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EVALUATION OF FLOOD PROTECTION MEASURES UNDER CLIMATE CHANGE SCENARIOS

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Abstract

Floods are estimated to be one of the most frequently occurring natural hazards in Europe, which brings significant damages and threats to human life. Different mitigating strategies are being implemented nowadays to cope with different flood events due to the unpredictability of each particular flood disaster. What is more, the frequency and magnitude of this devastating natural phenomenon is expected to increase over time, which makes it necessary to establish effective flood mitigation measures to deal with the severe hazard. This research was conducted in order to define the most effective and suitable flood mitigation facilities for the selected case study, which is the Glinščica River catchment, located within the Ljubljana municipality in Slovenia. In this study to achieve the main research objective the following grey, green and hybrid flood mitigation measures were chosen for further modelling based on the conducted literature review: sidewalks and drywells/cisterns (grey measures), urban trees and rain gardens (green measures), green roofs and stormwater tree trenches (hybrid measures). The hydrological modelling was performed in HEC-HMS software to analyze the performance of the selected flood mitigation measures and define the most feasible ones for the chosen case study. To accomplish this, synthetic rainfall events and climate change scenarios were used as precipitation data. The modelling procedure was based on the SCS Curve Number (CN) method, where the CNs for each subbasin and each particular scenario were chosen according to the SCS soil type and land use type maps. In addition, lag time parameters were also calculated for each case based on the defined CNs and characteristics of each subbasin. In this study rain gardens were found to be the most effective measure with respect to the reduction in peak discharge and outflow volume at the final point of the Glinščica River model. Both green roofs and stormwater cisterns 1 (volume~11.4 m^3) also showed relatively good results compared to the remaining measures. Depending on the scenario (1-8), the last place was occupied by permeable sidewalks and stormwater cisterns 2 (volume~5.7 m^3). The detailed modelling procedure and final outcomes of the research are presented throughout this study.

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Izvleček:

Ocenjuje se, da so poplave ena najpogostejših naravnih nesreč v Evropi, ki povzroča znatno škodo in ogroža človeška življenja. Dandanes se zaradi nepredvidljivosti vsake posamezne poplave izvajajo različne strategije za zmanjšanje tveganja, da bi se spopadli z različnimi poplavnimi dogodki. Poleg tega se pričakuje, da se bosta pogostost in intenzivnost tpoplav povečala, zaradi česar je treba vzpostaviti učinkovite ukrepe za zmanjšanje poplavne škode. Raziskava je bila izvedena z namenom, da bi opredelili najučinkovitejše in najprimernejše ukrepe za ublažitev poplav za izbrano študijo primera, to je povodje reke Glinščice, ki se nahaja v občini Ljubljana v Sloveniji. V tej nalogi smo za dosego glavnega raziskovalnega cilja uporabili modeliranje na podlagi izvedenega pregleda literature izbranih sivih, zelenih in hibridnih ukrepov za ublažitev poplav. Upoštevali smo naslednje ukrepe: porozni pločniki in zadrževalniki vode/cisterne (sivi ukrepi), urbana drevesa in dežni vrtovi (zeleni ukrepi), zelene strehe in jarki za meteorne vode (hibridni ukrepi). Hidrološko modeliranje je bilo izvedeno v programski opremi HEC-HMS, da bi analizirali uspešnost izbranih ukrepov za zmanjšanje poplav in opredelili najbolj učinkovite ukrepe za izbrano študijo primera. Da bi to dosegli, smo kot vhodne podatke o padavinah uporabili sintetične dogodke padavin in scenarije podnebnih sprememb. Postopek modeliranja je temeljil na metodi SCS Curve Number (CN), pri kateri so bili CN parametri za vsak primer in vsak posamezen scenarij izbrani glede na karte vrste tal in vrste rabe zemljišč. Poleg tega so bili za vsak primer izračunani tudi parametri časovnega zamika na podlagi opredeljenega CN parametra in značilnosti vsakega podporečja. V tej študiji je bilo ugotovljeno, da so dežni vrtovi najbolj učinkovit ukrep glede zmanjšanja odtoka (konica in volumen) na sotočju Glinščice in Gradaščice. Tako zelene strehe kot cisterne za meteorne vode (prostornina~11.4 m^3) so pokazale tudi razmeroma dobre rezultate v primerjavi s preostalimi ukrepi. Glede na scenarije (1-8) so zadnje mesto zasedli drenažni pločniki in meteorne cisterne (prostornina~5.7 m^3). Podroben postopek modeliranja in končni rezultati raziskave so predstavljeni v celotni nalogi.

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ABBREVIATIONS AND SYMBOLS

EEA - European Environment Agency
ASDSO - Association of State Dam Safety Officials
FEMA - Federal Emergency Management Agency
NRC - National Research Council
PUD - Public Utilities Board
US EPA - United States Environmental Protection Agency
DWA - German Association for Water Wastewater and Waste
CNT - Center for Neighborhood Technology
CN – curve number
GR – green roof

1. INTRODUCTION

One of the most highly controversial issues facing the globe today is climate change. Frequency and magnitude of natural phenomena caused as a result of climate change are expected to increase each time, causing the population to suffer more and more from the terrible consequences that these events usually bring (Liu et al., 2019). In particular, climate variations can be one of the main contributors to changes in precipitation patterns in different parts of the world leading even to higher rainfall intensities and, consequently, more devastating floods (Trenberth, 2011). Today many scientists and professionals in water-related disciplines from all over the globe try to make an effort to combat the issue of increasing flood risks. At the same time, urbanization can also further exacerbate the situation (Feng et al., 2021). Thus, higher probability of occurrence of this natural hazard makes it necessary to undertake different actions aimed at reducing its upcoming risks (Gandini et al., 2020). To be able to adapt to highly variable weather conditions in combination with other occurring burdens, for example, as it was previously mentioned, urbanization, various grey, green, and combined hybrid flood reduction measures can be implemented today (Hartmann et al., 2019; Kabisch et al., 2017; Kryžanowski et al., 2014).

Recently the frequency of floods is following an upward trend causing enormous damages not only in Europe, but also globally (Kundzewicz et al., 2010). Flood risk is also projected to increase mainly as a result of climate change (Trenberth, 2011). Furthermore, climate change is expected to cause particularly more fluvial floods around European countries, which makes it necessary to establish an effective flood risk management system to properly deal with this natural hazard. Different mitigating strategies and techniques are being considered today for different flood events due to the unpredictability and unique nature of each particular flood disaster. Encroachment of people into floodplains makes the question of human protection against floods even more relevant as a result of the increased vulnerability (Kundzewicz et al., 2010).

Therefore, as flood is considered to be the most frequently occurring natural disaster in Europe (Kundzewicz et al., 2010) with significant annual damages and threats to human life, it is important to find the most effective and practical solutions to mitigate the adverse effects coming from this devastating natural phenomenon. In this case, green, grey and combined solutions can be seen as a feasible solution to reduce the risks coming from floods and, as a result, provide a sustainable disaster management system in case of such emergencies (Pamungkas and Purwitaningsih, 2019).

Even though in general multiple research works were conducted focusing on the investigation of the effectiveness of different grey, green, and blue measures and their co-benefits in terms of reducing impacts coming from floods (Kryžanowski et al., 2014; Pudar et al., 2020), still sufficient research in this field with reference to different climate change scenarios is lacking. Following this, in this work the Glinščica River catchment located in Slovenia will be taken to analyze the influence of selected measures on flood risk, particularly, with respect to different climate change scenarios. Furthermore, considering the fact that different catchments usually have varied hydrological conditions, it is often quite difficult to comprehend what kind of measures can be suitable for a particular investigated area. Thus, it is necessary to conduct additional research that aims to define a number of engineering and nature-based solutions for flood mitigation based on the specific characteristics that the Glinščica River possesses. With more comprehensive and detailed research it would be possible to analyze the impact of the suggested infrastructure (i.e., selected green, grey and hybrid measures) on the flood risk in Ljubljana city considering different climate change scenarios allowing eventually the most suitable measures for this area to be highlighted. In addition, despite the worldwide implementation of grey infrastructure and their wide public approval, nature-based solutions are still on their way to getting general acceptance. Thus, due to limited trust in purely nature-based solutions, grey measures still remain the most prevailing solution in many areas around the globe (Anderson et al., 2022).

Additionally, many research works focus mainly on one major measure aimed at reducing the impact of floods (e.g., Johnen et al., 2020); however, additional studies on the effectiveness of multiple measures and their combinations are needed to find a better and more optimal solution to the problem. Therefore, it is believed that with this study it would be possible to provide comprehensive additional research on the investigation of the effectiveness and usefulness of various grey and green solutions, and their combinations (i.e., hybrid solutions) to manage flood risks in the future in the Glinščica River catchment with respect to different climate change scenarios.

1.1. Research objectives and hypothesis

A working research hypothesis that will be used within this thesis can be stated as: "Even though both green and grey solutions can significantly mitigate flood risk, it is believed that a combination of both nature-based and grey flood (i.e., hybrid solutions) mitigation measures can provide more substantial results in terms of reducing the adverse impact of floods".

Following this, the main objective of this research work is to evaluate the performance of various flood risk mitigation measures based on their characteristics, such as feasibility, cost-effectiveness, contribution to climate change, and other aspects with respect to synthetic rainfall events and different climate change scenarios in the Glinščica River catchment.

To accomplish this research goal five flood mitigation measures for each category (i.e., grey, green, and hybrid) are going to be selected and analysed. Subsequently, based on the result obtained from the literature review on the selected infrastructure, in each category the selected flood mitigation measures will be compared with each other following the suggested evaluation criteria and, as a result, in each category two the most suitable and effective measures for the selected case study will be proposed. Curve numbers (CNs) and corresponding lag time parameters, necessary for HEC-HMS modelling, will be calculated based on the land use types and catchment characteristics. Following this, the HEC-HMS modelling procedure will be first performed using synthetic rainfall events, which were derived in the previous studies. While in the first part of this work synthetic precipitation events are going to be used to analyze the performance of the selected six flood mitigation measures, in the second part climate change scenarios and their influence on the effectiveness of the measures is going to be examined with the same modelling software. Finally, results of both cases (modelling with synthetic rainfall events and climate change scenarios) will be analysed and discussed in the "Results and discussion" section.

Research questions that will be investigated in the scope of this work are:

- What impact do green, grey and hybrid measures exert on flood risk?
- How does performance of the selected green, grey and hybrid measures vary based on the different climate change scenarios?
- What are the most effective measures for mitigating flood risk in the Glinščica River catchment?

2. DATA AND METHODS

2.1. Case study

The Glinščica River catchment is taken as a case study to analyze the effectiveness of implementation of the grey, green and hybrid measures for the flood risk mitigation based on the synthetic rainfall event and different climate change scenarios. The area of the catchment is comparatively small and estimated to be around 16.9 km^2 (Bezak et al., 2021). The catchment can be categorized by a temperate continental climate with a mean precipitation of around 1,500 mm per year (Johnen et al., 2020). The catchment itself is located within the Ljubljana municipality border with the Glinščica River later being discharged into the Gradaščica River at the downstream part (Bezak et al., 2018b). While upper parts of the catchment are mainly characterized by natural areas, in particular, most of this area is occupied by forest, lower lands are more intended for urbanized and agricultural regions. The former takes around 50 percent of the total area of the catchment, while the latter ones account for nearly 20 percent (Bezak et al., 2021). The river basin has relatively steep slopes ranging between around 210 and 590 m above sea level, which, in turn, accelerates the water flow (Bezak et al., 2021). Table 1 summarizes the main characteristics of the Glinščica River catchment.

Table 1. Glinščica River catchment characteristics.

Case study	Area	Annual precipitation	Land cover	Climate	Elevation difference	Time of concentration
Glinščica River catchment	16.9 km^2	~1,500 mm	Forest: 50% (upstream) Urbanized area and agriculture: 20% (mostly downstream)	Temperate continental	210 and 590 m above sea level	6 hours

One part of the urbanized region of Ljubljana belongs to the catchment, which makes this area relatively densely populated compared to other regions in Slovenia (Johnen et al., 2020). As a result of a continuous expansion of the city leading to an increasing area of impervious surfaces throughout the significant part of the urbanized area, the hydrological conditions of the Glinščica River have changed. Heavy thunderstorms in summer and continuous precipitation in both spring and autumn in combination with the changing hydrological characteristics of the river as a result of uncontrolled urbanization and climate change make this area frequently subjected to flood events. Location of the Ljubljana municipality and of the Glinščica River catchment within the municipality is presented in Figure 1.

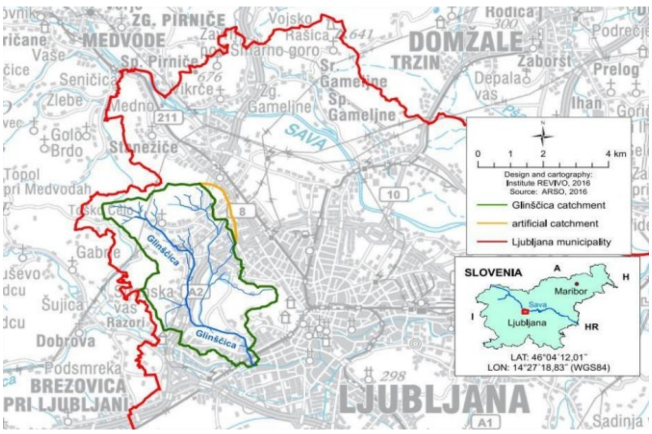

Figure 1. Location of the Glinščica River catchment within Ljubljana municipality border (Pagano et al., 2019).

2.2. Selection and evaluation of measures

In this work literature review on grey, green and hybrid flood protection measures was first conducted. Aspects as feasibility, cost-effectiveness, flexibility, maintenance procedure, impact on and mitigation of climate change were considered during the review of the selected measures. In addition, short summary and case study are presented for each particular measure.

However, before going deep into details about each measure, first it is important to mention how these measures were distributed among these three different categories. Thus, with respect to grey measures, traditional and more or less conventional flood mitigation infrastructure was chosen. Compared to other flood risk reduction techniques, grey measures visually represent rigid infrastructure usually made of hardly degradable materials, such as concrete or steel, and are known to have prevailing "grey" visual effect. Furthermore, this kind of measures usually provide restricted or almost no ecosystem services. Green measures, on the other hand, tend to have prevailing ecosystem functions compared to other flood risk reduction categories and are mainly made of degradable materials. Even though certain technical equipment is usually needed during the implementation stage to build green flood protection measures, subsequently after the set-up procedure these measures tend to have only "green" visual effect. With regard to hybrid measures, flood mitigation solutions that include functions of both grey and green measures were selected. It should be also mentioned that in this case hybrid measures refer mostly to those solutions that visually look greener and provide more ecosystem services (compared to grey measures); however, they still contain elements of grey infrastructure that help the system to properly perform its functions.

Following this, Table 2 and 3 present a list of the selected grey, green and hybrid measures and description of the parameters that were investigated during the literature review for each particular measure, respectively. Detailed literature review of each measure is presented at the end of this work in the "Appendix A" section.

Table 2. Selected measures for grey, green and hybrid flood mitigation measures.

Category	Selected measures
Grey	Dams, floodwalls, underground stormwater detention tanks, permeable concrete pavements, infiltration shafts/drywells.
Green	Afforestation, river re-meandering and floodplain restoration, rain gardens, urban parks and urban forests, infiltration ponds/basins.
Hybrid	Retention (wet) reservoirs, detention (dry) reservoirs/basins, green roofs, stormwater tree trenches, permeable vegetated surfaces.

Table 3. List of parameters analysed during literature review and their explanation.

Descriptor	Explanation
Short summary	Short explanation/description of the selected grey, green or hybrid measure.
Feasibility	How difficult it is to implement the measure in terms of design, implementation procedure, etc. In addition, durability (lifetime) of the measure can be also considered in this section.
Cost-effectiveness	How effective is the measure in terms of flood mitigation and other aspects (if applicable) based on the amount of investments (e.g., construction costs).
Flexibility	Influence of the selected measure on the risk of any other hazard, such as landslides, erosion, sedimentation, groundwater contamination, etc. (if applicable).
Maintenance	Maintenance activities (efforts) needed to keep the structure in the desirable conditions. In addition, maintenance costs can be also considered in this section.
Impact on climate change	Influence of the selected measure on climate change. Here, depending on the selected measure, mitigation or, in contrast, negative impact on climate change can be considered.
Case study example	Description of a case study where the selected measure was implemented or where its implementation was tested.

When the literature review on the selected flood mitigation measures was conducted (see "Appendix A" section), evaluation of the selected measures was further performed. Here, based on the conducted literature review, such aspects as feasibility, cost-effectiveness, flexibility, etc. (Table 5, 6 and 7) of each particular measure were assessed. By comparing all measures among each other relative to the evaluation criteria, the most suitable measures for the flood risk management in the Glinščica River catchment were highlighted in each category (Table 5, 6 and 7). As it was mentioned at the beginning of this research work, the most effective and suitable flood mitigation measures for the selected case study are then going to be modelled in the HEC-HMS software in order to further evaluate their performance characteristics in terms of peak discharge and outflow volume reduction in the Glinščica River catchment. However, it is also important to take into consideration that not all measures, that were defined in this research, can be easily modelled in the HEC-HMS software. In addition, some of these measures, such as afforestation, flood mitigation reservoirs and permeable concrete pavements, were already modelled in the previous studies (Bezak et al., 2021; Johnen et al., 2020). Thus, these factors were also considered while selecting measures for further modelling. At the same time, it should be also noted that the selection process of the flood mitigation measures can be relatively subjective since along with the information obtained from the literature review it also involves subjective opinion of a person, who performs the selection.

Table 4. Ranking categories.

Level of suitability of a measure for flood risk management in the Glinščica River catchment	Color indicator	Numeric indicator
Highly suited		3
Suited		2
Partially suited		1
Not suited/no effect		0

Table 5. Grey measures ranking (most suitable and effective measures are presented in bold text).

	Dams	**Floodwalls**	**Underground stormwater detention tanks**	Permeable concrete pavements	**Infiltration shafts/drywells**
Feasibility	1	**2**	**2**	1	**2**
Cost-effectiveness	1	**3**	**2**	2	**2**
Flexibility	1	**0**	**0**	0	**0**
Maintenance	1	**2**	**2**	1	**2**
Impact on climate change	0	**0**	**0**	0	**0**
Score	4	**7**	**6**	4	**6**

Table 6. Green measures ranking (most suitable and effective measures are presented in bold text).

	Afforestation	River re-meandering and floodplain restoration	**Rain gardens**	**Urban parks and urban forests**	Infiltration pond/basin
Feasibility	**2**	1	**3**	**2**	2
Cost-effectiveness	**3**	2	**3**	**3**	2
Flexibility	**3**	2	**2**	**3**	2
Maintenance	**2**	1	**3**	**2**	2
Impact on climate change	**3**	2	**1**	**3**	0
Score	**13**	8	**12**	**13**	8

Table 7. Hybrid measures ranking (most suitable and effective measures are presented in bold text).

	Retention reservoirs (wet reservoirs)	Detention reservoirs (dry reservoirs)	**Green roofs**	**Stormwater tree trenches**	Permeable vegetated surfaces
Feasibility	1	1	**2**	**2**	2
Cost-effectiveness	3	2	**3**	**2**	2
Flexibility	1	1	**2**	**2**	2
Maintenance	1	2	**1**	**2**	2
Impact on climate change	0	0	**3**	**3**	1
Score	6	6	**14**	**14**	11

2.3. Synthetic rainfall events

In the first part of this study synthetic rainfall events (design rainfall events) of the 2-, 10- and 25-years return periods were used in order to analyze the effectiveness of the selected flood mitigation measures in terms of discharge and outflow volume reduction in the final section of the Glinščica River when it flows into the Gradaščica River. The design precipitation events are known as hypothetical rainfall events of a specific duration and frequency, which can be utilized to perform analysis of a flood risk mitigation infrastructure. These rainfall events were derived with the help of Huff curves and intensity-duration-frequency (IDF) curves in the previous works on the same case study (Bezak et al., 2018a; Dolšak et al., 2016), which is the Glinščica River catchment, and were taken for further analysis in this work. Huff curves, in turn, were initially developed by Huff in 1967 and represent a method of expressing dimensionless rainfall depth-duration curves of a specific precipitation station or area (Bezak et al., 2018a). These curves can help to generate input precipitation (synthetic/design rainfall events) for a hydrological model, as it was done in the previous studies on the Glinščica River catchment. Huff curves were developed by Dolšak (2015) for 30 different rainfall stations in Slovenia based on the available historical precipitation data, one of which, Ljubljana-Bežigrad, is very close to the investigated Glinščica River catchment. For this station Dolšak (2015) developed dimensionless hyetographs for 4 different time periods: 3-6, 6-12, 12-24 and >24 hours. In this study synthetic rainfall events developed by Dolšak et al. (2016) of the 6-hours duration were taken, as the concentration time of the Glinščica River catchment corresponds to 6 hours. Figure 2 presents 6-hours synthetic rainfall events for the 2-, 10- and 25-years return periods.

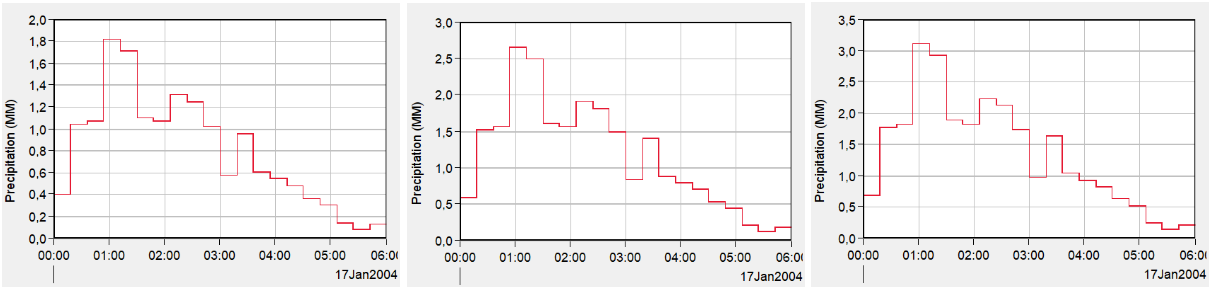

Figure 2. Synthetic rainfall events of 6 hours with the return periods of 2-, 10- and 25-years for the Ljubljana-Bežigrad meteorological station.

2.4. Climate change scenarios

In addition to the synthetic rainfall events that were described in the previous section, as a second part of this work precipitation data of different climate change scenarios was used and processed in R programming software for further analysis. As an input high-resolution CORDEX regional climate model (RCM) simulations for the European domain (EURO-CORDEX) were implemented. Regional climate model (RCM) simulations are necessary to describe climate variations relative to the local level with the help of downscaling (Bertalanič et al., 2018). In this case bias-corrected and downscaled to 1 km^2 spatial resolution, three EURO-CORDEX future climate change projections (RCP2.6, RCP4.5, RCP8.5) by the year 2100 for Slovenia were incorporated into R software to extract local precipitation data for further analysis of the flood mitigation measures in the selected Glinščica River catchment. RCP scenarios, in turn, are known as representative concentration pathways, which refer to the predicted future concentrations of greenhouse gases in the surrounding environment. Radiative forcing value (2.6, 4.5, 8.5) expressed in W per m^2 is used to identify each scenario. RCP2.6 is considered as the most optimistic scenario and assumes low concentration of greenhouse gases emissions. RCP4.5 is known as moderately optimistic scenario, while RCP8.5 as the most extreme (pessimistic) one with the rise in emissions up to 2100 and even after (Bertalanič et al., 2019).

Table 8 represents a list of the global climate models (GCM), regional climate models (RCM) and their climate change simulations. An example of a code that was used to extract precipitation data from the climate change simulation files is presented in the "Appendix E" section. The files are in "nc" format and contain precipitation data within the 1981-2100 time period.

Table 8. RCP2.6, RCP4.5, RCP8.5 future climate change projections of the regional and global climate models (RCM and GCM, respectively) (Bertalanič et al., 2018).

GCM	RCM	RCP2.6	RCP4.5	RCP8.5
CNRM-CM5-LR	CCLM4-8-17		+	+
MPI-ESM-LR	CCLM4-8-17		+	+
EC-EARTH	HIRHAM5	+	+	+
IPSL-CM5A-MR	WRF331F		+	+
HadGEM2-ES	RACMO22E	+	+	+
MPI-ESM-LR	RCA4		+	+

As presented in Table 8, in total there were 14 different files of 6 different climate models, 2 of which correspond to RCP2.6, 6 to RCP4.5 and 6 to RCP8.5 (Table 8). The code presented in the "Appendix E" section was incorporated into R in order to extract precipitation data (for the Glinščica River catchment) for each year between 1981 and 2100 for the first regional climate model of RCP2.6. This procedure was also repeated for the other 13 combinations of climate change projections and models shown in Table 8.

