” retains, slows down and utilizes rainwater by exploiting urban areas, green space systems and various technical methods, which also helps prevent the formation of flash floods. The elements of the sponge city include chains of nature-based solutions such as rain gardens, green roofs, green facades, biologically active green areas and green spaces, permeable pavements, rainwater reservoirs, drainage ditches, water reservoir lakes, water squares, mini forests, etc. Water retention reduces the negative effects of droughts and also contributes to the maintenance of quality green spaces.

Recommended professional materials:

- Water-sensitive design in urban open spaces
https://archiv.budapest.hu/Documents/V%C3%A1ros%C3%A9p%C3%ADt%C3%A9si%20F%C5%91oszt%C3%A1ly/ZOLDINFRASTRUKTURA_csapdek_10_01_online.pdf
- Water-permeable pavements
<https://archiv.budapest.hu/Documents/V%C3%A1ros%C3%A9p%C3%ADt%C3%A9si%20F%C5%91oszt%C3%A1ly/Z%C3%B6ldinfrastrukt%C3%BAra%20f%C3%BCzetek%201.%20-%20Vizatereszto%20burkolotok.pdf>
- A new approach to urban in stormwater management
<https://www.esokert.hu/uj-szemlelet-a-varosi-csapadekviz-gazdalkodasban/>



Gorton Sponge Park, Manchester.

(Photo: <https://www.manchesterclimateready.com/mcr-initiatives/gorton-climate-resilient-sponge-park/>)

8.12. Photo attachment [Fülep T.]



Photo attachment Photo 1: The surface of the Boating Lake completely covered with reeds, Hajdúböszörmény, 2024.06.20. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 2: Green island at a bus stop, Hajdúböszörmény, 20.06.2024.
(Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 3: The desolate surroundings of the Hajdúböszörmény Cheese Factory,
Hajdúböszörmény, 2024.06.20. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 4: Vapor gate on Bocskai István Square, Hajdúböszörmény, 2024.06.20.
(Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 5: Fountain on Bocskai István Square, Hajdúböszörmény, 2024.06.20.
(Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 6: Green island in the Bathing Garden, Hajdúböszörmény, 2024.06.20.
(Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 7: Garden pond on the Bath Garden nature trail,
Hajdúböszörmény, 2024.06.20. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 8: Traditional public blue pressure drinking water fountain, Baltázár Dezső Street, Hajdúböszörmény, 2024.06.20. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 9: The mill of sustainable urban transport development, Hajdúböszörmény, 2024.04.22. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 10: New bicycle path for sustainable urban transport development, Hajdúböszörmény, 2024.04.22. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 11: Sustainable transport: bicycle parking in the Kálvin Square grove, bus station, Hajdúböszörmény, 20.06.2024. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 12: Tree planting in the paving stones of the previously completely paved Vörösmarty Square, Miskolc, 2024.03.19. (Photo: Fülep Teofil VeloTeoFoto.net)



Photo attachment Photo 13: Tree planting in the paving stones of Vörösmarty Square, which was previously completely paved, Miskolc, 2024.07.28. (Photo: Fülep Teofil VeloTeoFoto.net)



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