While in the previous part synthetic rainfall events were used to analyze performance of the selected flood mitigation measures, in this case it was necessary to derive new precipitation patterns for each climate change scenario that would help to perform analysis of the same measures. This was done with the help of antecedent conditions (in order to consider the wetness of the catchment as well), where antecedent 3-day rainfall was considered before maximum precipitation event in each year between 1981 and 2100. After running the code in R, the following data was extracted: daily (mm/day), monthly (mm/month), yearly (mm/year) precipitation between 1981 and 2100, maximum precipitation event (mm/day) in each year between 1981 and 2100 and sum of antecedent 3-day rainfall (mm/3 days) before maximum precipitation event in each year between 1981 and 2100 for all RCP scenarios. The last two, maximum precipitation event in each year and sum of three consecutive daily rainfall events before maximum, were then taken for further analysis of flood mitigation measures with respect to antecedent conditions. Following this, the precipitation value representing antecedent 3-day rainfall event (mm/3 days) was divided by 3 to get precipitation per each of the three days (mm/day), which occurred before extreme-magnitude rainfall event. As a result, four values were obtained for each year: precipitation per each day during three days before maximum event and precipitation during the fourth day, which represents the maximum amount of daily precipitation that occurred in a year. As a next step, the median of the precipitation results of all models was found for each of the four precipitation days (3-days antecedent rainfall and maximum precipitation event) and for every year. The simulation period was between 1981 and 2100; however, this period was later divided into three time periods: 1981-2020, 2021-2060 and 2061-2100. The first one represents the historical time period, while the other two future time periods (i.e., near- and far-future). This division was done in order to further analyse the performance results of the selected flood mitigation measures with respect to different climate change scenarios and time periods. As a final step, the median of all the values for each of the four days was calculated in order to get one precipitation event per day (consisting of four numbers) in each time period (past, near-future, far-future). In total, there were nine precipitation events (consisting of four numbers) for the three time periods (past, near-future, far-future) and three climate change scenarios (RCP2.6, RCP4.5, RCP8.5). Median of all values for historical time-series (1981-2020) of RCP2.6 is presented below as an example in Table 9. In this case one precipitation event consisting of four days was defined. Here, during the first three days the median precipitation value was found to be around 7.08 mm/day and during the last day it was nearly 61.26 mm/day, which indicates the maximum rainfall. All other calculations of the remaining climate change scenarios and time periods are shown in the “Appendix F” section.

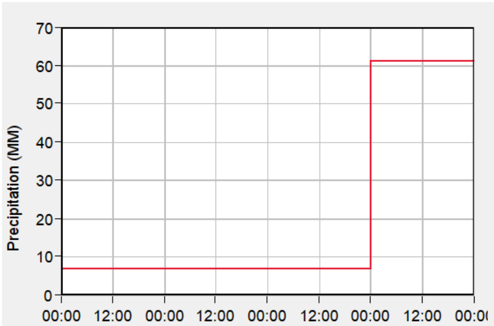

Figure 3. 4-days precipitation event for the 1981-2020 past time period (RCP2.6).

Table 9. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 1981-2020 past time period of RCP2.6.

PAST: 1981-2020												
RCP2.6	PRECIPITATION DAY 1			PRECIPITATION DAY 2			PRECIPITATION DAY 3			PRECIPITATION DAY 4 MAX		
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Median [mm/day]
1981	5.3	6.5	**5.9**	5.3	6.5	**5.9**	5.3	6.5	**5.9**	73.1	52.7	**62.9**
1982	22.5	4.4	**13.4**	22.5	4.4	**13.4**	22.5	4.4	**13.4**	57.1	59.1	**58.1**
1983	0.0	4.4	**2.2**	0.0	4.4	**2.2**	0.0	4.4	**2.2**	52.4	48.2	**50.3**
1984	20.8	0.3	**10.5**	20.8	0.3	**10.5**	20.8	0.3	**10.5**	87.3	81.1	**84.2**
1985	0.6	0.4	**0.5**	0.6	0.4	**0.5**	0.6	0.4	**0.5**	81.8	61.4	**71.6**
1986	1.1	4.0	**2.6**	1.1	4.0	**2.6**	1.1	4.0	**2.6**	62.0	48.6	**55.3**
1987	22.0	5.7	**13.9**	22.0	5.7	**13.9**	22.0	5.7	**13.9**	60.0	58.7	**59.4**
1988	6.4	3.3	**4.9**	6.4	3.3	**4.9**	6.4	3.3	**4.9**	74.0	72.0	**73.0**
1989	0.0	0.1	**0.1**	0.0	0.1	**0.1**	0.0	0.1	**0.1**	81.1	55.6	**68.4**
1990	0.3	9.1	**4.7**	0.3	9.1	**4.7**	0.3	9.1	**4.7**	73.7	86.7	**80.2**
1991	16.4	14.3	**15.3**	16.4	14.3	**15.3**	16.4	14.3	**15.3**	57.2	93.7	**75.5**
1992	14.4	22.6	**18.5**	14.4	22.6	**18.5**	14.4	22.6	**18.5**	53.9	60.0	**57.0**
1993	1.2	27.7	**14.4**	1.2	27.7	**14.4**	1.2	27.7	**14.4**	49.3	63.1	**56.2**
1994	0.1	1.7	**0.9**	0.1	1.7	**0.9**	0.1	1.7	**0.9**	43.3	73.7	**58.5**
1995	19.0	6.7	**12.9**	19.0	6.7	**12.9**	19.0	6.7	**12.9**	52.4	65.1	**58.7**
1996	14.1	1.3	**7.7**	14.1	1.3	**7.7**	14.1	1.3	**7.7**	51.5	59.6	**55.5**
1997	8.7	2.1	**5.4**	8.7	2.1	**5.4**	8.7	2.1	**5.4**	58.1	45.0	**51.6**
1998	1.4	0.2	**0.8**	1.4	0.2	**0.8**	1.4	0.2	**0.8**	80.6	66.6	**73.6**
1999	1.7	5.6	**3.6**	1.7	5.6	**3.6**	1.7	5.6	**3.6**	71.4	66.5	**69.0**
2000	2.1	0.1	**1.1**	2.1	0.1	**1.1**	2.1	0.1	**1.1**	70.4	60.5	**65.5**
2001	13.7	25.3	**19.5**	13.7	25.3	**19.5**	13.7	25.3	**19.5**	61.0	61.6	**61.3**
2002	2.9	2.7	**2.8**	2.9	2.7	**2.8**	2.9	2.7	**2.8**	66.9	67.3	**67.1**
2003	0.2	0.1	**0.2**	0.2	0.1	**0.2**	0.2	0.1	**0.2**	80.8	56.8	**68.8**
2004	5.9	15.8	**10.9**	5.9	15.8	**10.9**	5.9	15.8	**10.9**	85.8	60.0	**72.9**
2005	13.7	0.3	**7.0**	13.7	0.3	**7.0**	13.7	0.3	**7.0**	47.5	65.7	**56.6**
2006	10.0	4.3	**7.2**	10.0	4.3	**7.2**	10.0	4.3	**7.2**	50.0	59.8	**54.9**
2007	13.5	10.9	**12.2**	13.5	10.9	**12.2**	13.5	10.9	**12.2**	54.4	45.6	**50.0**
2008	3.7	0.0	**1.9**	3.7	0.0	**1.9**	3.7	0.0	**1.9**	51.4	70.9	**61.2**
2009	0.1	0.6	**0.4**	0.1	0.6	**0.4**	0.1	0.6	**0.4**	73.8	69.6	**71.7**
2010	15.4	17.0	**16.2**	15.4	17.0	**16.2**	15.4	17.0	**16.2**	52.7	60.6	**56.7**
2011	6.6	0.2	**3.4**	6.6	0.2	**3.4**	6.6	0.2	**3.4**	61.2	53.7	**57.4**
2012	0.5	16.0	**8.2**	0.5	16.0	**8.2**	0.5	16.0	**8.2**	58.8	117.9	**88.4**
2013	7.0	8.8	**7.9**	7.0	8.8	**7.9**	7.0	8.8	**7.9**	47.5	54.6	**51.0**
2014	6.1	9.9	**8.0**	6.1	9.9	**8.0**	6.1	9.9	**8.0**	66.7	53.9	**60.3**
2015	8.1	9.1	**8.6**	8.1	9.1	**8.6**	8.1	9.1	**8.6**	78.4	47.2	**62.8**
2016	0.1	7.1	**3.6**	0.1	7.1	**3.6**	0.1	7.1	**3.6**	83.7	58.3	**71.0**
2017	15.1	19.0	**17.1**	15.1	19.0	**17.1**	15.1	19.0	**17.1**	74.0	65.4	**69.7**
2018	11.7	5.3	**8.5**	11.7	5.3	**8.5**	11.7	5.3	**8.5**	52.0	50.9	**51.4**
2019	8.4	1.9	**5.1**	8.4	1.9	**5.1**	8.4	1.9	**5.1**	52.7	65.5	**59.1**
2020	15.9	1.6	**8.8**	15.9	1.6	**8.8**	15.9	1.6	**8.8**	78.9	52.8	**65.8**
	MEDIAN		**7.1**	**MEDIAN**		**7.1**	**MEDIAN**		**7.1**	**MEDIAN**		**61.2**

Table 10 presents precipitation amounts [mm/day] during each of the four days for each investigated climate change scenario and time period.

Table 10. 4-days precipitation event for each time period (past, near-future, far-future) and climate change scenario (RCP2.6, RCP4.5, RCP 8.5).

	Precipitation [mm/day] DAY 1	Precipitation [mm/day] DAY 2	Precipitation [mm/day] DAY 3	Maximum precipitation [mm/day] DAY 4
RCP2.6				
Past: 1981-2020	7.1	7.1	7.1	61.2
Near-future: 2021-2060	5.1	5.1	5.1	63.3
Far-future: 2061-2100	5.8	5.8	5.8	62.8
RCP4.5				
Past: 1981-2020	4.7	4.7	4.7	61.1
Near-future: 2021-2060	7.6	7.6	7.6	67.9
Far-future: 2061-2100	5.5	5.5	5.5	67.8
RCP8.5				
Past: 1981-2020	6	6	6	61
Near-future: 2021-2060	5.3	5.3	5.3	69.8
Far-future: 2061-2100	6	6	6	78.2

2.5. Hydrological modelling

2.5.1. Description of the model

In this part the modelling procedure is going to be described. Following the data preparation stage hydrological modelling was performed using HEC-HMS modelling software. Previously selected measures were incorporated into the model to perform hydrological modelling and consequently analyze performance of each selected measure in terms of peak discharge and outflow volume reduction during floods. As the HEC-HMS model was already set-up in previous studies for the same study area (Bezak et al., 2021, 2018b; Johnen et al., 2020), in this case the same model was used and adjusted according to the current study. As it was already previously mentioned, in this work the modelling procedure of the selected measures is divided into two parts. The first one is related to the implementation of the previously derived synthetic rainfall events, whereas the second part focuses on the climate change scenarios. For the synthetic precipitation events the time step (control) used during modelling procedure was 5 min, while for the climate change scenario this value corresponded to 1 h. Both cases aim to analyse the performance of the flood mitigation measures and their effectiveness with respect to the flood risk mitigation in the selected case study. Prior to modelling, it was necessary to find average curve numbers (CNs) and lag times parameters for each of the investigated cases relying on the catchment characteristics and conditions that each flood mitigation measure and subbasin possess. The detailed procedure of how these CNs and lag time parameters were found is described below. For both cases (synthetic rainfall events and climate change scenarios) the CNs, lag time parameters, selected measures and scenarios were the same. The only difference between the two modelling parts of this work was the input precipitation data.

In addition, with respect to model reliability it should be also mentioned that urban drainage network was also taken into consideration in this case during the catchment delineation process in the previous study of Dirnbek (2009). The position of the watershed within the urban area was determined by the drainage of stormwater with the sewage system, so the orographic watershed divide does not always coincide with the contributing area of Glinščica. The total contributing area of Glinščica is slightly larger and covers an area of 19.3 km^2, because runoff from the area between Gunclje, the railway and the orographic watershed divide between the Glinščica and Sava basins, as well as part of the urban areas along the estuary of Glinščica is channeled to the area of the Glinščica catchment via the sewage storm network (Dirnbek, 2009). As for model calibration and validation, this was already previously done in the same study of Dirnbek (2009) based on the measured discharge data in the catchment. However, it should be noted that comparison of different flood protection measures was done taking into consideration theoretically derived CN and lag time parameters.

With regard to the modelling procedure, for the model simplicity the whole catchment was divided into the three subbasins. Figure 4 presents land use types of the Glinščica River catchment and its subdivisions into sub-catchments.

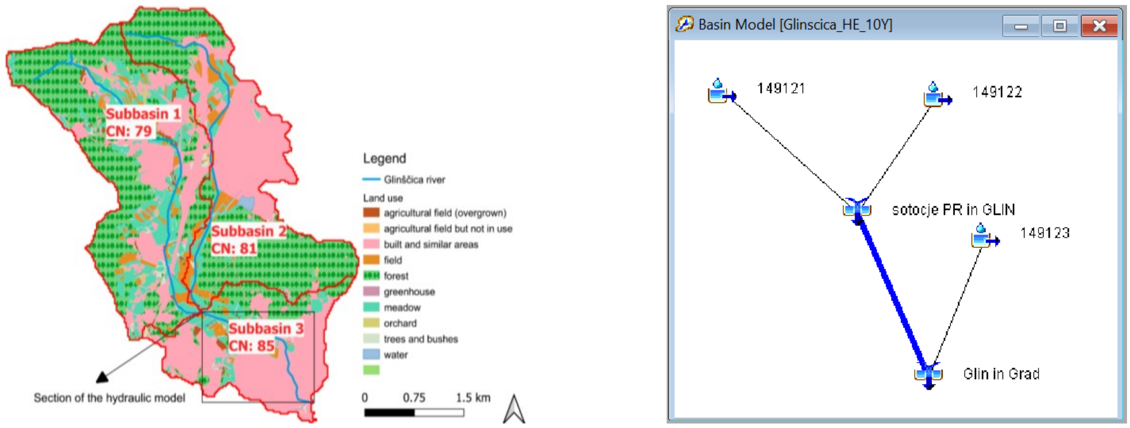

Figure 4. Subdivisions of the catchment and its model in the HEC-HMS (Bezak et al., 2021).

The HEC-HMS modelling software provides simulation results of various hydrological processes by using different conventional hydrological techniques. In this particular study the SCS Curve Number (CN) method was used as a rainfall loss method, where the CNs were chosen based on the SCS soil type and land use type maps. As a transform method (effective rainfall into runoff) the SCS Unit Hydrograph method was implemented, where the lag time for each particular case was found based on the characteristics of each subbasin.

2.5.2. Description of the modelling procedure

With respect to the selection procedure of the measures, from each category (i.e., grey, green and hybrid) two of the most effective flood mitigation measures were chosen to be further modelled in HEC-HMS software. In total, from all three categories there were six different measures that were selected for further analysis: sidewalks and drywells (grey measures), urban trees and rain gardens (green measures), green roofs and stormwater tree trenches (hybrid measures). In this section the modelling procedure is explained with the example of green roofs.

1) As a first step, all land use types of the three subbasins were defined in the QGIS software with the help of the provided shapefiles (Figure 5).

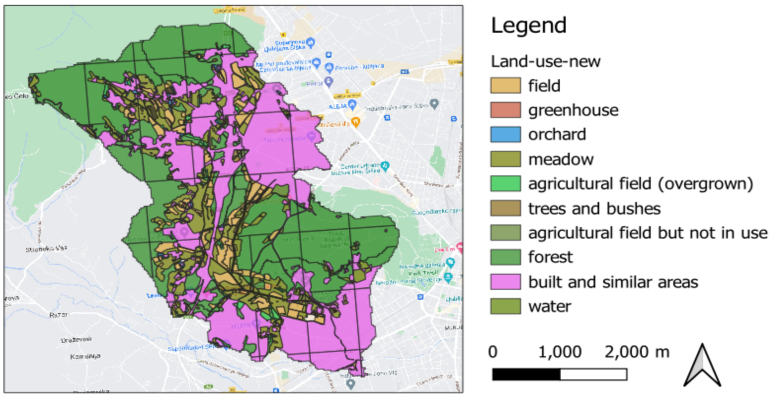

Figure 5. Land use types of the Glinščica River catchment.

2) As a next step it was necessary to define an area of interest inside the “built and similar areas” in order to find a fraction of roof cover relative to the defined area of interest (Figure 6).

Figure 6. Area of interest inside the “built and similar areas”.

3) When the area of interest was defined, potential green roof cover was delineated based on the available roof cover (Figure 7).

Figure 7. Potential green roof cover (represented with green color) in the area of interest.

4) Following this, the ratio between potential green roof cover and defined area of interest was found to be 30 percent. This was necessary to find the approximate area of the green roofs in each subbasin. Table 11 shows the area of the defined polygon (area of interest), area of the roof cover, calculated percentage of the roof cover in the defined area of interest and curve number (CN) of the new land use type. The

CN of the green roof cover itself was obtained with the help of the green values calculator (CNT, 2020a), which calculates the CNs based on the defined area and land use types.

Table 11. Fraction of the roof cover and curve number (CN).

Area of interest (obtained from QGIS), [m2]	235,879
Roof cover (obtained from QGIS), [m2]	69,730
Fraction of roof cover relative to the area of interest, [%]	~30
Curve number (CN) of green roof cover (CNT, 2020a)	80

5) As a next step, it was necessary to come up with possible scenarios for the green roofs. As presented in Table 12, in total, 4 different scenarios were established for further modelling in HEC-HMS. Scenario 1 implies implementation of the green roofs in all three subbasins, whereas scenarios 2, 3, and 4 refer to the implementation of the green roofs just in subbasin 1, 2 and 3, respectively. Knowing that the green roofs correspond to 30 percent of the total built area in each subbasin, the following scenarios shown in Table 12 were finally established.

Table 12. Scenarios for the green roofs.

SCENARIOS	
Scenario 1	30% of "built and similar areas" in all three subbasins are green roofs
Scenario 2	30% of "built and similar areas" in subbasin 1 are green roofs
Scenario 3	30% of "built and similar areas" in subbasin 2 are green roofs
Scenario 4	30% of "built and similar areas" in subbasin 3 are green roofs

6) Following this, the next step was to calculate thr average CN of each subbasin for the initial state (before implementation of the green roofs) and for the case when the green roofs are introduced. By knowing the percentage of the green roofs relative to the total built area, area of each land use type and their corresponding CNs, the following average CNs for each subbasin were obtained (Table 13, 14 and 15).

Table 13. Initial average CN without green roofs (left table) and average CN with green roofs (right side) for subbasin 1 (units of total area: m^2).

INITIAL STATE: SUBBASIN 1			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1812024	built and similar areas
7000	99	12212	water
	79	**7075600**	

SCENARIO 1,2,3,4: SUBBASIN 1			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1268417	built and similar areas
3000	80	543607	green roofs
7000	99	12212	water
	78	**7075600**	

Table 14. Initial average CN without green roofs (left table) and average CN with green roofs (right side) for subbasin 2 (units of total area: m^2).

INITIAL STATE: SUBBASIN 2			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	350268	field
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1987520	built and similar areas
7000	99	49065	water
	81	**5883998**	

SCENARIO 1,2,3,4: SUBBASIN 2			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	350268	field
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1391264	built and similar areas
3000	80	596256	green roof
7000	99	49065	water
	80	**5883998**	

Table 15. Initial average CN without green roofs (left table) and average CN with green roofs (right side) for subbasin 3 (units of total area: m^2).

INITIAL STATE: SUBBASIN 3			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	168599	field
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	2148513	built and similar areas
7000	99	11054	water
	85	**3587207**	

SCENARIO 1,2,3,4: SUBBASIN 3			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	168599	field
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	1503959	built and similar areas
3000	80	644554	green roof
7000	99	11054	water
	83	**3587207**	

7) With respect to the lag time, for each specific scenario and subbasin the following formula was used (Krest Engineers, 2021):

$$Tp = L^{0.8} * \frac{(Sr+25.4)^{0.7}}{28.14*\sqrt{Y}}, \quad (1)$$

where, Tp – lag time [h], L – hydraulic length of the basin [km], Sr – maximum retention [mm] and Y – slope of the basin [%].

The maximum retention, in turn, was calculated in the following way (Krest Engineers, 2021):

$$Sr = \frac{25400-254*\mathrm{CN}}{\mathrm{CN}} \quad (2)$$

Table 16 summarizes the CNs (green roofs, scenario 1) and constant parameters (hydraulic length L, average slope Y) of each subbasin (149121, 149122, 149123), which were used to calculate the maximum retention Sr and lag time Tr.

Table 16. Different parameters used to calculate lag time Tr for each specific scenario and subbasin.

Subbasin	**Hydraulic length *L* [km]**	**Average slope *Y* [%]**	**CN (green roofs - scenario 1)**	**Maximum retention *Sr* [mm]**	**Lag time *Tr* [min]**
149121	5.751	13.100	78	71.64	58.733
149122	5.510	10.685	80	63.50	59.103
149123	2.479	6.8230	83	52.02	35.443

The following Table 17 represents the calculated lag times and CN parameters for each particular subbasin depending on the previously estimated scenarios. Here, fields highlighted with white color indicate the initial state when the green roofs are not taken into consideration, whereas yellow colored fields show the state with green roofs.

Table 17. Curve number (CN) and lag time for each scenario and subbasin (green roofs).

	Subbasin 1	Subbasin 2	Subbasin 3
CN: scenario 1	78	80	83
CN: scenario 2	78	81	85
CN: scenario 3	79	80	85
CN: scenario 4	79	81	83

	Subbasin 1	Subbasin 2	Subbasin 3
Lag time [min]: scenario 1	58.73	59.10	35.44
Lag time [min]: scenario 2	58.73	57.27	33.10
Lag time [min]: scenario 3	56.98	59.10	33.10
Lag time [min]: scenario 4	56.98	57.27	35.44

The above-mentioned CN parameters and lag times were then substituted into the model for each scenario and investigated return period (2-year, 10-year and 25-year return periods) to obtain results of the hydrological modelling first using the synthetic rainfall events and then implementing the climate change scenarios. Note that the same modelling procedure was also performed for the other five selected measures. The initial CNs of each flood mitigation measure, as in the case with the green roofs (CN 80), were obtained using the stormwater management calculator (CNT, 2020a). The additional tables and figures related to the modelling procedure are included in the "Appendix B" section of this work.

Table 18 presents a summary of the proposed scenarios for the selected flood mitigation measures. Here, with respect to the urban tree cover, potential areas of the new trees were manually defined in each subbasin in QGIS. Based on the defined regions, it was found that around 14, 14 and 6 percent of the "built and similar areas" can be substituted by the urban trees in subbasin 1, 2 and 3, respectively. Following this, similar to the green roofs, proportion of the rain gardens in the defined area of interest was found. In addition, scenarios 5, 6, 7 and 8 of the same flood mitigation measure also consider potential runoff from the roofs that can be hypothetically captured by the rain gardens. In this case, it was proposed that in addition to the area of the rain gardens itself, which corresponds to 15 percent of the "built and similar areas", 50 percent of the roof runoff is going to be directed to the rain gardens for further infiltration. This was, in turn, calculated based on the roof area, which was previously found for the green roofs. Thus, additionally to the area of the rain gardens (15 percent of the built areas), 50 percent of the roof area was also considered as an area of the rain gardens during the calculation procedure of the average CNs of each subbasin. With regard to the permeable sidewalks, in the previously defined area of interest (as it was shown for the green roofs) an approximate area of the sidewalks was calculated by taking the average width of the sidewalk as 1.5 m and calculating the distance of each sidewalk on both sides of the road in the defined area of interest in QGIS. As a result, it was found that the sidewalks correspond to nearly 6 percent of the total area of the defined polygon, which was then used when calculating the average CN for each subbasin. With respect to the tree trenches, similar scenarios were established as for the rain gardens and permeable sidewalks with the last four scenarios considering additional 50 percent runoff from the roads. Thus, 50 percent of the area of roads was considered in a similar way as with the rain gardens. In the case of this flood mitigation measure, it was decided to place tree trenches on both sides of the road with an interval of 3 m. Knowing the length of each road in the area of interest, a potential number of tree trenches was found in the defined polygon. According to the CNT (2020a), the area of a single tree trench is around 16 ft^2 (~1.5 m^2). When the area of one tree trench and the total number of tree trenches in the defined area of interest were known, the total area and subsequently the fraction of the tree trenches in the defined area of interest could be calculated. Knowing the fraction of tree trenches relative to the defined area of interest, proportion of tree trenches in each subbasin (within built areas) was later found. Regarding the infiltration shafts/drywells, the same stormwater management calculator (CNT, 2020a) was used to define the initial CN of the measure, as it was done in the case with green roofs and other selected flood mitigation facilities. In this case, it was not possible to calculate the fraction of the measure relative to the total built area with the help of its surface area, since drywells are usually located under the ground. Thus, it was necessary to find another solution, which would be similar to those that were accomplished with the other measures and, which would not affect the final results of the study. In fact, the stormwater management calculator (CNT, 2020a) offers an option to its users, which allows to define initial characteristics of any subbasin and, as a result, obtaining the average CN of the defined subbasin. In addition, with the same tool it is also possible to implement one of the available flood mitigation measures (drywells in this case) and then find the average CN of the same subbasin after implementation of the selected measure. However, the tool did not indicate any change in the average CN of the defined subbasins, which was later found to be due to the small volume of the drywells. To solve this issue, it was decided to change the drywells to cisterns, which perform more or less the same function, but with the larger volumes. In this case two types of cisterns were selected for further analysis: 3000- (~11.4 m^3) and 1500-gallons (~5.7 m^3) cisterns.

Table 18. Summary of the proposed scenarios for the selected flood mitigation measures.

MEASURE: GREEN ROOFS	
Scenario 1	30% of "built and similar areas" in all three subbasins are green roofs
Scenario 2	30% of "built and similar areas" in subbasin 1 are green roofs
Scenario 3	30% of "built and similar areas" in subbasin 2 are green roofs
Scenario 4	30% of "built and similar areas" in subbasin 3 are green roofs
MEASURE: URBAN TREE COVER	
Scenario 1	14, 14, 6% of "built and similar areas" in subbasin 1, 2, 3, respectively, is new urban tree cover
Scenario 2	14% of "built and similar areas" in subbasin 1 is new urban tree cover
Scenario 3	14% of "built and similar areas" in subbasin 2 is new urban tree cover
Scenario 4	6% of "built and similar areas" in subbasin 3 is new urban tree cover
MEASURE: RAIN GARDENS	
Scenario 1	15% of "built and similar areas" in all three subbasins are rain gardens
Scenario 2	15% of "built and similar areas" in subbasin 1 are rain gardens
Scenario 3	15% of "built and similar areas" in subbasin 2 are rain gardens
Scenario 4	15% of "built and similar areas" in subbasin 3 are rain gardens
Scenario 5	15% of rain gardens + 50% of runoff from roofs in all three subbasins
Scenario 6	15% of rain gardens + 50% of runoff from roofs in subbasin 1
Scenario 7	15% of rain gardens + 50% of runoff from roofs in subbasin 2
Scenario 8	15% of rain gardens + 50% of runoff from roofs in subbasin 3
MEASURE: PERMEABLE SIDEWALKS	
Scenario 1	6% of "built and similar areas" in all three subbasins are permeable sidewalks
Scenario 2	6% of "built and similar areas" in subbasin 1 are permeable sidewalks
Scenario 3	6% of "built and similar areas" in subbasin 2 are permeable sidewalks
Scenario 4	6% of "built and similar areas" in subbasin 3 are permeable sidewalks
Scenario 5	6% of permeable sidewalks + 50% of runoff from roofs in all three subbasins
Scenario 6	6% of permeable sidewalks + 50% of runoff from roofs in subbasin 1
Scenario 7	6% of permeable sidewalks + 50% of runoff from roofs in subbasin 2
Scenario 8	6% of permeable sidewalks + 50% of runoff from roofs in subbasin 3
MEASURE: TREE TRENCHES	
Scenario 1	2% of "built and similar areas" in all three subbasins are tree trenches
Scenario 2	2% of "built and similar areas" in subbasin 1 are tree trenches
Scenario 3	2% of "built and similar areas" in subbasin 2 are tree trenches
Scenario 4	2% of "built and similar areas" in subbasin 3 are tree trenches
Scenario 5	2% of tree trenches + 50% of runoff from roads in all three subbasins
Scenario 6	2% of tree trenches + 50% of runoff from roads in subbasin 1
Scenario 7	2% of tree trenches + 50% of runoff from roads in subbasin 2
Scenario 8	2% of tree trenches + 50% of runoff from roads in subbasin 3
MEASURE: CISTERNS 1	
Scenario 1	1 cistern per each house in all three subbasins (in total 6560 cisterns; volume of 1 cistern~11.4 m^3)
Scenario 2	1 cistern per each house in subbasin 1 (in total 2200 cisterns; volume of 1 cistern ~ 11.4 m^3)
Scenario 3	1 cistern per each house in subbasin 2 (in total 2000 cisterns; volume of 1 cistern ~ 11.4 m^3)
Scenario 4	1 cistern per each house in subbasin 3 (in total 2360 cisterns; volume of 1 cistern ~ 11.4 m^3)
MEASURE: CISTERNS 2	
Scenario 1	1 cistern per each house in all three subbasins (in total 6560 cisterns; volume of 1 cistern~5.7 m^3)
Scenario 2	1 cistern per each house in subbasin 1 (in total 2200 cisterns; volume of 1 cistern~5.7 m^3)
Scenario 3	1 cistern per each house in subbasin 2 (in total 2000 cisterns; volume of 1 cistern~5.7 m^3)
Scenario 4	1 cistern per each house in subbasin 3 (in total 2360 cisterns; volume of 1 cistern~5.7 m^3)

3. RESULTS AND DISCUSSION

In this section results of the hydrological modelling using synthetic rainfall events and climate change scenarios are presented. The results were generated with the help of HEC-HMS software for each of the selected measures. Additional tables and figures, which are not presented in this part, are included in the "Appendix C" and "Appendix G" sections.

3.1. Results of the hydrological modelling using synthetic rainfall events

In the first part of this study synthetic rainfall events were used in order to analyse the performance of the selected flood mitigation measures in terms of flood risk reduction in the Glinščica River catchment with respect to three return periods (2-, 10- and 25-years). As can be observed from Tables 20, 21 and 22, the results of the hydrological modelling are expressed in terms of the percentage difference between two different states of the model: before and after applying one of the selected flood mitigation measures. To have a clearer understanding of the percentage difference, which is used to express the obtained results, green roofs are taken as an example in this section. Table 19 shows results for outflow volume and peak discharge of different hydrologic elements of the model developed for the green roofs (2-year return period, scenario 1). Here, as a first step, the model was set up for the case without green roofs to get results for the initial condition, when the measure is not applied. Following this, as a second step, the modelling procedure was computed considering application of the green roofs. In this case, as already mentioned in the "Data and methods" section, CNs and lag time parameters were changed to observe the effectiveness of the applied flood mitigation measure in terms of peak discharge and outflow volume reduction.

Table 19. Results of the hydrological modelling using synthetic rainfall events for the 2-year return period scenario 1 (before and after applying the green roofs).

2-YEAR RETURN PERIOD: GREEN ROOFS					
	Hydrologic element	**Drainage area [m^2]**	**Peak discharge [m^3/s]**	**Time of peak**	**Outflow volume [mm]**
BEFORE applying green roofs	sotocje PR in GLIN	13.19	13.7	17jan.2004. 04:05	12.55
	Glin in Grad	16.85	17.7	17jan.2004. 04:15	13.77
	Reach-1	13.19	13.2	17jan.2004. 04:35	12.55
	149121	7.20	7.00	17jan.2004. 04:05	11.66
	149122	5.99	6.70	17jan.2004. 04:00	13.61
	149123	3.66	6.10	17jan.2004. 03:10	18.17
AFTER applying green roofs	sotocje PR in GLIN	13.19	12.7	17jan.2004. 04:10	11.60
	Glin in Grad	16.85	16.2	17jan.2004. 04:20	12.51
	Reach-1	13.19	12.3	17jan.2004. 04:40	11.60
	149121	7.20	6.50	17jan.2004. 04:10	10.77
	149122	5.99	6.20	17jan.2004. 04:05	12.61
	149123	3.66	5.20	17jan.2004. 03:15	15.77

The following Table 20 shows the percentage difference between the results of the two conditions, which were presented in Table 19. In addition, results for the 10- and 25-years return periods of the same measure are also included in Table 20. Here, for the 2-year return period the percentage difference (before and after applying the green roofs) in peak discharge is ranging between 6.8 and 14.8 percent depending on the hydrologic element of the model. It can be also observed that with the increase in the return period the percentage difference for both volume and peak discharge is decreasing, which indicates the higher effectiveness of the flood mitigation measure with the lower return period events.

Table 20. Results of the hydrological modelling using synthetic rainfall events for the 2-, 10- and 25-years return periods expressed in terms of the percentage difference (scenario 1).

GREEN ROOFS SCENARIO 1						
DIFFERENCE % (before and after applying green roofs)	**2-year return period**		**10-year return period**		**25-year return period**	
	Peak discharge %	**Volume %**	**Peak discharge %**	**Volume %**	**Peak discharge %**	**Volume %**
sotocje PR in GLIN	7.3	7.6	5.9	5.3	5.2	4.6
Glin in Grad	8.5	9.2	5.8	6.4	5.3	5.6
Reach-1	6.8	7.6	5.4	5.3	4.9	4.6
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	14.8	13.2	9.6	9.6	8.8	8.4

The following Tables 21 and 22 present summary of the results for scenarios 1-4 and 5-8, respectively. In this case, the hydrologic element "Glin in Grad" (outflow) of the model, which represents the confluence of the Glinščica River and the Gradaščica River, was considered. All subsequent results that are going to be presented in this section will be focused specifically on this element of the model as it represents the final point of the Glinščica River model. As can be observed from Tables 21 and 22, to be able to compare the performance of the selected flood mitigation measures with each other with respect to each particular scenario, the results for each measure are distributed separately among previously established scenarios.

In general, rain gardens showed the best results among all flood mitigation measures with respect to peak discharge and outflow volume reduction in almost all scenarios. Considering scenarios 1-4 (Table 21) and all investigated flood mitigation measures, the highest difference between the results (before and after applying the measures) was achieved in scenario 1. In this case the scenario assumes that the flood mitigation measures are implemented in all three subbasins of the Glinščica River catchment, which certainly increases the effectiveness of the measures in terms of flood risk mitigation. Here, the highest reduction in both parameters (peak discharge and volume) was achieved by rain gardens for the 2-year return period, which corresponds to 13 and 15 percent, respectively. These results were then followed by the green roofs and stormwater cisterns 1 (volume ~ 11.4 m^3), which also showed higher flood risk mitigation capabilities compared to the remaining measures. In the same scenario the lowest results among all measures were obtained for the 25-year return period by permeable sidewalks and cisterns 2 (volume ~ 5.7 m^3), where the latter ones occupied the last position among all measures with respect to the capability of the measure to reduce flood peak discharge and volume.

While in scenario 1 rain gardens clearly showed their advantage over other flood mitigation facilities, in scenario 2 green roofs, rain gardens, new urban tree cover and cisterns 1 indicated the same results. However, compared to scenario 1, in scenario 2 the difference between the results (before and after applying the measures) became relatively smaller, since in this case the measures were implemented just in subbasin 1. What is more, in this scenario permeable sidewalks, stormwater cisterns 2 and tree trenches did not exert any influence on flood risk mitigation and again were the most lagging flood risk mitigation facilities as in the previous scenario. In scenarios 3 and 4 rain gardens once more occupied the leading position in terms of flood risk reduction in the selected case study compared to other measures. While in scenario 3 the highest difference by the same measure was achieved for peak discharge, in scenario 4, in contrast, the same was true in case of volume (for all investigated return periods). Here, in scenarios 3 and 4 (rain gardens) the percentage difference for peak discharge was ranging between 4.0-5.6 and 2.5-4.0 percent, respectively. With regard to the reduction in volume by the same measure, the range was between 3.2-5.0 and 4.2-7.2 percent, respectively. Regarding the performance of the remaining flood mitigation facilities, in scenario 3 all other measures showed the same results except cisterns 2, for which no difference was observed as in the previous case (scenario 2). In scenario 4 permeable sidewalks, tree trenches, urban tree cover and cisterns 2 were also the least effective measures among all other alternatives, where the former ones did not indicate any difference for the second time.

Table 21. Results of the hydrological modelling using synthetic rainfall events for scenarios 1-4 (hydrologic element: "Glin in Grad" - outflow).

SYNTHETIC RAINFALL EVENTS: SCENARIOS 1-4						
DIFFERENCE %	**2-year return period**		**10-year return period**		**25-year return period**	
	Peak discharge %	**Volume %**	**Peak discharge %**	**Volume %**	**Peak discharge %**	**Volume %**
SCENARIO 1: MEASURE IS IMPLEMENTED IN ALL SUBBASINS						
Green roofs	8.5	9.2	5.8	6.4	5.3	5.6
Tree trenches	4	4.5	2.8	3.1	2.5	2.7
Rain gardens	13	15	9.4	10.6	8.2	9.2
Permeable sidewalks	2.8	2.6	2.2	1.8	1.9	1.6
Urban tree cover	7.3	7.3	5.2	5.2	4.8	4.5
Cisterns 1	8.5	9.2	5.8	6.4	5.3	5.6
Cisterns 2	1.1	2	0.6	1.3	0.6	1.1
SCENARIO 2: MEASURE IS IMPLEMENTED IN SUBBASIN 1						
Green roofs	3.4	2.8	2.5	2	2.3	1.8
Tree trenches	0	0	0	0	0	0
Rain gardens	3.4	2.8	2.5	2	2.3	1.8
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	3.4	2.8	2.5	2	2.3	1.8
Cisterns 1	3.4	2.8	2.5	2	2.3	1.8
Cisterns 2	0	0	0	0	0	0
SCENARIO 3: MEASURE IS IMPLEMENTED IN SUBBASIN 2						
Green roofs	2.8	2.6	2.2	1.8	1.9	1.6
Tree trenches	2.8	2.6	2.2	1.8	1.9	1.6
Rain gardens	5.6	5	4.1	3.6	4	3.2
Permeable sidewalks	2.8	2.6	2.2	1.8	1.9	1.6
Urban tree cover	2.8	2.6	2.2	1.8	1.9	1.6
Cisterns 1	2.8	2.6	2.2	1.8	1.9	1.6
Cisterns 2	0	0	0	0	0	0
SCENARIO 4: MEASURE IS IMPLEMENTED IN SUBBASIN 3						
Green roofs	2.3	3.8	1.4	2.5	1.1	2.2
Tree trenches	1.1	2	0.6	1.3	0.6	1.1
Rain gardens	4	7.2	2.8	4.9	2.5	4.2
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	2	0.6	1.3	0.6	1.1
Cisterns 1	2.3	3.8	1.4	2.5	1.1	2.2
Cisterns 2	1.1	2	0.6	1.3	0.6	1.1

The following scenarios 5-8 (Table 22) were established just for the three measures considering additional potential 50 percent runoff from the roofs (rain gardens and permeable sidewalks) or roads (tree trenches), which could hypothetically be directed to the infiltration area of these flood mitigation facilities. This additional runoff was calculated based on the surface area of the roofs and roads, which was defined in QGIS. To be more precise, depending on the measure (tree trenches, rain gardens and permeable sidewalks) 50 percent of the roof or road area was added to the area of this measure during the calculation procedure of the average CNs of each subbasin (see "Data and methods" section).

As can be observed from Table 22, in scenarios 5-8 rain gardens again took the leading position with respect to its alternatives. While rain gardens showed the highest effectiveness in reduction of both parameters (peak discharge and volume), permeable sidewalks, in contract, were found to be the least effective option among three investigated measures in all four scenarios (Table 22). In scenario 5, where the selected flood mitigation measures are introduced in all three subbasins as in the case with scenario 1 (Table 21), the highest percentage difference was observed. Comparing scenarios 1 and 5, it can be seen that in scenario 5 the effectiveness of the tree trenches and permeable sidewalks increased around five times, whereas for rain gardens it became more than two times higher than in scenario 1. For instance, while in scenario 1 in case of rain gardens the percentage difference for both peak discharge and volume for the 2-year return period was 13 and 15 percent, in scenario 5 it became 29.9 and 32.6 percent, respectively.

Coming to scenarios 5-8, the next scenario, which indicated the most effective performance of the selected measures, was scenario 7. Even though in this case performance of the measures became around two times less than in scenario 5, in general all measures showed favorable results compared to the results of these flood mitigation facilities in the remaining scenarios.

Table 22. Results of the hydrological modelling using synthetic rainfall events for scenarios 5-8 (hydrologic element: "Glin in Grad" - outflow).

SYNTHETIC RAINFALL EVENTS: SCENARIOS 5-8						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
SCENARIO 5: MEASURE IS IMPLEMENTED IN ALL SUBBASINS						
Tree trenches	22	23.7	16.3	17.1	14.7	15
Rain gardens	29.9	32.6	22.3	23.8	20	20.9
Permeable sidewalks	11.3	11.6	8	8.2	7.1	7.2
SCENARIO 6: MEASURE IS IMPLEMENTED IN SUBBASIN 1						
Tree trenches	6.8	5.4	5	4.1	4.2	3.6
Rain gardens	9.6	7.9	7.4	6	6.7	5.3
Permeable sidewalks	3.4	2.8	2.5	2	2.3	1.8
SCENARIO 7: MEASURE IS IMPLEMENTED IN SUBBASIN 2						
Tree trenches	11.3	9.5	8.5	7	7.8	6.2
Rain gardens	14.1	11.6	10.5	8.6	9.7	7.6
Permeable sidewalks	5.6	5	4.1	3.6	4	3.2
SCENARIO 8: MEASURE IS IMPLEMENTED IN SUBBASIN 3						
Tree trenches	5.1	8.8	3.6	6	3.2	5.2
Rain gardens	8.5	13	5.8	9.2	4.8	8
Permeable sidewalks	2.3	3.8	1.4	2.5	1.1	2.2

The following Figures 8, 9 and 10 represent variation of discharge at the outflow section of the model ("Glin in Grad") for the 2-, 10- and 25-years return periods (scenario 1), respectively. These graphs were generated using the synthetic rainfall events and can be used to visually observe reduction in peak discharge after implementation of a particular flood mitigation measure. It can be seen from the graphs that the initial condition (before implementation of the measures) indicated with the black color has the highest peak discharge, whereas the lowest peak discharge was achieved by rain gardens in all three cases. Here, as presented in Figures 8, 9 and 10 almost no reduction in discharge was observed in case of cisterns 2, which was already indicated in Table 21 (scenario 1). Note that while in Tables 21 and 22 the results are expressed in terms of percentage difference, the graphs, in contrast, present computed discharge values in m^3 per s. Here, we will not go further deep into details, since the performance of all measures in terms of peak discharge reduction was already presented in Tables 21 and 22.

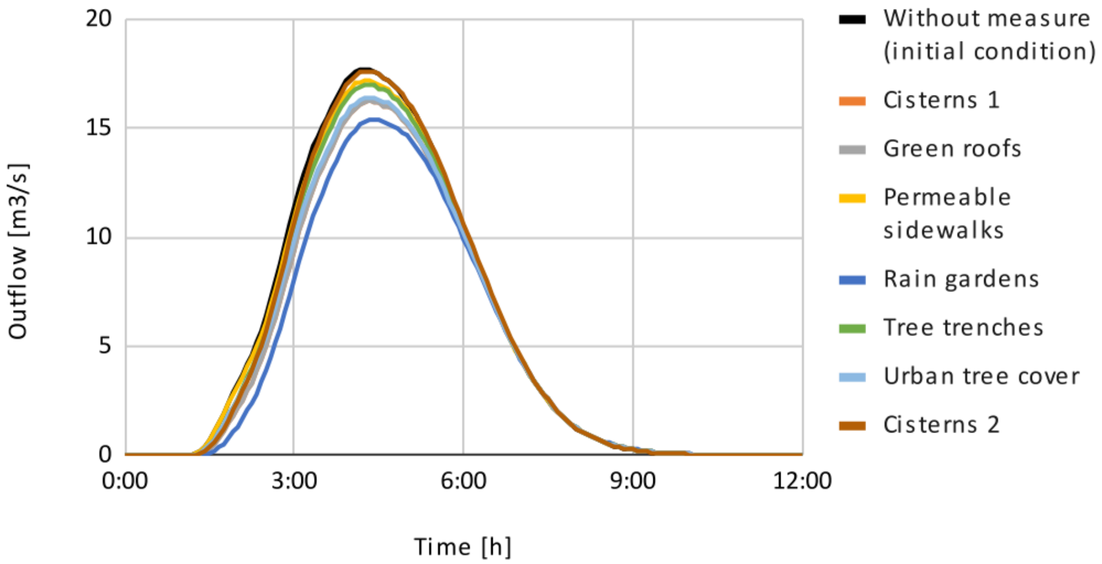

Figure 8. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 1).

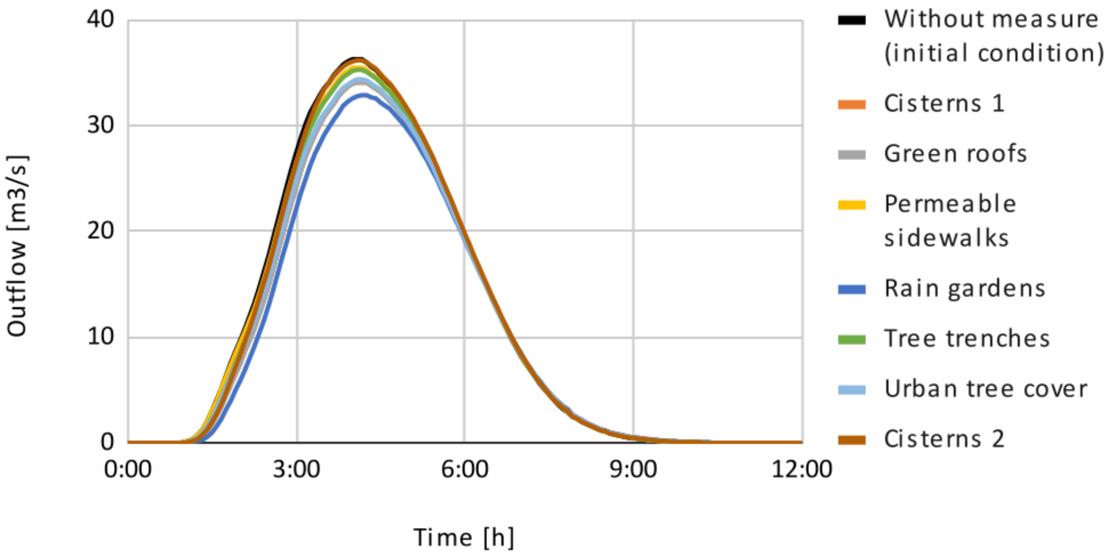

Figure 9. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 1).

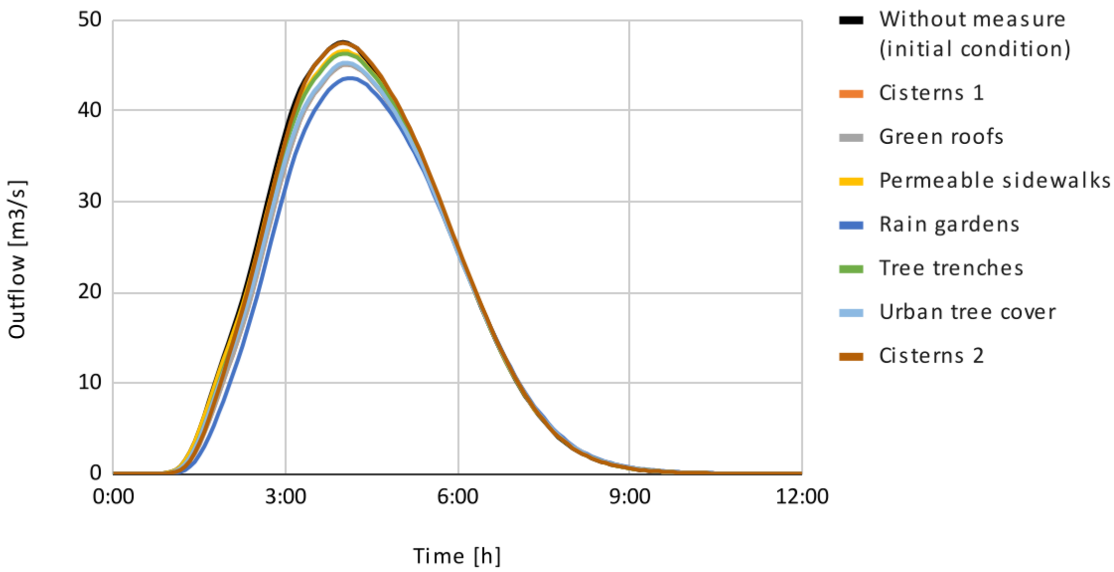

Figure 10. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 1).

3.2. Results of the hydrological modelling using climate change scenarios

As a second part of this research work, climate change scenarios (RCP2.6, RCP4.5 and RCP8.5) were used to get results for the hydrological modelling. As described in the “Data and methods” section of this study, regional climate projections (RCP) were incorporated into R programming software to generate mean precipitation results. To be more precise, the maximum precipitation event in each year and the sum of three antecedent daily precipitation values before the maximum event in each year were obtained. Subsequently, the average of the three consecutive rainfall values before maximum was found to eventually get 4-days precipitation event per each year, consisting of 3-days antecedent rainfall and maximum precipitation event during the fourth day. Following this, the whole time period was divided into the following categories: past (1981-2020), near-future (2021-2060) and far-future (2061-2100). After taking the median first of the results of all regional climate models (for each of the four days) in each year and then of the obtained median precipitation values per each day of the four days and in each year, one 4-days precipitation event per each time period (past, near-future, far-future) and climate change scenario (RCP2.6, RCP4.5, RCP8.5) was found. In total, there were nine precipitation events for the three time periods and three RCP scenarios.

Table 23 summarizes results of the hydrological modelling obtained for scenario 1 for the three investigated time periods (past, near-future, far-future) and climate change scenarios (RCP2.6, RCP4.5, RCP8.5). Compared to the results using synthetic rainfall events (Tables 21 and 22), the first thing that can be noticed from Table 23 is that the percentage difference between numbers became smaller when simulated climate change scenarios were implemented. For example, while for green roofs in scenario 1 (Table 21) the decrease in peak discharge was 8.5 percent, in case of RCP2.6 (Table 23) this value became 3.2 percent. For RCP4.5 and RCP8.5 the same parameter corresponds to 3.4 and 3.3 percent, respectively. However, the main objective of this work is not to compare synthetic precipitation events with climate change scenarios, so in this section the results of the hydrological modelling using climate change scenarios are not going to be compared with the results from the previous part. The main idea of this research is to separately analyze the performance of the selected flood mitigation facilities based on the design rainfall events (synthetic rainfall events) and climate change scenarios to eventually define the most favourable measures for the investigated case study, which is the Glinščica River catchment.

In general, for scenario 1 the difference between the results of the three RCP scenarios is not significant and varies within 0.1-0.9 percent for the same measures (Table 23). In each climate change scenario the most effective results were achieved by rain gardens. With regard to the highest percentage difference in each particular climate change scenario, for RCP2.6 the highest decrease in peak discharge compared to the initial condition was achieved by the rain gardens in the past time period, while the major decrease in volume was within the 2021-2060 time period (near-future). For both RCP4.5 and RCP8.5 the highest percentage difference in both parameters was observed in the past time period by the same flood mitigation measure. For RCP4.5 the reduction for peak discharge and volume was 5.6 and 10 percent, while for RCP8.5 it was 5.5 and 9.5 percent, respectively. Note that since some of the obtained results are quite randomly distributed between different categories (e.g., past, near-future, far-future or RCP2.6, RCP4.5, RCP8.5) and it is rather difficult to perceive the results and see the main patterns, for the simplicity and better visual perception of the results the maximum percentage difference in both peak discharge and volume in each particular climate change scenario was highlighted in light yellow color. The reason for this random distribution of the results could be due to median precipitation values, which were calculated prior to modelling. Here, as it was already previously mentioned, to find one precipitation value per each of the four days in each year, median of the precipitation values of all regional climate models (RCM) in each particular RCP scenario was found for each year between 1981-2020, 2021-2060 and 2061-2100. Following this, to obtain one precipitation event (consisting of 3-days antecedent rainfall and maximum precipitation event during the fourth day) for each time period (past, near-future, far-future) and climate change scenario (RCP2.6, RCP4.5, RCP 8.5), median of the previously obtained median precipitation results in each year (for each of the four days) was calculated. This could potentially have an effect on the final results; however, at that stage this was the only option to deal with the huge amount of precipitation data.

Table 23. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5, RCP 8.5) for scenario 1 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 1: MEASURE IS IMPLEMENTED IN ALL SUBBASINS						
DIFFERENCE %	**Past: 1981-2020**		**Near-future: 2021-2060**		**Far-future: 2061-2100**	
	Peak discharge %	**Volume %**	**Peak discharge %**	**Volume %**	**Peak discharge %**	**Volume %**
RCP2.6						
Green roofs	3.2	5.6	3.2	5.8	3.2	5.7
Tree trenches	2.2	2.7	2.1	2.8	2.1	2.8
Rain gardens	5.4	9.1	5.3	9.5	5.3	9.4
Permeable sidewalks	1.1	1.6	1.1	1.7	1.1	1.6
Urban tree cover	3.2	4.5	3.2	4.7	3.2	4.6
Cisterns 1	3.2	5.6	3.2	5.8	3.2	5.7
Cisterns 2	1.1	1.1	1.1	1.2	1.1	1.1
RCP4.5						
Green roofs	3.4	6	2.8	5.1	2.9	5.4
Tree trenches	1.1	2.9	0.9	2.5	1	2.6
Rain gardens	5.6	10	4.7	8.4	4.9	9
Permeable sidewalks	1.1	1.7	0.9	1.5	1	1.6
Urban tree cover	2.2	4.9	1.9	4.1	1.9	4.4
Cisterns 1	3.4	6	2.8	5.1	2.9	5.4
Cisterns 2	1.1	1.2	0.9	1	0	1.1
RCP8.5						
Green roofs	3.3	5.8	2.8	5.4	2.4	4.9
Tree trenches	2.2	2.8	1.9	2.6	0.8	2.3
Rain gardens	5.5	9.5	4.7	8.8	4	8
Permeable sidewalks	1.1	1.7	0.9	1.5	0.8	1.4
Urban tree cover	3.3	4.7	2.8	4.3	1.6	3.9
Cisterns 1	3.3	5.8	2.8	5.4	2.4	4.9
Cisterns 2	1.1	1.1	0.9	1	0	0.9

The following Figures 11, 12 and 13 present graphs for the peak discharge for RCP2.6, RCP4.5 and RCP8.5 (1981-2020 time period, scenario 1), respectively. Here, with respect to the scenario without any measure (initial condition), the highest peak discharge was observed for RCP2.6, where the maximum detected outflow was found to be 9.2 m^3 per s. For the other two climate change scenarios, the maximum peak discharge at the outflow section of the Glinščica River differed from the result of RCP2.6 by a relatively small amount. For RCP4.5 and RCP8.5 (without measure, initial condition) this value accounted for 8.8 and 9.1 m^3 per s, respectively. To have a better understanding of the reduced amount of the outflow discharge (as in this section, except for the graphs, all results are presented in terms of the percentage difference), an example of green roofs is going to be further considered. After application of this measure, for RCP2.6 the peak discharge at the outflow section dropped to 9 m^3 per s, whereas for RCP8.5 to 8.8 m^3 per s. For the same measure for RCP4.5 the reduction was slightly lower and was found to be 8.7 m^3 per s. Note that green roofs and cisterns 1 showed the same results of the hydrological modelling, which is why the graphs for both measures are identical. The same applies to other flood mitigation facilities that indicated the same results. Considering also the rain gardens (the most effective measure) for comparison, the maximum outflow for RCP2.6, RCP4.5 and RCP8.5 was 8.8, 8.5 and 8.6 m^3 per s, respectively.

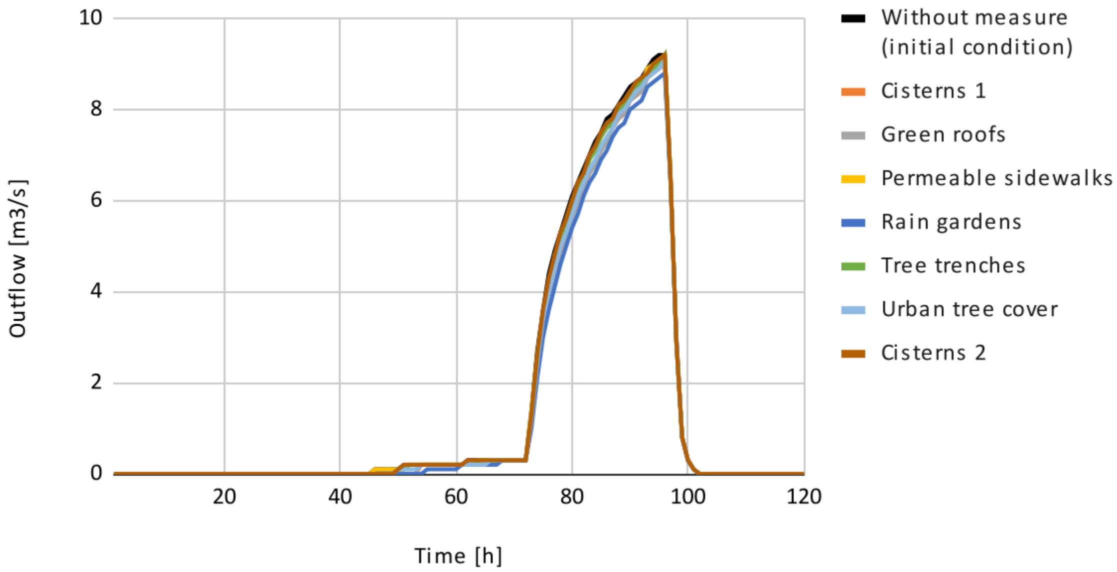

Figure 11. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP2.6 (past time period, scenario 1).

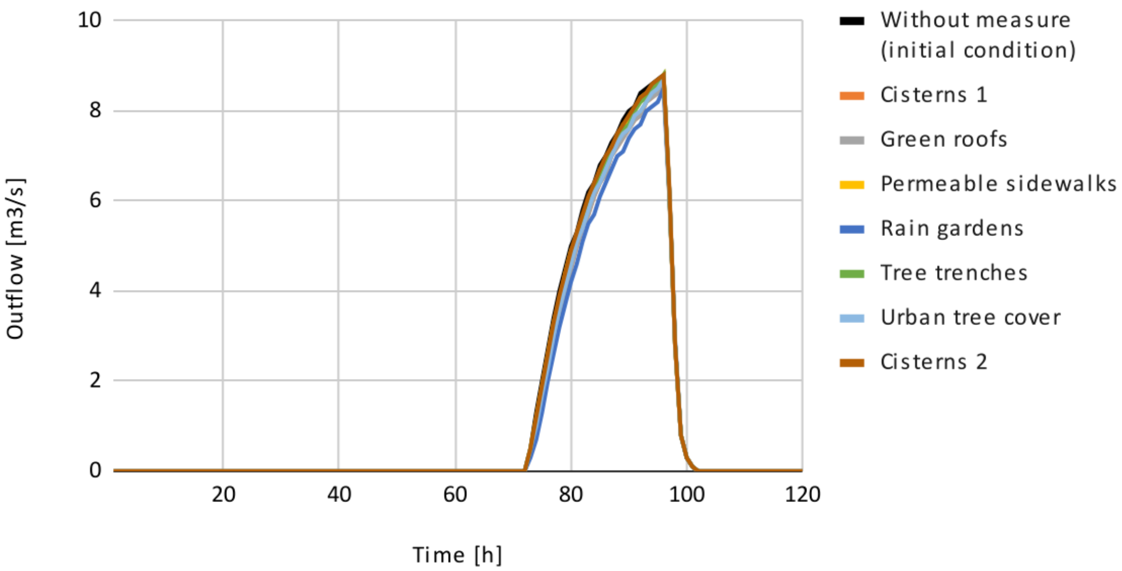

Figure 12. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP4.5 (past time period, scenario 1).

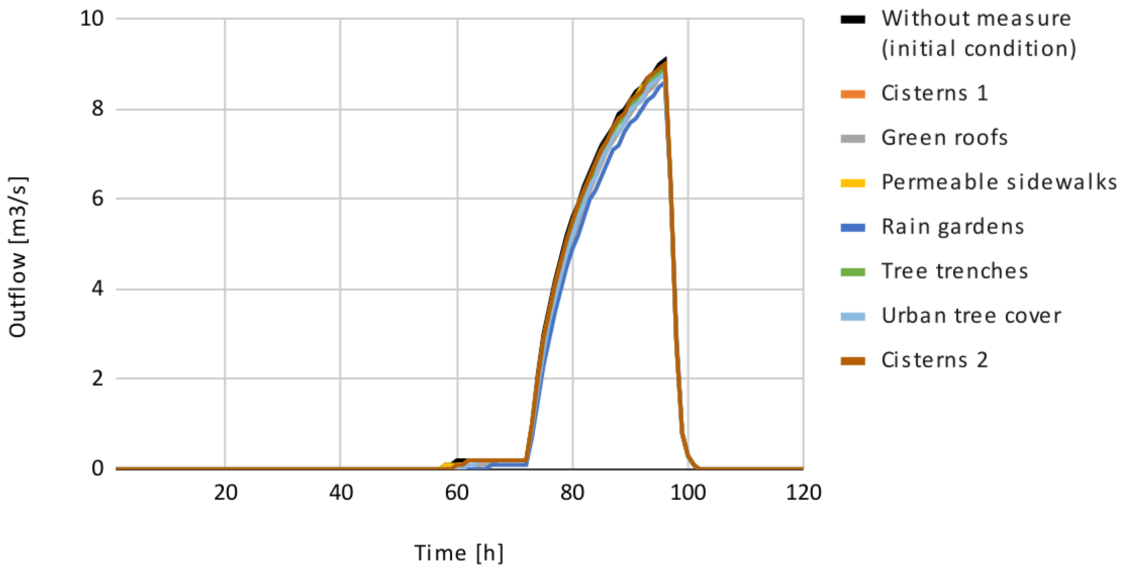

Figure 13. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP8.5 (past time period, scenario 1).

Table 24 shows results of the hydrological modelling for scenario 2, which implies that the measures are implemented just in subbasin 1. In this case, compared to the previous Table 23, the results are significantly smaller, with some measures (tree trenches, permeable sidewalks, cisterns 2) even having no decrease compared to the initial condition. In this case no difference was observed due to the identical CNs and lag time parameters before and after application of the measures.

In general, in scenario 2 among all investigated climate change scenarios (Table 24), the highest percentage difference in the outflow volume was obtained by four flood mitigation measures (green roofs, rain gardens, urban tree cover, cisterns 1) for the past time period of RCP4.5 and was found to be 2 percent. For the peak discharge the maximum reduction corresponded to 1.1 percent and was achieved by the same measures in all three time periods of RCP2.6 and in the past time period of both RCP4.5 and RCP8.5.

Table 24. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 2 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 2: MEASURE IS IMPLEMENTED IN SUBBASIN 1						
DIFFERENCE %	Past: 1981-2020		Near-future: 2021-2060		Far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
RCP2.6						
Green roofs	1.1	1.8	1.1	1.9	1.1	1.8
Tree trenches	0	0	0	0	0	0
Rain gardens	1.1	1.8	1.1	1.9	1.1	1.8
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	1.8	1.1	1.9	1.1	1.8
Cisterns 1	1.1	1.8	1.1	1.9	1.1	1.8
Cisterns 2	0	0	0	0	0	0
RCP4.5						
Green roofs	1.1	2	0.9	1.7	1	1.8
Tree trenches	0	0	0	0	0	0
Rain gardens	1.1	2	0.9	1.7	1	1.8
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	2	0.9	1.7	1	1.8
Cisterns 1	1.1	2	0.9	1.7	1	1.8
Cisterns 2	0	0	0	0	0	0
RCP8.5						
Green roofs	1.1	1.9	0.9	1.8	0.8	1.6
Tree trenches	0	0	0	0	0	0
Rain gardens	1.1	1.9	0.9	1.8	0.8	1.6
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	1.9	0.9	1.8	0.8	1.6
Cisterns 1	1.1	1.9	0.9	1.8	0.8	1.6
Cisterns 2	0	0	0	0	0	0

In scenario 3 (Table 25) the obtained results of the selected flood mitigation measures were a bit higher compared to scenario 2, except cisterns 2, which again did not reduce any flood risk in the selected case study as in the previous case. In this scenario, the highest reduction in the outflow volume among all climate change scenarios was 3.4 percent and was achieved by rain gardens in the past time period of RCP4.5. In the other two climate change scenarios, RCP2.6 and RCP8.5, the maximum decrease in volume compared to the initial condition (without measure) accounted for 3.3 percent. For the former one it was within the 2021-2060 (near-future) time period, while for the latter one it was within the 1981-2020 (past) time period. With regard to the second investigated parameter, in all climate change scenarios the maximum decrease in the peak discharge was achieved by the same flood mitigation measure in the past time period and corresponded to 2.2 percent.

Table 25. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 3 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 3: MEASURE IS IMPLEMENTED IN SUBBASIN 2						
DIFFERENCE %	**Past: 1981-2020**		**Near-future: 2021-2060**		**Far-future: 2061-2100**	
	Peak discharge %	**Volume %**	**Peak discharge %**	**Volume %**	**Peak discharge %**	**Volume %**
RCP2.6						
Green roofs	1.1	1.6	1.1	1.7	1.1	1.6
Tree trenches	1.1	1.6	1.1	1.7	1.1	1.6
Rain gardens	2.2	3.1	2.1	3.3	2.1	3.2
Permeable sidewalks	1.1	1.6	1.1	1.7	1.1	1.6
Urban tree cover	1.1	1.6	1.1	1.7	1.1	1.6
Cisterns 1	1.1	1.6	1.1	1.7	1.1	1.6
Cisterns 2	0	0	0	0	0	0
RCP4.5						
Green roofs	1.1	1.7	0.9	1.5	1	1.6
Tree trenches	1.1	1.7	0.9	1.5	1	1.6
Rain gardens	2.2	3.4	1.9	2.9	1.9	3.1
Permeable sidewalks	1.1	1.7	0.9	1.5	1	1.6
Urban tree cover	1.1	1.7	0.9	1.5	1	1.6
Cisterns 1	1.1	1.7	0.9	1.5	1	1.6
Cisterns 2	0	0	0	0	0	0
RCP8.5						
Green roofs	1.1	1.7	0.9	1.5	0.8	1.4
Tree trenches	1.1	1.7	0.9	1.5	0.8	1.4
Rain gardens	2.2	3.3	1.9	3	1.6	2.8
Permeable sidewalks	1.1	1.7	0.9	1.5	0.8	1.4
Urban tree cover	1.1	1.7	0.9	1.5	0.8	1.4
Cisterns 1	1.1	1.7	0.9	1.5	0.8	1.4
Cisterns 2	0	0	0	0	0	0

In scenario 4 (Table 26), the same patterns were observed as in the previous scenarios. Here, considering three time periods separately, for the past time period the highest reduction in volume relative to the initial condition was achieved in case of RCP4.5, while for the other two time periods (near-future, far-future) the highest percentage difference was observed in case of RCP2.6. However, as in the case with scenario 3 (Table 25), in Table 26 an exception was the percentage difference in peak discharge in the past time period, where for all investigated climate change scenarios the values were the same.

With respect to the maximum percentage difference for both parameters (peak discharge and volume) in each particular climate change scenario, in RCP2.6 the highest reduction in peak discharge corresponded to the past time period, while in volume it was within the near-future time period. These values accounted for 2.2 and 4.4 percent, respectively. For both RCP4.5 and RCP8.5, the maximum reduction in both parameters was achieved within the 1981-2020 (past) time period.

Table 26. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 4 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 4: MEASURE IS IMPLEMENTED IN SUBBASIN 3						
DIFFERENCE %	**Past: 1981-2020**		**Near-future: 2021-2060**		**Far-future: 2061-2100**	
	Peak discharge %	**Volume %**	**Peak discharge %**	**Volume %**	**Peak discharge %**	**Volume %**
RCP2.6						
Green roofs	1.1	2.2	1.1	2.3	1.1	2.2
Tree trenches	1.1	1.1	1.1	1.2	1.1	1.1
Rain gardens	2.2	4.2	2.1	4.4	2.1	4.3
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	1.1	1.1	1.2	1.1	1.1
Cisterns 1	1.1	2.2	1.1	2.3	1.1	2.2
Cisterns 2	1.1	1.1	1.1	1.2	1.1	1.1
RCP4.5						
Green roofs	1.1	2.4	0.9	2	1	2.1
Tree trenches	1.1	1.2	0.9	1	0	1.1
Rain gardens	2.2	4.6	1.9	3.8	1.9	4.1
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	1.2	0.9	1	0	1.1
Cisterns 1	1.1	2.4	0.9	2	1	2.1
Cisterns 2	1.1	1.2	0.9	1	0	1.1
RCP8.5						
Green roofs	1.1	2.2	0.9	2.1	0.8	1.9
Tree trenches	1.1	1.1	0.9	1	0	0.9
Rain gardens	2.2	4.4	1.9	4	1.6	3.6
Permeable sidewalks	0	0	0	0	0	0
Urban tree cover	1.1	1.1	0.9	1	0	0.9
Cisterns 1	1.1	2.2	0.9	2.1	0.8	1.9
Cisterns 2	1.1	1.1	0.9	1	0	0.9

Tables 27, 28, 29 and 30 include results of the HEC-HMS modelling for the remaining scenarios 5, 6, 7 and 8, respectively. Considering the case, where the measures are implemented in all three subbasins (Table 27), and specifically each climate change scenario, in RCP2.6 the reduction in both peak discharge and outflow volume in near-future and far-future time periods was higher than in the past time period, while in the other two climate change scenarios the situation was vice versa. Here, in RCP2.6 for both near-future and far-future the maximum percentage difference in volume was achieved by rain gardens and was 21.6 and 21.3 percent, respectively, whereas the reduction in peak discharge for both time periods was 12.8 percent. In RCP8.5 the maximum percentage difference in peak discharge and volume was 12.1 and 21.5 percent, respectively. In RCP4.5 the maximum decrease in both parameters compared to the initial condition (without measure) in the past time period was slightly higher than the maximum decrease in RCP2.6 (near-future and far-future) and in RCP8.5 (past). In this climate change scenario the percentage difference in peak discharge and volume within the 1981-2020 time period was 13.5 and 22.4 percent, respectively.

Table 27. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 5 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 5: MEASURE IS IMPLEMENTED IN ALL SUBBASINS						
DIFFERENCE %	Past: 1981-2020		Near-future: 2021-2060		Far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
RCP2.6						
Tree trenches	8.6	14.9	8.5	15.5	8.5	15.2
Rain gardens	11.8	20.8	12.8	21.6	12.8	21.3
Permeable sidewalks	4.3	7.1	4.3	7.4	4.3	7.3
RCP4.5						
Tree trenches	9	16.1	7.5	13.7	7.8	14.6
Rain gardens	13.5	22.4	10.4	19.2	11.7	20.4
Permeable sidewalks	4.5	7.7	3.8	6.5	3.9	7
RCP8.5						
Tree trenches	8.8	15.4	8.4	14.4	6.5	13.1
Rain gardens	12.1	21.5	11.2	20.1	9.7	18.3
Permeable sidewalks	4.4	7.4	3.7	6.9	3.2	6.2

With regard to the remaining scenarios 6-8 (Tables 28, 29, 30), almost similar patterns in the results, except some specific cases, were observed. In general, among all further scenarios, the main thing that can be noticed is that in RCP2.6 the highest percentage difference between the results for all investigated flood mitigation measures was achieved in the near-future time period, whereas for the other two climate change scenarios this was true for the past time period. However, this was just a general pattern as in scenarios 5-8 (Table 27, 28, 29, 30), so in scenarios 1-4 (Table 23, 24, 25, 26). Some exceptions were still present in each scenario as, for example, in case of rain gardens in Table 28 (RCP8.5, near-future), where the reduction in the peak discharge in the near-future time period was higher than in the past time period.

Table 28. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 6 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 6: MEASURE IS IMPLEMENTED IN SUBBASIN 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
RCP2.6						
Tree trenches	2.2	3.6	2.1	3.7	2.1	3.6
Rain gardens	3.2	5.3	3.2	5.5	3.2	5.4
Permeable sidewalks	1.1	1.8	1.1	1.9	1.1	1.8
RCP4.5						
Tree trenches	2.2	3.8	1.9	3.3	1.9	3.5
Rain gardens	3.4	5.7	2.8	4.9	2.9	5.2
Permeable sidewalks	1.1	2	0.9	1.7	1	1.8
RCP8.5						
Tree trenches	2.2	3.7	1.9	3.5	1.6	3.2
Rain gardens	3.3	5.5	3.7	5.1	2.4	4.7
Permeable sidewalks	1.1	1.9	0.9	1.8	0.8	1.6

Table 29. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 7 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 7: MEASURE IS IMPLEMENTED IN SUBBASIN 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
RCP2.6						
Tree trenches	4.3	6.1	4.3	6.4	4.3	6.3
Rain gardens	5.4	7.5	5.3	7.9	5.3	7.7
Permeable sidewalks	2.2	3.1	2.1	3.3	2.1	3.2
RCP4.5						
Tree trenches	4.5	6.6	2.8	5.7	3.9	6
Rain gardens	4.5	8.1	3.8	7	3.9	7.4
Permeable sidewalks	2.2	3.4	1.9	2.9	1.9	3.1
RCP8.5						
Tree trenches	4.4	6.4	3.7	5.9	3.2	5.4
Rain gardens	5.5	7.8	4.7	7.3	4	6.7
Permeable sidewalks	2.2	3.3	1.9	3	1.6	2.8

Table 30. Results of the hydrological modelling using climate change scenarios (RCP2.6, RCP4.5 and RCP 8.5) for scenario 8 (hydrologic element: "Glin in Grad" - outflow).

SCENARIO 8: MEASURE IS IMPLEMENTED IN SUBBASIN 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
RCP2.6						
Tree trenches	3.2	5.2	3.2	5.4	3.2	5.3
Rain gardens	4.3	7.9	4.3	8.3	4.3	8.1
Permeable sidewalks	1.1	2.2	1.1	2.3	1.1	2.2
RCP4.5						
Tree trenches	2.2	5.6	1.9	4.7	1.9	5
Rain gardens	4.5	8.6	3.8	7.3	3.9	7.8
Permeable sidewalks	1.1	2.4	0.9	2	1	2.1
RCP8.5						
Tree trenches	3.3	5.4	2.8	5	1.6	4.5
Rain gardens	4.4	8.2	3.7	7.7	3.2	6.9
Permeable sidewalks	1.1	2.2	0.9	2.1	0.8	1.9

3.3. Discussion

Considering some limitations of the modelling procedure, it should be also mentioned that the results for both synthetic rainfall events and climate change scenarios were achieved considering rain gardens occupying 15 percent of the total built area in each subbasin. The fraction of rain gardens relative to the total built area was, in turn, calculated based on the available free green space in each house in the defined area of interest in QGIS. Considering a smaller area of rain gardens in the defined polygon could potentially change the final outcomes of the hydrological modelling. The same can be mentioned for the other measures, the area of which was also delineated manually in QGIS based on the available satellite maps. In addition, these maps do not always represent the actual reality and can include some distortions, which could also affect the results. Besides that, another point, which can be also seen as a study limitation, concerns the main focus of the research. In fact, this study presents the analysis of the selected flood mitigation measures only based on two parameters (CNs and lag time parameters). Focusing just on CNs and lag times helped to define the most effective measures relative to the delineated boundaries and scope of the study; however, at the same time taking also into account some other additional parameters could probably provide more realistic results.

In addition, it can be also observed that the shape of discharge graphs for the synthetic rainfall events and climate change scenarios slightly differs from each other. While for the design rainfall events the shape is smooth, for the climate change scenarios the peak is relatively sharp with the graph going abruptly down after reaching its maximum point. The reason for this is the distribution of precipitation data during the modelling procedure in HEC-HMS. For the synthetic rainfall events the precipitation values were gradually distributed by small amounts within 6 hours with the interval of 6 min, whereas for climate change scenarios the rainfall data included 4-days precipitation event consisting of four precipitation values (3-days antecedent rainfall and maximum event during the last day).

It can be also argued that some of the established scenarios are not reasonable, as, for example, implementation of the measures in the whole catchment can be quite an expensive and resource-intensive option. However, the practicability of applying a particular scenario in real life is not included in the scope of this study and was not considered in this work. This study was conducted to compare flood mitigation facilities with each other in the selected case study and define the most distinctive ones based on the potential scenarios, which could hypothetically occur. Comparing measures in relatively similar conditions and frameworks can eventually help to highlight the most effective options among all investigated alternatives.

At this stage it is also important to focus on other research works, which analysed the same or other flood mitigation measures and their influence on the flood risk, to have a clearer understanding of the final outcomes of this study and its correlation with the findings from other research works. Considering the same case study area, the application of different flood mitigation facilities was studied in the research work of Bezak et al. (2021). The study analysed the effectiveness of three different flood mitigation measures in the Glinščica River catchment with a particular attention to retention reservoirs. The following measures were considered in the research: afforestation, permeable concrete pavements, dry and wet reservoirs. The study revealed that in the case of afforestation and permeable concrete surfaces, significantly large areas are required to obtain either a significant peak discharge decrease or a shift in the timing of peak discharge with an associated mitigation of flood risks. Application of these flood mitigation options on relatively small areas cannot lead to the desirable results and substantially reduce consequences from floods. What is more, Bezak et al. (2021) also mention that an increase in the scope of these measures will lead to a significant rise in costs, which is also an undesirable factor when choosing the most suitable flood mitigation options for a particular case study. However, with regard to permeable concrete pavements, this measure can be considered as an additional option at a local scale when contribution to the reduction in peak discharge is necessary and when reconstruction of an urbanized area is taking place. With respect to the last flood mitigation measure analysed by Bezak et al. (2021), both dry and wet reservoirs can be considered as a traditional flood mitigation facility, which can also serve for other purposes such as irrigation. Bezak et al. (2021) concluded that even though these types of reservoirs are known as a more classical way of reducing flood risks, their capability to reduce peak discharge was found to be higher than for afforestation and permeable pavements. According to the study, implementation of afforestation in all three subbasins of the Glinščica River catchment is expected to have 10, 10 and 8 percent decrease in peak discharge for the 2-, 10-, and 25-years return periods, respectively. For both Podutik and Brdnikova reservoirs, which are the reservoirs located in the Glinščica River catchment, the reduction in peak discharge for the same return periods was calculated as 33, 43 and 46 percent, respectively.

The next research, which also focused on the same case study area, was done by Johnen et al. (2020). In addition to cost-benefit analysis, the study also performed both hydraulic and hydrological modelling using KRPAN, HEC-RAS and HEC-HMS softwares, respectively. Based on the obtained results, generally, a reduction in flood peak between 9 and 13 percent occurred when the amount of tree cover was increased by 15-60 percent. As a result, Johnen et al. (2020) concluded that even though it is highly improbable that afforestation on floodplains alone would be able to provide substantial results and completely protect urbanized areas located further downstream the Glinščica River, in combination with other flood mitigation solutions it could provide more significant outcomes.

Considering also other studies beyond the scope of this research (outside of the the Glinščica River catchment), Te Linde et al. (2010) studied the effectiveness of various flood management options in relation to peak discharge reduction in the Rhine River basin considering an extreme climate change scenario for 2050. The measures that were analysed include retention polders, afforestation, meandering of the Upper Rhine River, reforestation of floodplains, dike heightening and some others. According to Te Linde et al. (2010), ranging from a few centimeters to 137 cm, the average rise in maximum water level caused by climate change in 2050 is expected to be 50 cm. The study revealed that the flood mitigation options that are used nowadays in the Rhine River basin and that are planned by the Rhine Action Plan on Floods appear quite insufficient to deal with the rising flood magnitudes and probabilities anticipated in the case of future climate change. However, at the same time Te Linde et al. (2010) also concluded that dike heightening by 1.29-3.25 m could be considered as the only flood mitigation option, which could reduce the flood risks at specific locations of the investigated case study.

Another study of Dietz and Clausen (2005) also assessed the effectiveness of rain gardens in relation to runoff control and water quality improvement. As in the current research, the study of Dietz and Clausen (2005) concluded that rain gardens have high infiltration capacity and can be considered as an effective solution for peak flow rate reduction, since only 0.8 percent of the runoff in the experiment was left as overflow (runoff).

Following this, in the study of Liu et al. (2014) the effectiveness of green infrastructure in terms of runoff and peak flow reduction of urban floods in Beijing was also investigated. In this research expansion of green areas, implementation of permeable pavements, runoff retention facilities and some other flood mitigation measures were assessed. The study concluded that pervious pavements have more potential to reduce flood risks than expansion of green areas. With the help of a model, which contained an algorithm of hydrological models to assess the capability of a particular flood mitigation facility relative to the reduction of flood consequences, Liu et al. (2014) revealed that replacement of impermeable pavements with permeable ones could significantly improve the situation during floods in Beijing. Assuming half of urban impermeable pavements being replaced by pervious surfaces, both peak discharge and runoff were decreased by 37.9-35.7 and 46.2-42.0 percent, respectively, depending on the return period of a particular flood event. What is more, an increase in the area of permeable surfaces from 50 to 80 percent, which implied full implementation of pervious pavements instead of impervious ones (except roofs), could reduce both parameters by 54.2-51.0 and 66.5-59.6 percent, respectively. However, similar to the current study, Liu et al. (2014) also found that particularly during more severe storm events, the capability of a single green infrastructure in relation to runoff and peak flow reduction was constrained. They concluded that integrated solutions, meaning combination of multiple green infrastructure facilities, provided more substantial results in relation to flood mitigation and control in the urban area.

From the study of Liu et al. (2014) it can be observed that for permeable pavements the percentage reduction of peak discharge and runoff volume is relatively high compared to the current study, where the assessment of the effectiveness of the measure was also included in the scope of the study. While in the current research pervious pavements were concluded to be one of the least effective measures among all investigated flood mitigation options with respect to the flood risk mitigation, in the study of Liu et al. (2014), in contrast, pervious surfaces showed relatively significant results. However, it is worth mentioning that Liu et al. (2014) assumed relatively extreme scenarios, which seem quite unreasonable and irrational to implement in reality. As it was already previously mentioned, in the first case Liu et al. (2014) considered 50 percent of impervious pavements being converted to brick permeable surfaces and, as a second case, they also assessed full implementation of permeable pavements (excluding roofs). In contrast, in the current study only urban sidewalks were considered as a potential area, which could be replaced by pervious surfaces. Based on the manually defined length of sidewalks in QGIS (and taking the width as 1.5 m), the total potential area of permeable sidewalks was estimated as 6 percent of the total built area in each subbasins. In this case practicability of replacing impervious urban pavements was also taken into account, which was not done in the study of Liu et al. (2014). In particular, removing all existing impervious surfaces in an urban area and fully replacing them with pervious ones would be almost impossible to accomplish in real life. Similar to permeable pavements, for other selected measures (e.g., tree trenches, rain gardens, etc.) feasibility and practicability of applying a particular flood mitigation option was also taken into account in the current study. For example, in case of rain gardens instead of choosing the total green area, which seems quite unfeasible, potential areas of the measure were manually defined in almost every house (where it was possible to find free available green space) in QGIS. Thus, in this study the results of the hydrological modelling reflect a more or less real picture of the possible reduction in flood risk relative to the defined characteristics of each flood mitigation measure and subbasin.

Another study of Roehr and Kong (2010) assessed implementation of green roofs and their influence on runoff reduction in Vancouver, Kelowna and Shanghai. The research revealed that green roofs could be a good solution for flood mitigation in both Vancouver and Shanghai, where the annual precipitation exceeds 1200 mm. While in Vancouver the runoff reduction was varying between 29-58 percent, in Shanghai it was within 28-55 percent. However, at the same time the study also concluded that selection of proper plants for green roofs also exerts a significant influence on the effectiveness of the facility. Depending on the amount of rainfall during summer period, in Vancouver only plants, which require small amount of water, were found to be a good option for green roofs, whereas in the second city the same was true for both high and low water use vegetation. With regard to Kelowna, Roehr and Kong (2010) came to conclusion that rain gardens and bioswales would be more feasible solution (instead of green roofs) for runoff reduction in the city due to the low density of the investigated urban area and relatively low amount of precipitation per year (400 mm annually) compared to other analysed cities.

The effectiveness of green roofs was also assessed in the study of Kourtis et al. (2020). In addition, permeable surfaces, detention tanks and enlargement of the sewerage system were also considered as flood mitigation options in the scope of the research. Kourtis et al. (2020) developed an integrated methodological framework, which included economic, hydraulic and hydrologic aspects, aiming to analyse the selected flood mitigation measures from different perspectives. The aim of the study was to compare low impact development options (green roofs and pervious surfaces) with traditional/conventional drainage measures (detention tanks and enlargement of the sewerage system) to eventually define the most effective solutions. Based on the SWMM model the study concluded that both types could effectively cope with floods. What is more, in contrast to the current study, Kourtis et al. (2020) found that the selected flood mitigation options could be also beneficial in case of low probability flood events. However, even though all solutions were found to be effective while dealing with floods, from an economic point of view expansion of the sewer system outperformed all other options. In addition, when some additional aspects (e.g., how difficult to implement a measure, traffic blocking, effect on downstream part, etc.) were taken into account, both green roofs and permeable surfaces (low impact development measures) were found to be the most effective measures among all investigated options with green roofs being in the first place.

4. CONCLUSION

Recently, the frequency and magnitude of floods has noticeably increased, bringing with it more and more serious consequences and having an increasingly negative impact on the environment and people's life in general. This study was conducted in order to define the most effective flood mitigation measures, which could be implemented to mitigate flood risks. The Glinščica River catchment was taken as a case study in this research. To accomplish the research goal, literature review was first conducted to analyse fifteen grey, green and hybrid flood mitigation facilities according to the proposed criteria. Based on the results of the literature review two most promising and effective measures were chosen from each category to be further modelled in HEC-HMS software. As a result, the following flood mitigation measures were selected for modelling: permeable sidewalks and drywells/cisterns (grey measures), urban trees and rain gardens (green measures), green roofs and stormwater tree trenches (hybrid measures).

The hydrological modelling, in turn, was divided into two parts. While in the first part synthetic rainfall events were used to analyse selected measures and define the most effective ones based on the hydrological modelling, in the second part climate change scenarios were implemented. However, the main objective of this study was not to compare the performance and effectiveness of the selected flood mitigation measures using synthetic rainfall events and climate change scenarios (RCP2.6, RCP4.5, RCP8.5) with each other. The study is focusing separately on the design rainfall events (synthetic precipitation events) and climate change scenarios to observe the influence of the proposed flood mitigation facilities on the flood risk in the selected case study in both cases.

In this research the modelling procedure was computed with the focus on the curve numbers (CNs) and lag time parameters of each subbasin. Here, during the modelling procedure the SCS Curve Number method was used as a rainfall loss method. The average CN for each subbasin was calculated based on the SCS soil type and land use type maps. To transform effective rainfall into runoff (transform method) the SCS Unit Hydrograph method was implemented, where the lag time for each particular case was found based on each subbasin's characteristics.

The initial hypothesis of this research was the following: "Even though both green and grey solutions can significantly mitigate flood risk, it is believed that a combination of both nature-based and grey flood mitigation measures (i.e., hybrid solutions) can provide more substantial results in terms of reducing the adverse impact of floods". However, the study revealed that rain gardens, which refer to the "green" category, is the most effective flood mitigation measure that can be potentially implemented in the Glinščica River catchment to reduce the flood risks in this area. Following the rain gardens, green roofs and stormwater cisterns 2 showed the second highest results related to the reduction in peak discharge and volume at the outflow point of Glinščica River catchment model. The former ones were initially categorized as "hybrid" flood mitigation measures, whereas the latter ones refer to the "grey" category. Based on the results of the hydrological modelling, the last place among all flood mitigation facilities was occupied by cisterns 2 and permeable sidewalks (depending on the scenario).

In general, among all eight conducted scenarios the highest results in reducing peak discharge and outflow volume relative to the initial condition (without any measure) were achieved in scenario 1, which assumes that the measures are implemented in all three subbasins. For the synthetic rainfall events the percentage difference between the results of the initial condition and after implementation of a particular measure were higher than for the climate change scenarios. Considering synthetic rainfall events, the highest percentage difference (before and after applying the measures) for all flood mitigation facilities and scenarios (1-8) was observed for the 2-year return period. Meaning that smaller magnitude floods can be better mitigated with measures investigated within the scope of this study compared to more extreme floods. With regard to climate change scenarios, the whole investigated period was divided into three categories: past (1981-2020), near-future (2021-2060) and far-future (2061-2100). Considering each RCP scenario separately, for RCP2.6 the highest reduction in volume almost for all flood mitigation facilities and scenarios (1-8) was achieved in the near-future (2021-2060) time period, while for both RCP4.5 and RCP8.5 the same is true for the past (1981-2020) time period. With regard to the general pattern in peak discharge, in RCP2.6, RCP4.5 and RCP8.5 almost for all flood mitigation measures and scenarios (1-8) the highest decrease in the parameter relative to the initial condition (without measure) was in the past time period. However, this was just the general pattern, which combined all cases together, and in reality there were also many exceptions among all flood mitigation facilities and scenarios (1-8). In general, in both cases (synthetic rainfall events and climate change scenarios) the percentage decrease seems relatively low, especially in scenarios where the selected measures are implemented only in one of the subbasins. It is believed that combination of the most effective measures would provide more substantial results in relation to flood risk reduction; however, at this stage this can be considered only as a suggestion for further research on the same case study.

However, some limitations of the research still exist. In this study to find the average CN of each subbasin, area and CN of the new land use types (e.g., rain gardens, green roofs, etc.) were needed. Thus, during the calculation procedure of the average CNs of each subbasin, the area of the flood mitigation measures (except cisterns 1 and 2) was estimated manually in QGIS, which could affect the final outcomes of this study. Considering a smaller area of the selected flood mitigation facilities in the defined polygon could potentially change the results of the hydrological modelling. Thus, it is important also to keep in mind that the final results for each measure depend on the initially defined area of each flood mitigation option and, as in the case of cisterns, on the volume of the structure.

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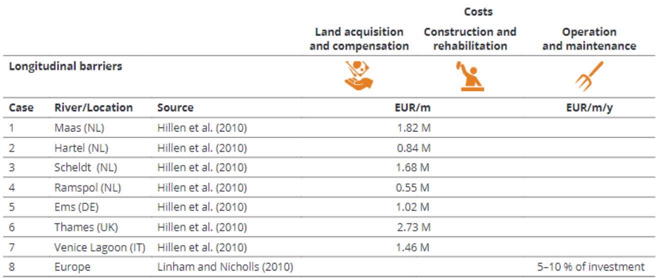
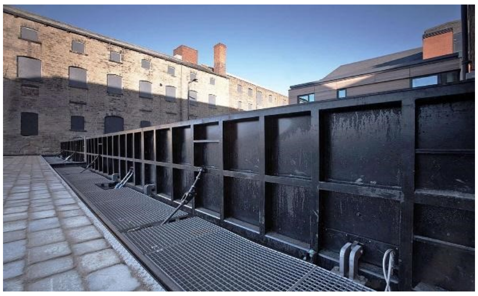
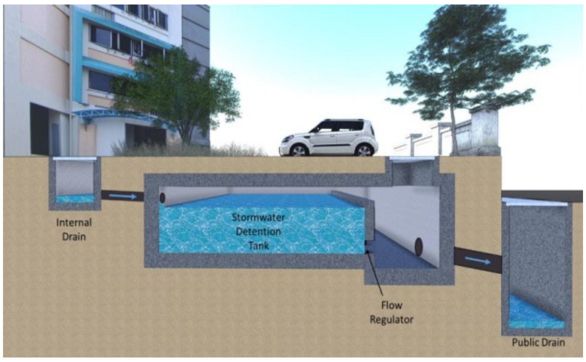
LIST OF APPENDICES

APPENDIX A: Literature review of the flood mitigation measures.

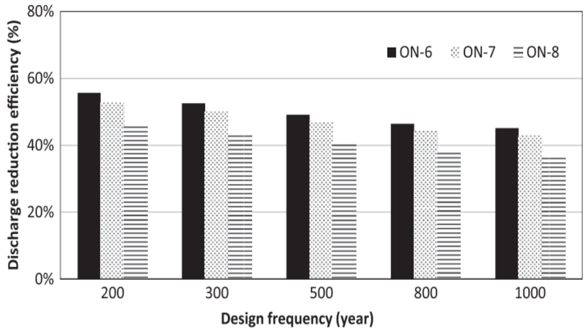
Table A1. Grey flood mitigation measures.

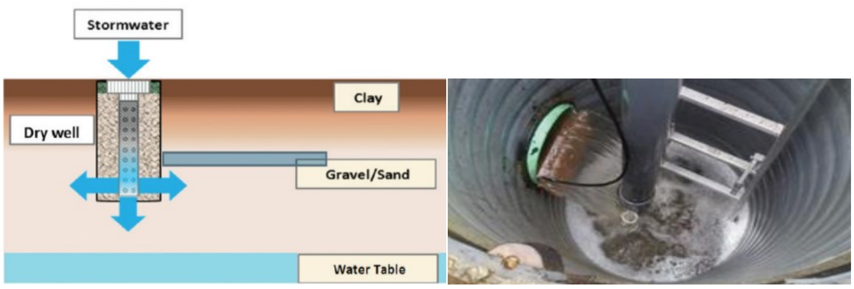
<table>
<tr><td>Descriptor</td><td>Explanation</td></tr>
<tr><td colspan="2">Measure: dams</td></tr>
<tr><td>Real case example where the measure was applied: Wivenhoe Dam in Australia (ASDSO, 2023).</td><td>
Figure A1. Concrete dam (Malm et al., 2016).</td></tr>
<tr><td>Short summary</td><td>According to the EEA (2017) report, dams are hydraulic structures that regulate flow of water in a river. Unlike dikes, which are usually constructed parallel to the river banks, in most cases dams are built perpendicular to the river, thereby, creating a barrier for the water to pass and, as a result, regulating the water flow further downstream.</td></tr>
<tr><td>Feasibility</td><td>The EEA (2017) report states that construction of dams requires huge investments due to their complex engineering structure. Ansar et al. (2014) mention that building a dam is an extremely expensive process, which is also associated with further large maintenance costs after its construction.</td></tr>
<tr><td>Cost-effectiveness</td><td>Dams are known to be effective in protecting downstream regions from floods by regulating water discharge in the upstream section of the river. In addition, dams can have multifunctional purposes, such as provision of water for irrigation, electricity generation, etc.
With respect to costs, the following Figure A2 summarizes the costs of dams at different locations in Europe:

<table>
<tr><td></td><td></td><td></td><td colspan="3">Costs</td></tr>
<tr><td></td><td></td><td></td><td>Land acquisition and compensation</td><td>Construction and rehabilitation</td><td>Operation and maintenance</td></tr>
<tr><td colspan="6">Longitudinal barriers</td></tr>
<tr><td>Case</td><td>River/Location</td><td>Source</td><td colspan="2">EUR/m</td><td>EUR/m/y</td></tr>
<tr><td>1</td><td>Maas (NL)</td><td>Hillen et al. (2010)</td><td colspan="2">1.82 M</td><td></td></tr>
<tr><td>2</td><td>Hartel (NL)</td><td>Hillen et al. (2010)</td><td colspan="2">0.84 M</td><td></td></tr>
<tr><td>3</td><td>Scheldt (NL)</td><td>Hillen et al. (2010)</td><td colspan="2">1.68 M</td><td></td></tr>
<tr><td>4</td><td>Ramspol (NL)</td><td>Hillen et al. (2010)</td><td colspan="2">0.55 M</td><td></td></tr>
<tr><td>5</td><td>Ems (DE)</td><td>Hillen et al. (2010)</td><td colspan="2">1.02 M</td><td></td></tr>
<tr><td>6</td><td>Thames (UK)</td><td>Hillen et al. (2010)</td><td colspan="2">2.73 M</td><td></td></tr>
<tr><td>7</td><td>Venice Lagoon (IT)</td><td>Hillen et al. (2010)</td><td colspan="2">1.46 M</td><td></td></tr>
<tr><td>8</td><td>Europe</td><td>Linham and Nicholls (2010)</td><td colspan="2"></td><td>5–10 % of investment</td></tr>
</table>
The report states that the total average cost of dam construction including land purchase of the 7 investigated cases in Europe was 1.6 million euros.
Figure A2. Costs of dams (EEA, 2017).</td></tr>
<tr><td>Flexibility</td><td>Tiessen et al. (2011) point out that large dams/reservoirs can be relatively effective in managing sediment loads. In particular, the study shows that the two investigated dams, Steppler multipurpose and Madill dry dam, were able to retain 77 and 66 percent of sediments, respectively.
Except the above mentioned information, no particular influence of dams on any other hazards, such as landslides, erosion, etc. was found in the literature.</td></tr>
<tr><td>Maintenance</td><td>Hughes (2023) mentions that regular inspections should be carried out to check whether there are no cracks, defects or other imperfections that may put safety of the structure in danger. As for cracks, one should remember that not all cracks are dangerous. During the inspection procedure it is important to pay attention to the following features to define the severity of cracking: length and width of cracks, depth, direction, and their location. Besides that, it is necessary to properly distinguish different types of cracks, such as thermal, shrinkage, structural cracks and others. Usually, constant monitoring of the identified cracks is suggested. Furthermore, besides cracks, concrete and masonry elements should be checked against other deterioration features, such as leakage</td></tr>
</table>

	along structural elements, surface defects such as honeycomb and stratification, displacement, seepage through foundation, etc. Records of the detected defects also need to be kept. In addition, as a regular maintenance, debris and undesirable vegetation should be constantly removed (Hughes, 2023; Klun et al., 2021).
Impact on climate change	International Rivers (2007) states that dams exert a negative impact on climate change by producing dangerous gas - methane (CH_4). In fact, the gas is produced at the bottom of the dam and is released into the air after a sudden pressure drop when water from the dam is released. However, when the gas rises up by itself and becomes in contact with the air, it is converted to CO_2. In addition, according to the Portland Cement Association (2023), the cement manufacturing process is considered to be one of the emitters of carbon dioxide into the atmosphere. However, the same source states that around 60 percent of the carbon dioxide released throughout the cement production process is very gradually absorbed by the concrete surface, when it becomes in contact with air.
Case study example	Galoie and Motamedi (2014) studied the effectiveness of a retention dam located in a small catchment in Austria in terms of flood control. The study revealed that availability of the 215,000 m^3 volume dam is not sufficient enough to reduce inundation extent in all investigated regions, caused as a result of a 100-year return period flood event. In fact, the dam was only able to manage half of the floods, making it necessary to construct another retention dam in this region in order to deal with the rest of the areas that were inundated the most.
Measure: floodwalls	
Real case example where the measure was applied: Bratislava, Slovakia (Kryžanowski et al., 2014)	 Figure A3. Different types of floodwalls as a flood protection measure in the city of Bratislava, Slovakia: (a) concrete (b) sealing (underground), (c) reinforced concrete and (d) mobile walls (Kryžanowski et al., 2014).
Short summary	According to the FEMA (2013), floodwalls is an engineering structure typically made of reinforced concrete and steel, and is designed to protect buildings in flood-prone areas from floodwaters.
Feasibility	Kádár (2015) mentions that the installation procedure, for example, of the mobile floodwalls usually does not take much time since its structural elements are quite light and, therefore, easy to move and transport. A manpower of 8 people is typically required to construct a 300-m long floodwall in one day. Furthermore, another advantage of mobile flood barriers refers mainly to the possibility to maintain the natural landscape when the walls are removed after a flood event. However, the same source indicates that mobile walls for flood protection also have a number of disadvantages. For example, the installation costs are relatively high and, furthermore, a place for storing the walls is required. Rickard (2009) states that in general floodwalls are one of the most favorable solutions for the flood-prone areas, where the available space for other flood mitigation defenses is restricted. Furthermore, the author mentions, even though this type of flood defense may seem relatively strong, it can still be damaged. When the structure becomes overtopped, it can lose its structural stability as a result of destabilized foundation, which eventually can lead to immediate collapse. To solve the problem a special hard surfacing should be implemented for the defense to reduce the probability of failure.

Cost-effectiveness	The cost of floodwalls mainly depends on the type of material, which is used to construct the flood defense (Rickard, 2009). According to the RetainingWall Solutions (2023), there are many factors that affect price formation of the floodwalls, in particular, type of material used, height of the structure, specific site constraints, soil characteristics and project scale. In general, for 0.675 m high floodwall built on clay soil the cost is around 300 pounds, whereas for sandy soil the price is nearly 350 pounds for the wall of the same height (RetainingWall Solutions, 2023). This, in turn, corresponds to nearly 342 and 399 euros, respectively.
Flexibility	No influence of floodwalls on mitigation of erosion, landslides or any other hazards was found in the literature. In contrast, Rickard (2009) states that this type of flood defenses can be quite vulnerable to river bank erosion, which usually leads to damage and final collapse of the structure.
Maintenance	Regular inspections should be conducted in order to check the condition of floodwalls. In particular, floodwalls should be periodically checked against seepage, sand boils, etc. Besides that, it is necessary to periodically inspect river banks to make sure that the floodwalls are stable and there are no saturated areas that may also affect the structure. In addition, any sort of debris should be regularly removed and the walls need to be inspected against encroachment to exclude any damages to the flood protection structure (NRC, 1982). Rickard (2009) argues that although floodwalls require regular inspections to be carried out in order to check their functionality, in general they need little maintenance.
Impact on climate change	No evidence of the influence of floodwalls on climate change mitigation was found.
Case study example	Flood Control International (2023) presents one example of the flood defense system in Wakefield, England. The system was designed to protect the city from constant floods from the River Calder. The unique feature of these floodwalls is that they are operated using a special main control unit, which initiates the system as soon as its water sensors detect the risk water level. The flood defense was built in 2008 with the goal to sustain the maximum projected hydraulic load including additional 30 percent for safety reasons.  Figure A4. Flood defense in Wakefield (Flood Control International, 2023).
Measure: underground stormwater detention tanks	
Real case example where the measure was applied: Gomeznarro Park in Madrid (Climate-ADAPT, 2022).	 Figure A5. Visual representation of the underground stormwater detention system (PUB, 2021).
Short summary	A stormwater detention tank is a special water storing facility that is used to keep stormwater runoff during flood events in order to reduce flood peak and then slowly release it into a drainage system. With respect to the PUB (2021),

	Singapore's National Water Agency, detention tanks can be categorized into two categories: aboveground and underground tanks. In this section the second type is considered.
Feasibility	According to the US EPA (2020), it is usually quite complicated to find a proper and favorable place for location of the USTs, since areas that are frequently inundated are most of the time covered with muddy soil and debris. Another problem that can be faced is related to buoyancy forces acting on the underground structure. If the UST is located in an area with highly saturated soil content, the structure becomes subjected to the upward buoyancy force that pushes up the tank, thereby, creating damages to pipes, pavements and other infrastructure elements that are located above the tank. Therefore, it is important to make sure that the tank will not go up as a result of the uplift force. To accomplish this, heavy sand bags or containers with rocks can be placed on the top of the UST as an additional load that can prevent the structure from going up (US EPA, 2020). The PUB (2021) states that the system should be designed in such a way that it is capable of releasing the accumulated water inside the tank after 4 hours when the flood event has happened. This, in turn, is done to make sure that there is available space in the tank in case the next flood event occurs.
Cost-effectiveness	The price of underground stormwater storage tanks is significantly higher than of the aboveground ones due to the more complicated procedure of tank installation and maintenance. However, at the same time the UST system can be more affordable in locations where land acquisition is relatively expensive and when there is a problem of land availability (Lakesuperiorstreams, 2009). As for many other flood mitigation measures, the cost of USTs highly depends on the site characteristics and location, type of tank material, amount of tank volume required to store stormwater, labor costs, volume of excavated soil, size of pipes and other factors. In general, the cost of USTs varies between 3-10 dollars per ft^3 of the volume stored, which equals to nearly 97-325 euros per m^3 (Lakesuperiorstreams, 2009).
Flexibility	No effect of underground stormwater detention tanks on risk reduction of any other hazards was observed in the literature.
Maintenance	With respect to maintenance activities, the Lakesuperiorstreams (2009) states that every month site inspection should be carried out to check the condition of the inlet and outlet pipes and inspect the inlet gates against accumulated debris. Furthermore, in case there is a need to repair any elements of the structure, it should be done on time to exclude the risk of poor functioning of the tank during a flood disaster. It is also recommended to mechanically remove accumulated sediments in the water storing facility minimum ones a year. If there is a filtering system installed for stormwater purification, the manufacturing company should be responsible to check its proper functionality.
Impact on climate change	No particular influence of the USTs on climate change was detected in the literature.
Case study example	Shin et al. (2022) studied the effectiveness of the USTs implementation in the most urbanized regions of the Oncheon stream basin in Korea. The study revealed that the USTs can be quite effective in reducing flood discharge and, as a result, protecting flood-prone areas from an upcoming flood disaster. For example, for the 200-year return period around 56, 55 and 53 percent reduction in flood discharge was observed in the Sa-jik stream (ON-6), before Geo-je (ON-7) and after Geo-je stream (ON-8), respectively (Figure A6). In general, for all flood frequencies reduction in the inundation extent in all investigated regions was found to be more than 40 percent. The highest decrease in the area of inundation was observed for 200- and 300-year return periods (88 and 79 percent, respectively).

	 Figure A6. Reduction in the discharge after implementation of the USTs in the Sa-jik stream (ON-6), before Geo-je (ON-7) and after Geo-je stream (ON-8) (Shin et al., 2022).
Measure: permeable concrete pavements	
Real case example where the measure was applied: parking lots of the Finley Stadium in Chattanooga, Tennessee (US EPA, 2013).	 Figure A7. Permeable concrete (Upper Midwest Water Science Center, 2019).
Short summary	With the expansion of urbanized areas, the number of impervious surfaces also increases. When flooding occurs, the city drainage system plays an important role in removing excess stormwater from the streets (Huang et al., 2020). However, as there are many surfaces that do not allow water to be infiltrated during floods, the drainage system experiences additional pressure when the amount of water is too high (Bae and Lee, 2020; Mu et al., 2021). Consequently, the situation is worsened as the capacity of the drainage system is not enough to process the whole amount of water that can be accumulated as a result of the impermeability of many surfaces. In this case, permeable concrete pavement can be considered as an additional measure to reduce the risk coming from floods by allowing retained water to be slowly infiltrated, reducing at the same time additional pressure on the drainage system (Ma et al., 2020; Qin et al., 2013).
Feasibility	To implement permeable concrete surfaces, built-up areas should be removed, therefore, at a large scale it would be quite difficult and almost impossible to accomplish. Thus, in this case usually small areas such as parking spaces and bicycle roads can be selected to turn the idea into reality. Additionally, in order to implement this measure special soil should be selected, in particular, soil with high infiltration capacity is required (Bezak et al., 2021). With respect to its lifespan, according to the Green Building Alliance (2023), the expected lifetime of permeable concrete is between 20 and 40 years.
Cost-effectiveness	Costs of permeable concrete typically include costs of installation of the pervious surfaces and their further maintenance (Bezak et al., 2021). The Environment Agency (2015) states that the cost of permeable pavement varies between 30-40 per m^2 of the pavements, which equals to nearly 34-46 euros per m^2. Benefits are usually the following: runoff reduction, recharging of groundwater, and reduction of surface temperature (Green Building Alliance, 2023). The Stormwater Management Calculator of the CNT (2020a) indicates that in the United States construction cost of pervious parking, sidewalks, and streets corresponds to 8.68 dollars per ft^2 (~0.0929 m^2), which equals to 67.9 euros per m^2, whereas annual maintenance cost is accounted for 0.02 dollars per ft^2 (~0.2 euros per m^2).

Flexibility	The US EPA (2021a) states that permeable pavements are able to remove pollutants from the stormwater. Depending on the layering system of the pavement, concentration of contaminants in the water can be reduced as a result of physical filtration. Except this information, no particular influence of concrete pavement on any hazard was found in the literature.
Maintenance	During the maintenance of permeable concrete one important aspect that should be considered concerns mainly clogging of its pores with contaminants (Kryeziu et al., 2013). As a result of pore blocking, permeability of material is decreasing leading even to a shorter lifetime (Kia et al., 2017). Power vacuuming and pressure washing are two main maintenance techniques for permeable concrete. Both methods prevent pore clogging with contaminants to allow stormwater to pass into the ground easily (Kryeziu et al., 2013).
Impact on climate change	Permeable pavement is known as one of the contributors to the reduction in the so-called Heat Island effect of cities. Haselbach (2009) found that if permeable concrete with 23 percent porosity is used, the heat transfer rate for non-pervious pavement is 41 percent higher than for pervious one. The study concluded that pervious concrete can reduce the Heat Island effect by evaporating water from its pores. As it was previously mentioned in the section for dams, being one of the components of the concrete, cement is also known to be one of the emitters of carbon dioxide into the atmosphere during its manufacturing process (Portland Cement Association, 2023), which can exert a negative impact on climate change.
Case study example	A case study of the Shoreview city, where permeable concrete has been implemented for road pavements since 2009, can be demonstrated. Before 2009 the city was implementing conventional hydraulic infrastructure to manage stormwater runoff, however, to promote a more sustainable design of the city and reduce pressure coming from excess precipitation, pervious pavements were introduced. The study revealed that the costs of traditional concrete pavements considerably outweigh the costs of permeable pavements. In general, permeable concrete has a significant advantage over its non-pervious alternative due to its ability to infiltrate water. However, on the other hand, it was also shown that the performance of permeable pavements decreases with time due to clogging, which shows the need for constant maintenance and control (Izevbekhai and Schroeder, 2017).
Measure: infiltration shafts/drywells	
Real case example where the measure was applied: Oregon, Arizona, Washington (City of Elk Grove, 2023).	 Figure A8. Drywell (City of Elk Grove, 2023).
Short summary	Infiltration shaft, also called drywell or percolation shaft, is a special underground system composed of one main shaft and some other attributes necessary to collect stormwater runoff. The system allows excess amounts of water to infiltrate into the well, which then slowly releases the percolated stormwater runoff in the surrounding soil (City of Elk Grove, 2023; DWA, 2005).
Feasibility	Sasidharan et al. (2021) studied performance of two flood mitigation measures: drywells and infiltration basins. The study revealed several advantages of drywells over infiltration basins, in particular, percolation shafts occupy less surface area, which makes the process of land acquisition much easier. Furthermore, Sasidharan et al. (2021) argue that drywells do not spoil the aesthetic appearance of urban parks, streets and other places as they usually look like utility holes. In addition, compared to infiltration basins, drywells allow

<table>
<tr><td></td><td>water to be pretreated before entering the well without having any influence on the performance of the structure.
With respect to the City of Elk Grove (2023), during the design and implementation stage a proper location needs to be selected for placing the percolation shafts. It is not recommended to locate the shafts in areas close to gas stations or any other facilities that utilize dangerous substances to reduce the risk of groundwater contamination. Furthermore, even though percolation shafts can use special filtration mechanisms to remove contaminated particles from the stormwater, the City of Elk Grove (2023) is not recommending placing the shafts in highly polluted soils to exclude the risk of soil contaminants entering the drywell. In addition, the source mentions that pre-treatment of stormwater is needed to reduce concentration of hazardous pollutants.</td></tr>
<tr><td>Cost-effectiveness</td><td>According to the Stormwater Management Calculator of the CNT (2020a), the medium capital cost of drywell construction in the United States is nearly 250 dollars (~230 euros), while the highest cost is around 5,000 dollars (~4,600 euros). Maintenance costs of the same drywell account for 20 dollars per year, which equals nearly 18.4 euros per year. The useful life of this flood mitigation infrastructure is around 70 years.
However, it should be also noted that the cost also depends on the size of the drywell. For example, in the United States for 1,500-gallon MaxWell Type IV (~5.7 m^3) and 2,500-gallon MaxWell Plus (~9.6 m^3) the cost varies between nearly 25,750-32,200 and 34,950-41,400 euros, respectively (Sasidharan et al., 2021; Torrent Resources, 2023).
Regarding the effectiveness of this measure, the same Stormwater Management Calculator was used to define the number of 265-gallon (~1 m^3) drywells needed to have around 90 percent reduction in stormwater runoff in a manually defined area. Site characteristics are presented in Figure A9:

Total Land Use
<table>
<tr><th>Land Use</th><th>Original Area</th><th>Area including BMP(s)</th></tr>
<tr><td>Total Impervious Area</td><td>1,885 ft^2</td><td>1,885 ft^2</td></tr>
<tr><td>Flat Roof</td><td>400 ft^2</td><td>400 ft^2</td></tr>
<tr><td>Pitched Roof</td><td>900 ft^2</td><td>900 ft^2</td></tr>
<tr><td>Sidewalk</td><td>585 ft^2</td><td>585 ft^2</td></tr>
<tr><td>Total Landscape Area</td><td>4,190 ft^2</td><td>4,190 ft^2</td></tr>
<tr><td>Lawn/Turf</td><td>3,850 ft^2</td><td>3,850 ft^2</td></tr>
<tr><td>Flower Bed/Garden</td><td>340 ft^2</td><td>340 ft^2</td></tr>
<tr><td>Total BMP Area</td><td></td><td>0 ft^2</td></tr>
<tr><td>Total Lot Area</td><td>6,075 ft^2</td><td>6,075 ft^2</td></tr>
<tr><td>Other Volume Control</td><td></td><td>530 gallons</td></tr>
<tr><td>Drywell</td><td></td><td>530 gallons</td></tr>
</table>
Figure A9. Land use characteristics of the investigated urban home (BMP – best management practice) (CNT, 2020a).

As a result, it was found that for the area specified in Figure A9 and with average rainfall of around 830 mm per year, and 59 mm per storm, 2 drywells are required in order to reduce the runoff volume by 90 percent. In this case, the volume of the drywell was taken as 265 gallons, which corresponds to around 1 m^3.</td></tr>
<tr><td>Flexibility</td><td>Drywells are considered a good solution for aquifer recharge. In 2005 a 10-year study was conducted in Los Angeles aiming to identify the recharging performance of underground drywells. It was found that in this region implementation of drywells could satisfy in total 750,000 houses in terms of water supply for the household needs (City of Elk Grove, 2023).</td></tr>
<tr><td>Maintenance</td><td>Similar to many other flood mitigation measures, infiltration shafts need regular maintenance. It is important to constantly clean the structure by removing accumulated debris, vegetation such as silt and other sources of litter to make sure there is no any stagnant water inside the well (Torrent Resources, 2023).
The City of Elk Grove (2023) mentions that purification of stormwater is always needed before it enters the drywell to reduce concentration of hazardous pollutants, which can create the risk of groundwater contamination. The DWA (2005) states that a filter sack can be installed in the infiltration shaft and utilized for a pre-treatment process.</td></tr>
<tr><td>Impact on climate change</td><td>No effect of drywells on climate change was observed in the literature.</td></tr>
<tr><td>Case study example</td><td>The study of Sasidharan et al. (2021) analysed the performance of the 38-m deep percolation shaft and 70-m wide infiltration pond with the total surface area of 3,847 m^2. Having compared both flood mitigation measures, the study concluded that implementation of five infiltration shafts can reduce significantly more stormwater runoff than one single infiltration pond, which shows a comparative advantage of drywells over infiltration basins.</td></tr>
</table>

	Sasidharan et al. (2018) analysed performance of the Maxwell Type IV implemented in Fort Irwin and Torrance in California. The former one is the National Training Center, whereas the latter one is a commercial organization. The study revealed that the infiltration performance highly depends on the hydraulic conductivity of a soil. It was found that the first drywell located in Fort Irwin could infiltrate nearly 53.2 m^3, while the second drywell only 12.6 m^3 during the period of around 18 h. With the given characteristics for both wells, the study concluded that the Torrance well performed less effectively due to the lower hydraulic conductivity, which could even result in shaft clogging and subsequent overflow.

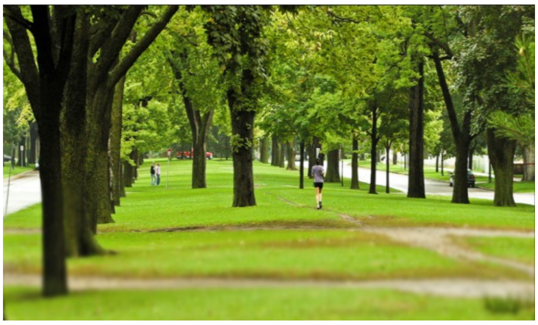
Table A2. Green flood mitigation measures.

Descriptor	Explanation
Measure: afforestation	
Real case example where the measure was applied: United Kingdom (Open Access Government, 2022).	 Figure A10. Afforestation in the United Kingdom (Open Access Government, 2022).
Short summary	Afforestation is a process of converting agricultural lands, marginal lands, or other types of land cover to forests. Here, as a result of the expansion of tree cover in the regions where previously there were no trees, carbon concentration in the air and flood peak discharge can be reduced (Arora and Montenegro, 2011; Johnen et al., 2020).
Feasibility	To implement this measure, first, it is required to find and prepare a land, where afforestation is going to take place. Following this, necessary tree species are selected and suitable fertilizers depending on the selected vegetation type are picked up. When the trees are planted, they should be maintained during the first years (Climate-ADAPT, 2020).
Cost-effectiveness	Afforestation as a flood mitigation option was already studied in previous works of Johnen et al. (2020) and Bezak et al. (2021), who explored the measure in terms of its effectiveness for flood risk management. The former one conducted a cost-benefit analysis to investigate the effect of tree cover expansion on peak flow in the Glinščica River for three return periods: 2, 10, and 25 years. They revealed that with 15-60 percent afforestation, the inundation peak can be decreased by nearly 9-14 percent. In particular, for 2, 10, and 25-years return periods the flood peak was diminished by 14, 10, and 9.5 percent, respectively. Thus, in this case, economic losses can be also reduced as the extent of the inundated area becomes lower as a result of afforestation. Johnen et al. (2020) found that among three investigated return periods, for the 25-year return period the process of afforestation contributed to the flood damage reduction the most. Here, the initial damage costs for the case with the current land-use practices were computed to be around 610,752 euros, whereas with the expansion of forest cover upstream, downstream, and throughout the whole area the total flood damages were significantly lower. Here, as a result of the increase in the tree cover in the upstream, downstream, and in both sections the total damages were reduced by 78, 65, and 80 percent, respectively. However, for the other two return periods, on the other hand, the total damages for all four cases were much lower and did not vary a lot with the difference in tree cover. Besides, the study also analysed the effectiveness of the investigated measure on different ecosystem services based on the three different afforestation scenarios. For example, Johnen et al. (2020) revealed a positive effect of afforestation on biodiversity, water quality, and carbon concentration. With respect to costs, the

	same study found that for 1 ha (10,000 m^2) of land around 3,500 trees are needed. Considering the fact that each tree needs around 1 euro to be planted, the total cost of planting 3,500 trees on 1 ha would be around 3,500 euros. The average price of the cropland that can be used for afforestation, in turn, was found to be around 60,000 euros per ha (Johnen et al., 2020).
Flexibility	By reducing soil moisture content, trees help to decrease the likelihood of landslides. Tree roots act as a barrier against soil displacement, at the same time they strengthen soil layers and attach the soil to bedrock. In addition, forests can also prevent fall of rocks and debris, shorten the run-out distance of landslides, and decrease the risks of soil erosion (RECOFTC, 2012). However, Forbes and Broadhead (2013) state that this is only true for shallow landslides.
Maintenance	According to the Climate-ADAPT (2020), during the first year after afforestation the average maintenance cost of tree cover is around 300 euros per ha (10,000 m^2), whereas during the third year the costs can go down to 100 euros per ha. In general, the maintenance process should be carried out during the first 3-5 years.
Impact on climate change	According to the United Nations, afforestation can be considered as one of the most effective measures in relation to climate change mitigation (Arora and Montenegro, 2011). Trees are known to absorb carbon dioxide, which helps to combat the problem of climate change. For example, 0.8 tons of CO_2 per ha (10,000 m^2) of green cover per year can be processed by urban greenery (CNT, 2020b). At the same time, trees are also known to mitigate the impact of climate change on stormwater runoff. In fact, the effect of climate change on generation of higher amount of precipitation and, as a result, subsequent increase in frequency and magnitude of floods is well known. With the help of rainfall interception forests tend to reduce some amount of precipitation that could potentially reach the ground and produce excess amount of runoff (Zabret and Šraj, 2015). Being more precise, Zabret and Šraj (2015) found that, for example, both *Pinus nigra* and *Betula pendula* could produce substantial results in terms of rainfall interception. In particular, the latter one could intercept up to 51 percent of the precipitation, while the latter one around 30 percent less. However, at the same time, according to Bonan (1997), forests tend to have a lower albedo coefficient, which, in turn, is proportional to the amount of solar radiation being reflected. This implies that croplands are more reflective than trees and, therefore, with the increase in the forest cover over a specific land, the amount of solar radiation absorbed by the trees is also increasing leading to the net climate warming, in particular, in the regions with higher elevations (Arora and Montenegro, 2011).
Case study example	Here, the case study of the upper Chao Phraya River Basin in Thailand can be highlighted. The study was conducted not only to investigate the effect of afforestation on flood risk, but also to compare it with the changes caused by climate change. It was found that afforestation can have a positive effect on flood mitigation; however, this impact is relatively small if compared with the rate of global warming, which we are facing today (Takata and Hanasaki, 2020).
Measure: river re-meandering and floodplain restoration	
Real case example where the measure was applied: Nijmegen, The Netherlands (World Landscape Architecture, 2017).	 Figure A11. Room for the River, Nijmegen, The Netherlands (World Landscape Architecture, 2017).
Short summary	Straightening of rivers as a flood risk reduction measure has faced a lot of disputes due to its negative effects on environmental aspects. Furthermore, river

	straightening can eventually contribute to a significantly higher discharge at the downstream part of the modified river channel, thereby, causing severe floods. Subsequently, as a result of numerous negative consequences, river restoration has taken place in many places to return rivers back to their original state, thereby mitigating flood impacts (Bechtol and Laurian, 2005).
Feasibility	To turn rivers back to their natural state can be quite problematic when the question concerns urban areas, as there is usually not enough available space for natural river meanders in cities (Guimarães et al., 2021).
Cost-effectiveness	Transforming meandering rivers that have previously been straightened back to their natural shape helps to make rivers more morphologically stable, reduce river slope and flow velocity, thereby, reducing risks of bank erosion and the amount of transported water per unit of time. Besides that, river meandering promotes both biological and hydrological diversification of rivers (Bechtol and Laurian, 2005). With respect to costs, Szalkiewicz et al. (2018) analysed 119 river restoration projects in Europe, in particular, their investments in reinstating their natural characteristics. They found that 310,000 euros per ha (10,000 m^2) was the average cost of the river restoration in Europe.
Flexibility	Floodplain restoration can prevent deposition of sediments in the river and decrease the rate of deposition further downstream of the river by allowing sedimentation to occur, namely in the floodplain itself. As a result of the sediment deposition soil quality and fertility can get better. Additionally, by creating a small stone dam on the sides of the floodplain it is possible to reduce the process of erosion. Furthermore, when a land is converted from a simple agricultural land to a forest land with some wetlands, the structure of soil can be improved (Natural Water Retention Measures, 2013).
Maintenance	Maintenance of rivers typically includes the following practices: repair of river bed, removal and control of unnecessary vegetation, regular inspections, removal of rubbish and obstructions, and other activities. According to the Environment Agency (2015), river cleaning costs depend mainly on how this process is done, in particular, whether it is done manually or implementing, for example, special cleaning equipment (mechanically). Furthermore, for rivers that are already properly maintained, the costs for the mechanical cleaning are typically lower than for the manual one. For the former one they vary usually between 1,680–17,096 dollars per km annually, which equals to nearly 1.6-15.7 euros per m per year, whereas for the latter one this number is accounted for 5,730–51,311 dollars per km per year (~5.3-47.2 euros per m per year). Besides that, the same source indicates that the river maintenance costs also depend on the final target state of the river that is planned to be achieved. In addition, when evaluation tests and inspections of the river are carried out, this typically costs 4,049 dollars per km (~3.7 euros per m) of the river length. Additionally, according to the Natural Water Retention Measures (2013), maintenance costs of restoration of the floodplain can usually correspond to 0.5-1.5 percent of the investment costs.
Impact on climate change	Large scale floodplain restoration projects can greatly affect climate conditions. Floodplain restoration can have an impact on the amount of precipitation and peak temperatures as a result of land use changes and, in particular, afforestation practices. Large scale afforestation can influence the evapotranspiration rate leading usually to the higher amount of precipitation. As a result of increased evapotranspiration, reduction in peak temperatures can be noticed. Furthermore, as in this case agricultural and artificial lands usually become converted to forests, the carbon dioxide is absorbed more as a result of the photosynthesis process, which, in turn, can lead to mitigation of climate change (Natural Water Retention Measures, 2013). According to the GeoForschungsZentrum Potsdam and Helmholtz Centre (2021), compared to straight manmade river courses, natural meandering rivers are more capable of removing CO_2 from the air. This happens because non-artificial rivers have much broader space for the erosion of their natural floodplains, thereby transporting accumulated carbon down the river right into the sea. However, artificially made straight rivers/channels cause the

	decomposition of carbon back to carbon dioxide allowing only suspended load to flow through the river section.
Case study example	"Room for the River" in The Netherlands is an example of the project where restoration of the river took place. The main objective of the project was to increase the capacity of the river discharge by implementing river modifications at 35 different locations on the Rhine River. This was accomplished by lowering the bed of the Rhine River with the following activities: river widening, river bed excavation, putting dikes at a farther distance from the river, making floodplains lower as they were before, etc. The total investment costs of the project were calculated to be around 2.64 billion dollars, which equals to nearly 2.4 billion euros (Aerts, 2018). Bechtol and Laurian (2005) showed the Napa River Flood Protection Project as a sustainable flood risk reduction example. This study has demonstrated how fluvial floods can be mitigated with the help of the restoration of the natural characteristics of the Napa River. In particular, in this project original floodplains of the river were restored by straightening it to its natural state (Bechtol and Laurian, 2005).
Measure: rain gardens	
Real case example where the measure was applied: St. Paul campus rain garden (The University of Minnesota) (Asleson et al., 2010).	 Figure A12. Rain garden (NOAA's Office for Coastal Management, 2015).
Short summary	Rain garden represents a small garden with planted shrubs, flowers, grass and other vegetation, usually located in the low-lying areas down the slope in order to collect stormwater runoff (NOAA's Office for Coastal Management, 2015). The rain gardens are designed in such a way that they can receive excess amounts of water coming from roofs, roads, lawns and other ways, consequently infiltrating it into the soil (Groundwater Foundation, 2022).
Feasibility	Rain gardens should be placed near buildings to be able to capture stormwater runoff coming from roofs, lawns, different kinds of pavements and other ways. To build the rain garden it is important to replace natural soil with the porous one so that necessary vegetation can favorably develop and excess amounts of water can be easily infiltrated. It is necessary to make sure that the garden gets dry fast enough after each rainfall event in order not to create a favorable medium for mosquitoes' growth (Qin, 2020).
Cost-effectiveness	The costs of rain gardens depend on different factors, in particular, what plant species are chosen, area of the garden, type of soil, etc. In addition, the costs depend on whether the garden is built hiring special landscaping company or if it is just a self-built rain garden. For the former one the installation costs vary between 10-15 dollars per square foot (nearly 100-150 euros per m^2), whereas for the latter one the price varies between 3-5 dollars per square foot, which equals to nearly 30-50 euros per m^2 (Groundwater Foundation, 2022). According to the Stormwater Management Calculator of the CNT (2020a), the capital cost of construction of a 100 ft^2 (~9.3 m^2) rain garden in the United States is nearly 607 dollars, which equals nearly 558 euros, whereas maintenance costs of the garden with the same area is 41 dollars per year (~37.7 euros per year). In this case, the same source mentions that the useful life of the rain garden is 22.5 years. In general, rain gardens are considered as an effective way of regulating runoff as they collect stormwater and allow it to be infiltrated deep into the ground, thereby, producing groundwater recharge. At the same time vegetation can help to filter the water from contaminants, such as fertilizers, dirt, litter, machine oil,

	which are accumulated in water while it passes on the top of driveways, roofs and other ways (NOAA's Office for Coastal Management, 2015).
Flexibility	No particular evidence indicating effectiveness of rain gardens on risk reduction of any other hazards was found in the literature. However, there are some sources that describe less significant benefits of rain gardens compared to stormwater runoff reduction, such as removal of sediments and pollutants in the stormwater runoff (Dietz and Clausen, 2005; Groundwater Foundation, 2022).
Maintenance	Rain gardens usually do not require implementation of fertilizers or pesticides, except the first year, since in this case typically native plant species are used. In general, during the first couple of years when the rain garden is set up, it is required to remove unnecessary weeds, dead plants and other vegetation that can prevent sustainable growth of normal plants and degrade aesthetics. When native plants take root and become well-established, they will be able to displace the weeds by themselves. Additionally, during the first years in case of lack of rainfall, it may be required to water the gardens in order to sustain the normal plant growth (Groundwater Foundation, 2022).
Impact on climate change	No relevant literature indicating significant influence of rain gardens on mitigation of climate change was found.
Case study example	Dietz and Clausen (2005) studied the effectiveness of rain gardens in terms of stormwater runoff reduction in Haddam. They found that this flood mitigation measure can be highly effective in mitigating flood impact, in particular, the study revealed that nearly 98.8 percent of water, which came from the roof, infiltrated into the soil and the rest was observed as overflow.
Measure: urban parks and urban forests	
Real case example where the measure was applied: Danube-Auen National Park in Vienna, Austria; Parkforest in Ghent, Belgium; Forest Ostend in Belgium (Network Nature, 2023).	 Figure A13. Urban park (Minnesota Pollution Control Agency, 2022).
Short summary	In the past years with the expansion of cities and overall urban development there was a tendency in urban areas to cut down trees and remove vegetative canopy from the ground, at the same time increasing the number of impermeable surfaces, which consequently led to the dramatic increase in the stormwater runoff and, as a result, generation of floods. However, trees play an important role in the water cycle, in particular, its canopy can intercept rain water allowing a part of it to evaporate back into the atmosphere, tree roots help stormwater runoff to percolate deeper into the soil and improve soil water holding capacity (Kuehler et al., 2017).
Feasibility	As impervious urban surfaces such as driveways are an integral part of an urban environment and it is quite difficult to remove all non-permeable pavements that are increasing stormwater runoff, urban forests on their own won't be able to combat the issue of high runoff volumes (Kuehler et al., 2017). Kuehler et al. (2017) also mention that only in combination with other stormwater reduction techniques urban forests will be able to reduce sufficient amounts of runoff.
Cost-effectiveness	McPherson et al. (2005) argue that in the United States, for example, the average price of an urban tree is in the range between 12.87-65 dollars, which equals nearly 11.8-60 euros. However, according to the Stormwater Management Calculator of the CNT (2020a), the capital cost of one tree in the United States is nearly 250 dollars (~230 euros), whereas maintenance costs of the tree is 180 dollars per year (~165 euros per year). In this case, the same source mentions that the useful life of one tree corresponds to 80 years.
Flexibility	As it was already mentioned in the section for afforestation, tree cover can only have an effect on shallow landslides, whereas for deep-seated landslides the

	impact is insignificant. In particular, trees can cope with minor landslides by preventing fall of rocks, strengthening and drying soil, which, in turn, helps to reduce water pressure in the soil (Forbes and Broadhead, 2013). In addition, with respect to the same section related to afforestation, as Zabret and Šraj (2015) mention in their study, trees can also mitigate the effect of climate change, particularly, by reducing the amount of precipitation reaching the ground as a result of the interception process.
Maintenance	With respect to Vogt et al. (2015), urban trees should be properly maintained through their whole life time, in particular, maintenance actions include pruning, disease and pests control, mulching, watering, fertilizing, providing support system for trees and other activities. Tree support system, in turn, implies provision of various support structures for trees such as cabling or bracing that help to support the tree truck at a time when it is highly vulnerable. In addition, such a support system is usually implemented for young trees that are particularly vulnerable and unstable, especially in windy regions (Vogt et al., 2015). Following this, watering of urban forests is an important step in maintaining their life: without sufficient watering trees may not survive, especially when the tree is just getting established during the first years. Another important maintenance step refers to infrastructure repair. This includes damages to drainage pipes, driveways, parking lots and other types of pavements by the root system. The damaged surfaces are then fixed or replaced by the new ones, and the tree roots are pruned if necessary.
Impact on climate change	According to Nowak and Crane (2002), trees in urban areas can store nearly 700 million tons of carbon. Safford et al. (2013) also mention that more than 708 million tons of carbon in the United States is stored by urban forests, which is estimated to be more than one-tenth of all CO_2 emissions that are produced in the country per year. Additionally, every year trees in urbanized regions of the United States also absorb 28.2 million tons of carbon.
Case study example	Rahman et al. (2023) analysed 92 papers to investigate the effectiveness of urban tree cover on flood risk management. The study revealed that compared to different land use types, forests have the highest potential in reducing stormwater runoff. It was found that conifer is considered to be the most effective tree type in terms of annual flood risk management as it has the highest transpiration and interception characteristics. However, its soil infiltration capacity is inferior to broadleaved trees. In general, Rahman et al. (2023) concluded that additional 4 percent reduction in excess amount of stormwater can be achieved with the 30 percent increase in the conifer canopy in areas experiencing essential amount of precipitation during the cold season, whereas 20 percent increase is expected to provide the same amount of additional runoff reduction for regions with only wet climate conditions.
Measure: infiltration ponds/basins	
Real case example where the measure was applied: Lehigh County in Pennsylvania (Pennsylvania Department of Environmental Protection, 2005).	 Figure A14. Infiltration pond (US EPA, 2021b).
Short summary	Infiltration pond or basin is an example of a green flood mitigation measure that is used to reduce stormwater runoff usually generated as a result of the increased number of impervious surfaces in urban areas, which do not allow water to be infiltrated into the soil (Massmann, 2003).

Feasibility	The Environment Agency (2015) specifies that infiltration ponds or basins have unlimited service life; however, only if topsoil material is replaced and tilling is performed every 5-10 years. As Massmann (2003) states, the design procedure of infiltration ponds is usually quite complicated, since projections of infiltration rates are known to be highly uncertain. In addition, it is important to choose the right dimensions for the basin due to the unfavorable consequences the improper design can cause. In particular, an infiltration pond with dimensions less than it is required can lead to flooding and, on the contrary, a pond with over-sized dimensions can be relatively ineffective with respect to the amount of land used and money spent (Massmann, 2003). With respect to the US EPA (2021b), one of the limitations of this type of pond is that not all soil types are applicable to them. For example, soil that infiltrates water at a slow rate or that is highly compacted is not considered as a good choice for this type of flood mitigation measure. In addition, before constructing the infiltration pond it is important to make sure that groundwater level is relatively low to allow excess stormwater to infiltrate easily.
Cost-effectiveness	As the Environment Agency (2015) states, in the United Kingdom the cost of one m^3 of the pond volume corresponds to nearly 10-15 pounds, which is close to 11.5-17 euros. According to King and Hagan (2011), in the United States the total construction cost of the retention basin is estimated to be around 55,000-85,000 dollars per acre of land, which, in turn, corresponds to nearly 12.5-19.3 euros per m^2. With regard to efficiency of infiltration basins, Sasidharan et al. (2021) argue that although infiltration basins are widely implemented for stormwater runoff management, this measure still cannot provide sufficient decrease in volume of the stormwater runoff in urban areas. Furthermore, clogging of infiltration basins always remains an issue. As a result of accumulation of contaminants and sediment disposal at the bottom of the pond, the infiltration capacity of the basin significantly decreases leading even to frequent overflows. To solve the problem regular maintenance is needed, which also requires sufficient financial resources (Sasidharan et al., 2021).
Flexibility	As the US EPA (2021b) states, infiltration ponds help to remove pollutants from the stormwater, thereby preventing these contaminants from entering groundwater.
Maintenance	According to the Environment Agency (2015), the cost of systematic maintenance of the infiltration basin is around 0.6 pounds per m^2 (~0.68 euros per m^2), while for periodic (less frequent) maintenance it goes up to 3.0 pounds for the same area, which equals nearly 3.5 euros. For example, the same source states that one of the intermittent/periodic maintenance practices for ponds is silt removal once every three years, which usually costs around 500 pounds (~570 euros) for one infiltration pond. Besides that, another intermittent activity that the source specifies refers to removal of polluted sediments and plantation of new aquatic vegetation. For these activities the price varies between 50-60 pounds and 3-5 pounds per m^2 (~57-68.5 and 3.4-5.7 euros per m^2), respectively. However, the report does not specify how often these two maintenance activities should be carried out. With respect to the required maintenance activities for infiltration basins, the US EPA (2021b) states that in case of clogging, which leads to poor infiltration capacity of the pond, the top layer of the soil should be replaced with the new one. Furthermore, regular inspections, preferably once in a month, should be conducted to check the pond for debris, eroded areas, stability of the structure and to remove mow grass, if necessary. Once every five years the basin should be inspected for sedimentation: accumulated sediments should be removed from the bottom of the basin, if necessary.
Impact on climate change	No particular evidence of the effectiveness of infiltration ponds in terms of mitigating impact of climate change was found in the literature.
Case study example	Helles and Mogheir (2022) investigated infiltration capacity and different factors affecting this parameter of three infiltration basins in the Gaza Strip. The study revealed that rate of infiltration of the basins highly depends on the amount of

	sedimentation that is accumulated inside these water infiltrating facilities as a result of clogging of the bottom layer. Furthermore, the study also concluded that infiltration capacity is directly proportional to the depth of the accumulated stormwater inside the basins. However, this is only true when the depth reaches a particular point after which the infiltration rate starts slowing down.

Table A3. Hybrid flood mitigation measures.

Descriptor	Explanation
Measure: retention reservoirs (wet reservoirs)	
Real case example where the measure was applied: Radzyny retention reservoir in Poznan, Poland (Waligórski et al., 2019).	 Figure A15. Retention reservoir Radzyny located in Poznan, Poland (Waligórski et al., 2019).
Short summary	Retention reservoir, also known as wet reservoir, is known as a special type of water storing infrastructure that is mainly used to reduce peak flow during floods. In contrast to detention (dry) reservoirs, retention ones store water on a permanent basis, which, in turn, also allows usage of the water for other purposes, such as agriculture, supply of water for residential areas, hydropower generation and others (Connecting Nature, 2020; Eastcoast Sitework, 2021).
Feasibility	During the implementation of the Podutik retention reservoir, for example, several difficulties were observed. In particular, it was quite complicated to get sufficient funds for the project and permissions from water-related organizations. Besides, poor communication between stakeholders was another factor hindering the process (Connecting Nature, 2020).
Cost-effectiveness	Bezak et al. (2021) mentioned in their study that the reconstruction of the Podutik retention reservoir was around 500,000 euros, whereas the construction cost, for example, of the Brdnikova detention reservoir located near Ljubljana accounted for 2,400,000 euros. According to the Connecting Nature (2020), the benefits of Podutik retention reservoir include the following: protection from floods, improvement in biodiversity, reduction in water pollution, recreational activities, irrigation purposes, etc.
Flexibility	As it was already mentioned in the section for dams, large reservoirs can be highly effective in reducing sedimentation in the downstream parts by retaining significant portions of nutrients (Tiessen et al., 2011).
Maintenance	According to the Eastcoast Sitework (2021), maintenance of retention ponds includes the following practices: regular removal of sediments, control of reservoirs against erosion, inspection of infrastructure to detect damages after heavy rainfall, removal of rubbish, unnecessary vegetation, etc.
Impact on climate change	No proof of the influence of retention ponds for flood mitigation on climate change was found in the literature.
Case study example	Bezak et al. (2021) studied the effect of Podutik retention and Brdnikova detention reservoirs in the Glinščica River catchment on flood risk. The study revealed relatively high effectiveness of the Brdnikova detention reservoir in reducing peak discharge during floods for two investigated return periods. Here, for return periods of 2 and 25 years the percentage of reduced peak discharge was 32 and 45 percent, respectively. However, for the second Podutik retention reservoir the results were quite different with a 30-percent peak discharge decrease for 25- and only 5 percent for the 2-years return period (Bezak et al., 2021).

Measure: detention reservoirs/basins (dry reservoirs)	
Real case example where the measure was applied: Meissen, Saxony, Germany (Interreg Central Europe, 2020); Savinja Valley, Slovenia (Glavan et al., 2020).	  Figure A16. Small detention basin (left picture) and clogging of outlet of the basin (right picture) (Sustainable Stormwater Management, 2009).
Short summary	Implementation of detention ponds/reservoirs is one of the methods to manage flood risks. The main purpose of detention reservoirs during floods is to temporarily store water, thereby decreasing flood peak and subsequently mitigating its possible negative consequences (Ngo et al., 2016).
Feasibility	Detention reservoirs should be constructed above the flood-prone region. In general, marshy lands and natural lakes can be considered as a land for reservoir construction, since usually they cannot be used for any other economic purposes. During the design procedure of the reservoir it is important to consider the probability of overtopping and perform the design of the flood mitigation infrastructure in the corresponding way (Majidi, 2020). With respect to the costs, Hettiarachchi (2011) argues that compared to other flood mitigation strategies, implementation of the detention reservoir for flood control can be seen as a sustainable and cost-efficient option.
Cost-effectiveness	As it was previously mentioned in the section for wet retention reservoirs, the cost, for example, of the construction of the Brdnikova detention reservoir was around 2,400,000 euros (Bezak et al., 2021).
Flexibility	As it was already mentioned in the section for dams, the study of Tiessen et al. (2011) demonstrated the effectiveness of large reservoirs in reducing undesirable sedimentation in the downstream regions.
Maintenance	Without proper construction and further maintenance, reservoir condition can rapidly deteriorate, eventually leading to a shorter service life and its inability to use. When the detention reservoir does not meet the desirable construction and maintenance standards, and is old enough, its reliability is in doubt. Thus, its regular maintenance is a crucial step in sustaining necessary reservoir characteristics and main purposes (Majidi, 2020). According to Rollins (2020), mechanical maintenance of structural elements of the basin, vegetation, debris and sedimentation control in the inlet and outlet pipes, and in the reservoir itself are the main maintenance steps during the lifespan of the reservoir. The Environment Agency (2015) mentions that 50 pounds (~57 euros) should be spent monthly to remove debris and any other source of litter from inlet and outlet pipes, whereas for valve inspection it is required to pay 10 pounds (~11.5 euros) once every six months. Visual control of the structure costs 15 pounds per month, which equals nearly 17 euros per month.
Impact on climate change	No relevant information about the impact of the dry reservoirs on mitigation of climate change was found.
Case study example	One example of such a reservoir is Olmos Creek detention reservoir located in San Antonio, Texas. The main purpose of the reservoir is regulation of floods during emergency events. However, the reservoir also serves for other additional purposes, such as sedimentation and debris control. The detention reservoir traps contaminants and litter, thereby, preventing different kinds of pollutants from entering the municipal water distribution system. Besides that, one of unique features of this water storing multifunctional facility is that it is located right in the urban area and additionally serves for recreational activities (Majidi, 2020).

Measure: green roofs	
Real case example where the measure was applied: Basel, Switzerland (Climate-ADAPT, 2016).	 Figure A17. Green roof (NOAA's Office for Coastal Management, 2015).
Short summary	Green roofs are one of the nature-based solutions that help not only to deal with increasing flood risks, but also have other no less important benefits such as creation of a proper environment for biodiversity development, provision of thermal comfort in buildings, reduction in energy consumptions and environmental pollution, improvements of the aesthetic appearance of buildings, etc. (Basu et al., 2021).
Feasibility	According to the Climate-ADAPT (2016), green roofs have a lifespan of around 50 years. With respect to implementation time, in Basel in Switzerland, for example, two governmental green roof initiative programs in 1996 and 2005 lasted for about 2 years each (Climate-ADAPT, 2016).
Cost-effectiveness	With one-tenth of buildings having green roofs installed, total stormwater runoff in the city can be reduced by 2.7 percent. Furthermore, in this case 54 percent decrease in runoff is estimated if considering buildings individually (Mentens et al., 2006). Furthermore, a study conducted by Jarosińska and Gołda (2020) revealed that a high number of green roofs in a city can contribute to the reduction of stormwater runoff and, as a result, improve its retention by 12.2-16.9 percent. Pervious concrete, for example, on the other hand, shows less effective results than green roofs in terms of rainwater reduction during floods improving retention just by 5.2-5.7 percent. Despite the positive impact of green roofs on flood risks, green stormwater infrastructure can also contribute to energy savings. Green roofs can provide insulation and decrease interior temperatures in buildings, as a result, reducing utility costs, by shading the buildings from the sun with the help of vegetation cover (CNT, 2020b). With respect to costs, as Francis and Lorimer (2011) state, installation costs are one of the major challenges of green roofs. From an economical perspective, the implementation of green roofs cannot be considered an economically feasible investment unless energy savings are taken into account. With the help of green vegetation on roofs, energy consumption can be improved, saving up to 215 dollars per year per building (~198 euros per year). Considering the fact that it will take a lot of time to get payback, more aspects should be considered to analyze the feasibility of green roofs before their installation (Francis and Lorimer, 2011). Furthermore, in cold climates green roofs cannot be seen as the most feasible solution due to low heating energy savings (Feng and Hewage, 2014). However, this is only the case if except flood risk reduction, energy savings are also another important factor to be considered during implementation. The Environment Agency (2015) mentions that depending on the cover material of the green roof the price is usually different. For example, for the sedum mat roof the cost is around 90 pounds per m^2, while for biodiverse one it is reduced to 80 pounds per m^2 (~103 and 91 euros per m^2, respectively).
Flexibility	No evidence indicating the effectiveness of green roofs on risk reduction of any other hazards was found in the literature.
Maintenance	Francis and Lorimer (2011) in their study highlight that the major limitation of this measure refers to its maintenance. The study conducted by Silva et al. (2015) on maintenance actions of green roofs in Mediterranean areas showed that green roof cover should undergo regular maintenance. Here, maintenance practices

	mainly concern gardening activities, which, in turn, include fertilization, removal of unnecessary and infested plant species, cleaning of roofs, a constant check of pests, etc. Furthermore, an irrigation system is another important aspect of green roofs that should be properly controlled and maintained. An irrigation system provides water for necessary plants to grow, thereby, also ensuring the proper development of vegetation. Besides, the drainage system of green roofs should be constantly cleaned from unnecessary debris and technical inspection on a regular basis should be present (Silva et al., 2015). According to the Environment Agency (2015), the maintenance costs also depend on the material, which is used to cover the roof, for example, sedum mat or biodiverse roof. The Environment Agency (2015) states that for the former one the price is around 2,500 pounds (~2,852 euros) per year during the first 2 years after implementation, while for the latter one the cost is 1,250 pounds (~1,426 euros) for the same period. After 2 years the annual maintenance costs are 600 and 150 pounds, which corresponds to nearly 685 and 171 euros, respectively.
Impact on climate change	One of the positive aspects of green roofs refers to their ability to combat climate change (CNT, 2020b). At the same time roof vegetation promotes the adaptation of cities to rapidly changing environmental conditions (Jarosińska and Gołda, 2020). The same as for afforestation, green roofs help to sequester carbon dioxide from the air, thereby, slowing down the process of global warming. According to the CNT (2020b), in the United States the annual value of reduced carbon dioxide as a result of decreased energy consumption was around 129 euros per ha (10,000 m^2) of trees. Besir and Cuce (2018) state that carbon dioxide emissions can be decreased annually by 2.2 × 103 kg by using double-skin green facades and at the same time approximately 133 kg of carbon dioxide can be decreased annually by a tree of a middle-size (Wong and Baldwin, 2016).
Case study example	Karteris et al. (2016) analysed how effective it would be to implement green roofs at the Thessaloniki Municipality in Greece. Here, despite such benefits as energy savings and enhancement of biodiversity, the study revealed that the expansion of green roofs by 7 times in the municipality can reduce rainwater runoff up to 45 percent.
Measure: stormwater tree trenches	
Real case example where the measure was applied: the City of Vancouver, Canada (Vega, 2018).	 Figure A18. Schematic representation of stormwater tree trench system (NOAA's Office for Coastal Management, 2015).
Short summary	Stormwater tree trenches (STT) represent a sequence of trees joined to each other below the ground by a trench system to manage the excess amount of stormwater (NOAA's Office for Coastal Management, 2015). STTs also provide a healthy environment for trees for sustainable growth in urban areas where impermeable pavements are dominating. With the special underground system engineered with soil medium, inlet, outlet pipes and special water distribution system, which allows stormwater to infiltrate and drain into the drainage system.
Feasibility	For SSTs special tree species should be selected in order to ensure that they will be able to survive in the urban environment. For such stormwater management system enough space for tree roots is required for a proper tree growth and development. Besides that, it is important to make sure that the tree roots will not touch any kind of underground structures, such as signs, pipes, building foundations, electric wires, etc.

	The Environment Agency (2015) reports that infiltration trenches have unlimited service life; however, it is required to change the filtering material every 10-15 years.
Cost-effectiveness	Some of the benefits of STTs include groundwater recharge, regulation of the stormwater runoff, air quality improvement, water quality enhancement through uptake of contaminants by vegetation (vegetative filtering). Additionally, according to McPherson et al. (2005), trees in urban areas are expected to save 485.8 million dollars (~447 million euros) or 2.5 percent of energy spent on air conditioning per year. The energy consumption associated with trees occurs as a result of shading effect, decrease in the number of impermeable pavements, cooling due to evapotranspiration process that trees provide (Minnesota Pollution Control Agency, 2022). With respect to costs, the Environment Agency (2015) reports that the cost of infiltration trenches is accounted for nearly 60 pounds per m^2, which corresponds to nearly 68.5 euros per m^2.
Flexibility	No evidence indicating the effectiveness of tree trenches on risk reduction of any other hazards was found in the literature, except stormwater filtration - removal of pollutants from the stormwater (US EPA, 2013).
Maintenance	The NOAA's Office for Coastal Management (2015) states that STTs require regular maintenance in order to keep the system in a desirable condition. In particular, it is necessary to water the trees, constantly make inspections in order to remove garbage and other sources of litter, control invasive species and maintain the pipes for stormwater to flow properly. In addition, the same source mentions that STTs have to be cleaned twice in a year. With respect to maintenance costs, the Environment Agency (2015) states that maintenance of infiltration trenches usually costs around 0.2-1.0 pounds per m^2 (~0.23-1.14 euros per m^2).
Impact on climate change	As it was already discussed in the sections for afforestation and urban forests, trees play an important role in climate change mitigation due to carbon sequestration. The US EPA (1998) states that depending on the type and the rate of development, a mature tree normally absorbs roughly 50 pounds (~57 euros), which equals to nearly 22.7 kg of CO_2 annually.
Case study example	Vega (2018) investigated the performance of the STTs in Vancouver, Canada. According to estimates of 2016, more than half of the surface area of the city was covered with impervious surfaces in this year. High number of impervious pavements leading to generation of relatively huge amounts of stormwater runoff made it necessary to promote sustainable design of the city, where the STTs were also implemented. Here, the report concludes that STT systems can be quite successful in managing stormwater runoff by allowing water to be infiltrated into the soil, especially in densely developed cities such as the City of Vancouver. Furthermore, based on the conducted literature review on the performance of STTs in Europe, United States and some other regions, Vega (2018) found STTs as a cost-effective infrastructure solution.
Measure: permeable vegetated surfaces (in parking lots)	
Real case example where the measure was applied: Horizon Village, Oregon (Environmental Oregon Council, 2014).	 Figure A19. Grass-concrete pavement (Atelier GROENBLAUW, 2016).

	 Figure A20. Open paving pattern (Atelier GROENBLAUW, 2016).
Short summary	Permeable surfaces in urban areas allow penetration of excess amounts of water during rain events. Although pervious pavements were already discussed in the section for grey measures, in this case permeable vegetated (grassed) surfaces are going to be analysed. Permeable vegetated pavements, such as, for example, grass-concrete pavers, usually have concrete piles with vegetated spaces in-between, which allow water to be infiltrated into the soil. Road bricks filled with soil and vegetation, such as grass, can be also used as a type of pervious pavement (Atelier GROENBLAUW, 2016).
Feasibility	According to the Atelier GROENBLAUW (2016), in case of heavy rainstorm events such kind of permeable surfaces is not always a good solution for stormwater runoff management. For heavy rains permeable surfaces will not be able to process the whole amount of excess water, which makes it necessary to additionally implement other flood mitigation measures. In addition, this type of pavement is usually implemented in parking lots, surfaces near garages and other pavements, which are not utilized intensively. Furthermore, another limitation, for example, of the so-called open paving patterns (Figure A20) concerns mainly its inability to sustain heavy loads.
Cost-effectiveness	According to the Verity Supply (2023), a commercial building company, the cost of a 240 ft^2 (~22.3 m^2) grassed-concrete permeable pavement is 1,020 dollars, which equals nearly 938 euros.
Flexibility	Besides reduction of the stormwater runoff, vegetated pervious pavements are also known to remove pollutants from the contaminated stormwater, but over time, this ability may deteriorate (Soil Retention, 2023).
Maintenance	The Soil Retention (2023) mentions that in general for all permeable pavement types including vegetated pervious surfaces the maintenance procedure is not complicated until there is no clogging of pavement pores. With respect to maintenance activities, it is important to carry out periodic site inspections in order to make sure that there is no flow of sedimented water from other facilities that may block pavement openings with sediments. Furthermore, it is necessary to control vegetation against undesirable diseases and better choose vegetation that is resistant to salt. In addition, after each flood event with the inundation depth exceeding 0.5 inch (1.27 cm), site check-ups should be conducted to exclude the risk of stagnant water (Soil Retention, 2023).
Impact on climate change	Vegetation over pervious concrete surfaces is known to absorb CO_2 and reduce so-called Urban Heat Island effect as a result of the cooling process caused by evapotranspiration (Soil Retention, 2023).
Case study example	The Environmental Oregon Council (2014) presents one example of a residential area in the Horizon Village in Oregon where grassy pervious pavement was implemented in its parking lots. Here, a combination of polyethylene panels and grass was introduced to create a permeable pavement able to manage stormwater runoff. The pavement itself is able to withstand 35.842 tons of load per ft^2 (~0.0929 m^2).  Figure A21. Pervious pavement in the Horizon Village in Oregon (Environmental Oregon Council, 2014).

APPENDIX B: Calculation of average CNs of each subbasin for the selected flood mitigation measures.

Table B1. Average CN of subbasin 1 after application of tree trenches for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 1			
RABA_ID	CN	Total area	Land use
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1775784	built and similar areas
3000	24	36240	tree trenches
7000	99	12212	water
	79	**7075600**	

SCENARIO 5,6,7,8: SUBBASIN 1			
RABA_ID	CN	Total area	Land use
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1621762	built and similar areas
3000	24	190263	tree trenches
7000	99	12212	water
	77	**7075601**	

Table B2. Average CN of subbasin 2 after application of tree trenches for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 2			
RABA_ID	CN	Total area	Land use
1100	86	350268	field
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1947769	built and similar areas
3000	24	39750	tree trenches
7000	99	49065	water
	80	**5883998**	

SCENARIO 5,6,7,8: SUBBASIN 2			
RABA_ID	CN	Total area	Land use
1100	86	350268	field
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1778830	built and similar areas
3000	24	208690	tree trenches
7000	99	49065	water
	77	**5883999**	

Table B3. Average CN of subbasin 3 after application of tree trenches for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 3			
RABA_ID	CN	Total area	Land use
1100	86	168599	field
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	2105542	built and similar areas
3000	24	42970	tree trenches
7000	99	11054	water
	84	**3587207**	

SCENARIO 5,6,7,8: SABBASIN 3			
RABA_ID	CN	Total area	Land use
1100	86	168599	field
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	1922919	built and similar areas
3000	24	225594	tree trenches
7000	99	11054	water
	80	**3587208**	

Table B4. Average CN of subbasin 1 after application of rain gardens for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 1				SCENARIO 5,6,7,8: SUBBASIN 1			
RABA_ID	**CN**	**Total area**	**Land use**	**RABA_ID**	**CN**	**Total area**	**Land use**
1100	86	468347	field	1100	86	468347	field
1190	86	1499	greenhouse	1190	86	1499	greenhouse
1222	86	57904	orchard	1222	86	57904	orchard
1300	72	1501286	meadow	1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)	1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes	1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use	1600	91	35343	agricultural field but not in use
2000	74	2966239	forest	2000	74	2966239	forest
3000	91	1540220	built and similar areas	3000	91	1268417	built and similar areas
3000	49	271804	rain gardens	3000	49	543607	rain gardens
7000	99	12212	water	7000	99	12212	water
	78	**7075600**			**76**	**7075600**	

Table B5. Average CN of subbasin 2 after application of rain gardens for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 2				SCENARIO 5,6,7,8: SUBBASIN 2			
RABA_ID	**CN**	**Total area**	**Land use**	**RABA_ID**	**CN**	**Total area**	**Land use**
1100	86	350268	field	1100	86	350268	field
1190	86	0	greenhouse	1190	86	0	greenhouse
1222	86	10090	orchard	1222	86	10090	orchard
1300	72	387574	meadow	1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)	1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes	1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use	1600	91	8013	agricultural field but not in use
2000	74	3023740	forest	2000	74	3023740	forest
3000	91	1689392	built and similar areas	3000	91	1391264	built and similar areas
3000	49	298128	rain gardens	3000	49	596256	rain gardens
7000	99	49065	water	7000	99	49065	water
	79	**5883998**			**76**	**5883999**	

Table B6. Average CN of subbasin 3 after application of rain gardens for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 3				SCENARIO 5,6,7,8: SUBBASIN 3			
RABA_ID	**CN**	**Total area**	**Land use**	**RABA_ID**	**CN**	**Total area**	**Land use**
1100	86	168599	field	1100	86	168599	field
1190	86	3675	greenhouse	1190	86	3675	greenhouse
1222	86	3521	orchard	1222	86	3521	orchard
1300	72	470106	meadow	1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)	1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes	1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use	1600	91	3086	agricultural field but not in use
2000	74	674228	forest	2000	74	674228	forest
3000	91	1826236	built and similar areas	3000	91	1503959	built and similar areas
3000	49	322277	rain gardens	3000	49	644554	rain gardens
7000	99	11054	water	7000	99	11054	water
	81	**3587207**			**77**	**3587208**	

Table B7. Average CN of subbasin 1 after application of permeable sidewalks for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 1			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1703303	built and similar areas
3000	82	108721	permeable sidewalks
7000	99	12212	water
	79	**7075600**	

SCENARIO 5,6,7,8: SUBBASIN 1			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1431499	built and similar areas
3000	82	380525	permeable sidewalks
7000	99	12212	water
	79	**7075600**	

Table B8. Average CN of subbasin 2 after application of permeable sidewalks for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SUBBASIN 2			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	350268	field
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1868269	built and similar areas
3000	82	119251	permeable sidewalks
7000	99	49065	water
	80	**5883998**	

SCENARIO 5,6,7,8: SUBBASIN 2			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	350268	field
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1570141	built and similar areas
3000	82	417379	permeable sidewalks
7000	99	49065	water
	79	**5883999**	

Table B9. Average CN of subbasin 3 after application of permeable sidewalks for scenarios 1-4 on the left side and scenarios 5-8 on the right side (units of total area: m^2).

SCENARIO 1,2,3,4: SABBASIN 3			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	168599	field
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	2019602	built and similar areas
3000	82	128911	permeable sidewalks
7000	99	11054	water
	85	**3587207**	

SCENARIO 5,6,7,8: SUBBASIN 3			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	168599	field
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	1697325	built and similar areas
3000	82	451188	permeable sidewalks
7000	99	11054	water
	83	**3587208**	

Table B10. Average CN of subbasin 1 after application of urban tree cover for scenarios 1-4 (units of total area: m^2).

SCENARIO 1,2,3,4: SABBASIN 1			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	468347	field
1190	86	1499	greenhouse
1222	86	57904	orchard
1300	72	1501286	meadow
1410	91	100442	agricultural field (overgrown)
1500	74	120304	trees and bushes
1600	91	35343	agricultural field but not in use
2000	74	2966239	forest
3000	91	1559390	built and similar areas
3000	72	252634	urban tree cover
7000	99	12212	water
	78	**7075600**	

Table B11. Average CN of subbasin 2 after application of urban tree cover for scenarios 1-4 (units of total area: m^2).

SCENARIO 1,2,3,4: SABBASIN 2			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	350268	urban forest
1190	86	0	greenhouse
1222	86	10090	orchard
1300	72	387574	meadow
1410	91	29089	agricultural field (overgrown)
1500	74	38640	trees and bushes
1600	91	8013	agricultural field but not in use
2000	74	3023740	forest
3000	91	1709267	built and similar areas
3000	72	278253	urban tree cover
7000	99	49065	water
	80	**5883998**	

Table B12. Average CN of subbasin 3 after application of urban tree cover for scenarios 1-4 (units of total area: m^2).

SCENARIO 1,2,3,4: SABBASIN 3			
RABA_ID	**CN**	**Total area**	**Land use**
1100	86	168599	urban forest
1190	86	3675	greenhouse
1222	86	3521	orchard
1300	72	470106	meadow
1410	91	47607	agricultural field (overgrown)
1500	74	56819	trees and bushes
1600	91	3086	agricultural field but not in use
2000	74	674228	forest
3000	91	2024240	built and similar areas
3000	72	124273	urban tree cover
7000	99	11054	water
	84	**3587207**	

APPENDIX C: Results of the hydrological modelling using synthetic rainfall events.

Table C1. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, green roofs).

GREEN ROOFS SCENARIO 1						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.3	7.6	5.9	5.3	5.2	4.6
Glin in Grad	8.5	9.2	5.8	6.4	5.3	5.6
Reach-1	6.8	7.6	5.4	5.3	4.9	4.6
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	14.8	13.2	9.6	9.6	8.8	8.4

Table C2. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, green roofs).

GREEN ROOFS SCENARIO 2						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	3.9	3.1	2.8	2.9	2.4
Glin in Grad	3.4	2.8	2.5	2.0	2.3	1.8
Reach-1	3.8	3.9	2.9	2.8	2.7	2.4
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C3. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, green roofs).

GREEN ROOFS SCENARIO 3						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	2.8	2.6	2.2	1.8	1.9	1.6
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C4. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, green roofs).

GREEN ROOFS SCENARIO 4						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.3	3.8	1.4	2.5	1.1	2.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	14.8	13.2	9.6	9.6	8.8	8.4

Table C5. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, tree trenches).

TREE TRENCHES SCENARIO 1						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	4.0	4.5	2.8	3.1	2.5	2.7
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	6.6	6.8	4.3	4.9	4.1	4.3

Table C6. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, tree trenches).

TREE TRENCHES SCENARIO 2						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C7. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, tree trenches).

TREE TRENCHES SCENARIO 3						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	2.8	2.6	2.2	1.8	1.9	1.6
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C8. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, tree trenches).

TREE TRENCHES SCENARIO 4						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.0	0.6	1.3	0.6	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	6.6	6.8	4.3	4.9	4.1	4.3

Table C9. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 5, tree trenches).

TREE TRENCHES SCENARIO 5						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	20.4	21.0	16.0	15.0	14.7	13.1
Glin in Grad	22.0	23.7	16.3	17.1	14.7	15.0
Reach-1	20.5	21.0	15.2	15.0	13.7	13.1
149121	14.3	15.0	11.3	10.6	10.0	9.2
149122	26.9	27.2	21.0	19.8	19.2	17.4
149123	32.8	30.6	23.5	22.8	20.4	20.1

Table C10. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 6, tree trenches).

TREE TRENCHES SCENARIO 6						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	8.0	7.6	6.3	5.5	5.5	4.8
Glin in Grad	6.8	5.4	5.0	4.1	4.2	3.6
Reach-1	7.6	7.6	5.8	5.5	5.2	4.8
149121	14.3	15.0	11.3	10.6	10.0	9.2
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	2.0	0.0

Table C11. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 7, tree trenches).

TREE TRENCHES SCENARIO 7						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	13.1	13.4	10.8	9.5	9.7	8.3
Glin in Grad	11.3	9.5	8.5	7.0	7.8	6.2
Reach-1	12.9	13.4	9.8	9.5	9.0	8.3
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	26.9	27.2	21.0	19.8	19.2	17.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C12. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 8, tree trenches).

TREE TRENCHES SCENARIO 8						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	5.1	8.8	3.6	6.0	3.2	5.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	32.8	30.6	23.5	22.8	18.4	20.1

Table C13. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, rain gardens).

RAIN GARDENS SCENARIO 1						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	10.9	11.0	8.3	7.7	7.6	6.7
Glin in Grad	13.0	15.0	9.4	10.6	8.2	9.2
Reach-1	10.6	11.0	7.6	7.7	7.1	6.7
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	13.4	14.3	10.9	10.2	9.9	8.9
149123	26.2	25.1	19.1	18.5	16.3	16.3

Table C14. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, rain gardens).

RAIN GARDENS SCENARIO 2						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	3.9	3.1	2.8	2.9	2.4
Glin in Grad	3.4	2.8	2.5	2.0	2.3	1.8
Reach-1	3.8	3.9	2.9	2.8	2.7	2.4
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C15. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, rain gardens).

RAIN GARDENS SCENARIO 3						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.3	7.1	5.2	4.9	4.7	4.3
Glin in Grad	5.6	5.0	4.1	3.6	4.0	3.2
Reach-1	6.8	7.1	5.1	4.9	4.7	4.3
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	13.4	14.3	10.9	10.2	9.9	8.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C16. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, rain gardens).

RAIN GARDENS SCENARIO 4						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	4.0	7.2	2.8	4.9	2.5	4.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	26.2	25.1	19.1	18.5	15.0	16.3

Table C17. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 5, rain gardens).

RAIN GARDENS SCENARIO 5						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	27.0	27.4	20.8	19.8	19.1	17.4
Glin in Grad	29.9	32.6	22.3	23.8	20.0	20.9
Reach-1	26.5	27.4	19.9	19.8	18.1	17.4
149121	21.4	21.9	16.7	15.7	15.0	13.7
149122	32.8	33.1	25.4	24.3	23.6	21.4
149123	47.5	45.5	36.5	34.6	32.7	30.8

Table C18. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 6, rain gardens).

RAIN GARDENS SCENARIO 6						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	11.7	11.2	9.4	8.1	8.4	7.2
Glin in Grad	9.6	7.9	7.4	6.0	6.7	5.3
Reach-1	11.4	11.2	8.7	8.1	7.9	7.2
149121	21.4	21.9	16.7	15.7	15.0	13.7
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C19. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 7, rain gardens).

RAIN GARDENS SCENARIO 7						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	16.1	16.3	13.2	11.7	12.0	10.2
Glin in Grad	14.1	11.6	10.5	8.6	9.7	7.6
Reach-1	15.9	16.3	12.3	11.7	11.2	10.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	32.8	33.1	25.4	24.3	23.6	21.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C20. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 8, rain gardens).

RAIN GARDENS SCENARIO 8						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	8.5	13.0	5.8	9.2	4.8	8.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	47.5	45.5	36.5	34.6	32.7	30.8

Table C21. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 1						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	2.8	2.6	2.2	1.8	1.9	1.6
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C22. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 2						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C23. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 3						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	2.8	2.6	2.2	1.8	1.9	1.6
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C24. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 4						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C25. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 5, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 5						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	10.9	11.0	8.3	7.7	7.6	6.7
Glin in Grad	11.3	11.6	8.0	8.2	7.1	7.2
Reach-1	10.6	11.0	7.6	7.7	7.1	6.7
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	13.4	14.3	10.9	10.2	9.9	8.9
149123	14.8	13.2	9.6	9.6	8.8	8.4

Table C26. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 6, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 6						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	3.9	3.1	2.8	2.9	2.4
Glin in Grad	3.4	2.8	2.5	2.0	2.3	1.8
Reach-1	3.8	3.9	2.9	2.8	2.7	2.4
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C27. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 7, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 7						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.3	7.1	5.2	4.9	4.7	4.3
Glin in Grad	5.6	5.0	4.1	3.6	4.0	3.2
Reach-1	6.8	7.1	5.1	4.9	4.7	4.3
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	13.4	14.3	10.9	10.2	9.9	8.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C28. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 8, permeable sidewalks).

PERMEABLE SIDEWALKS SCENARIO 8						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.3	3.8	1.4	2.5	1.1	2.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	14.8	13.2	9.6	9.6	8.8	8.4

Table C29. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, urban tree cover).

URBAN TREE COVER SCENARIO 1						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.3	7.6	5.9	5.3	5.2	4.6
Glin in Grad	7.3	7.3	5.2	5.2	4.8	4.5
Reach-1	6.8	7.6	5.4	5.3	4.9	4.6
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	6.6	6.8	4.3	4.9	4.1	4.3

Table C30. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, urban tree cover).

URBAN TREE COVER SCENARIO 2						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	3.9	3.1	2.8	2.9	2.4
Glin in Grad	3.4	2.8	2.5	2.0	2.3	1.8
Reach-1	3.8	3.9	2.9	2.8	2.7	2.4
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C31. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, urban tree cover).

URBAN TREE COVER SCENARIO 3						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	2.8	2.6	2.2	1.8	1.9	1.6
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C32. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, urban tree cover).

URBAN TREE COVER SCENARIO 4						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.0	0.6	1.3	0.6	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	6.6	6.8	4.3	4.9	4.1	4.3

Table C33. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, cisterns 1).

STORMWATER CISTERNS 1 SCENARIO 1						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.3	7.6	5.9	5.3	5.2	4.6
Glin in Grad	8.5	9.2	5.8	6.4	5.3	5.6
Reach-1	6.8	7.6	5.4	5.3	4.9	4.6
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	14.8	13.2	9.6	9.6	8.8	8.4

Table C34. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, cisterns 1).

STORMWATER CISTERNS 1 SCENARIO 2						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	3.9	3.1	2.8	2.9	2.4
Glin in Grad	3.4	2.8	2.5	2.0	2.3	1.8
Reach-1	3.8	3.9	2.9	2.8	2.7	2.4
149121	7.1	7.6	6.0	5.4	5.0	4.7
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C35. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, cisterns 1).

STORMWATER CISTERNS 1 SCENARIO 3						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	3.6	3.6	2.8	2.5	2.4	2.2
Glin in Grad	2.8	2.6	2.2	1.8	1.9	1.6
Reach-1	3.0	3.6	2.5	2.5	2.2	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	7.5	7.3	5.8	5.2	4.9	4.5
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C36. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, cisterns 1).

STORMWATER CISTERNS 1 SCENARIO 4						
DIFFERENCE %	2-year return period		10-year return period		25-year return period	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.3	3.8	1.4	2.5	1.1	2.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	14.8	13.2	9.6	9.6	8.8	8.4

Table C37. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 1, cisterns 2).

STORMWATER CISTERNS 2 SCENARIO 1						
	2-year return period		10-year return period		25-year return period	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.0	0.6	1.3	0.6	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	6.6	6.8	4.3	4.9	4.1	4.3

Table C38. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 2, cisterns 2).

STORMWATER CISTERNS 2 SCENARIO 2						
	2-year return period		10-year return period		25-year return period	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C39. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 3, cisterns 2).

STORMWATER CISTERNS 2 SCENARIO 3						
	2-year return period		10-year return period		25-year return period	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table C40. Modelling results at different hydrologic elements of the model using synthetic rainfall events (scenario 4, cisterns 2).

STORMWATER CISTERNS 2 SCENARIO 4						
	2-year return period		10-year return period		25-year return period	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.0	0.6	1.3	0.6	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	6.6	6.8	4.3	4.9	4.1	4.3

APPENDIX D: Discharge graphs (total outflow) at the outflow ("Glin in Grad") section of the model for difference return periods and scenarios (using synthetic rainfall events).

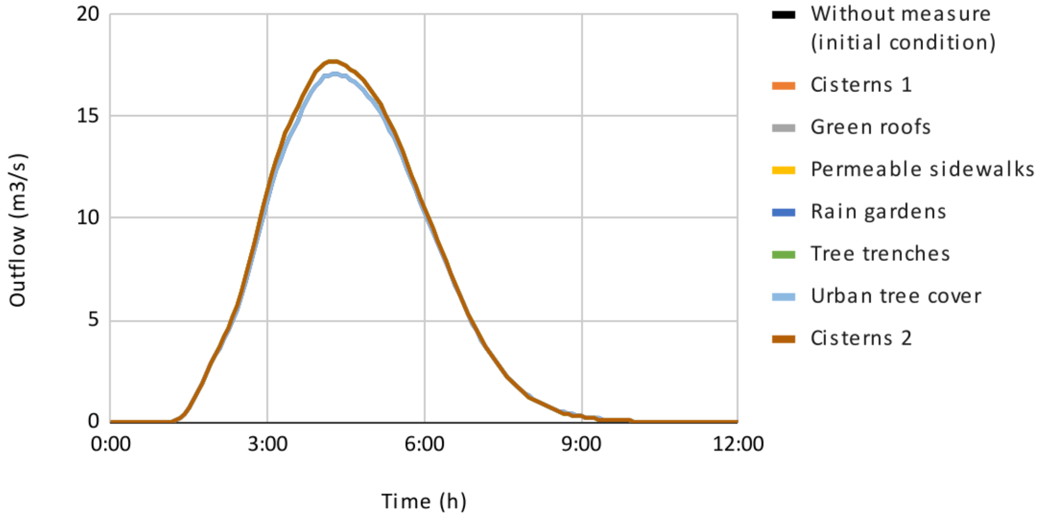


Figure D1. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 2).

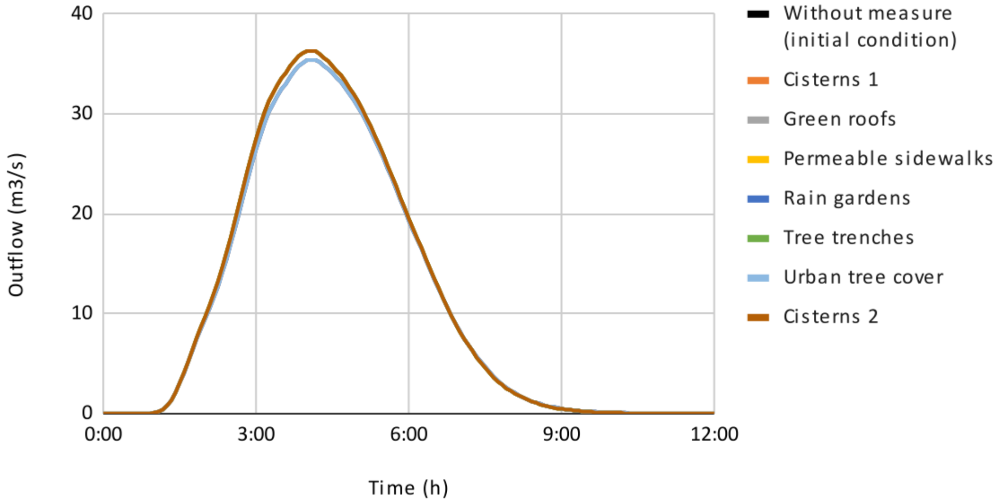


Figure D2. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 2).

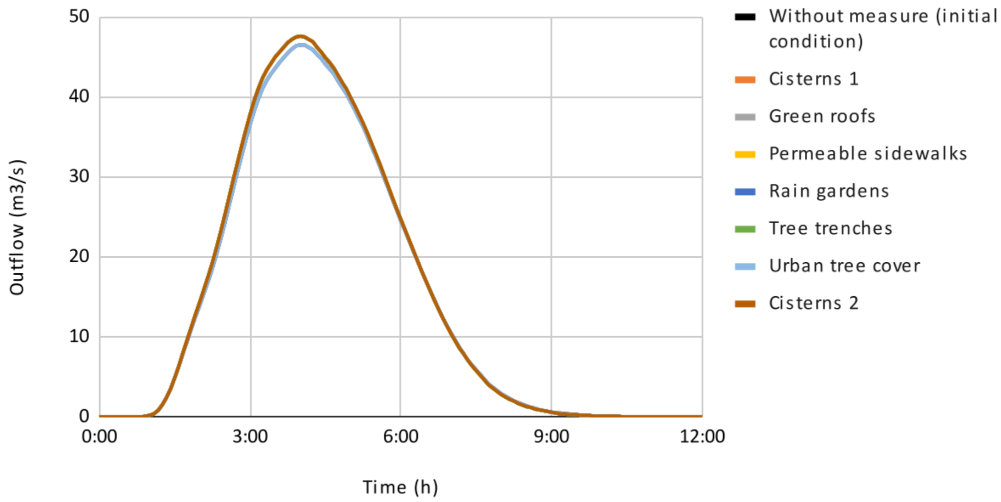


Figure D3. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 2).

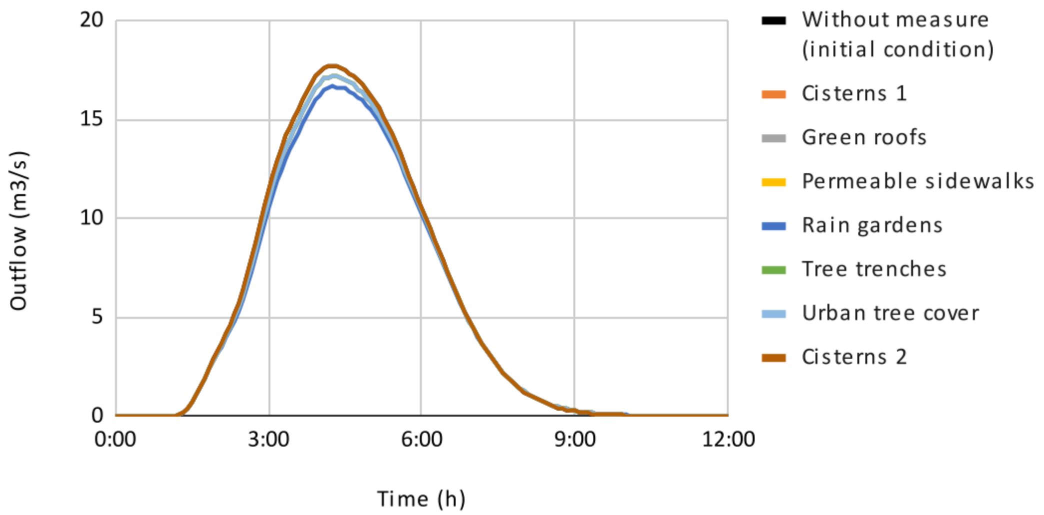


Figure D4. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 3).

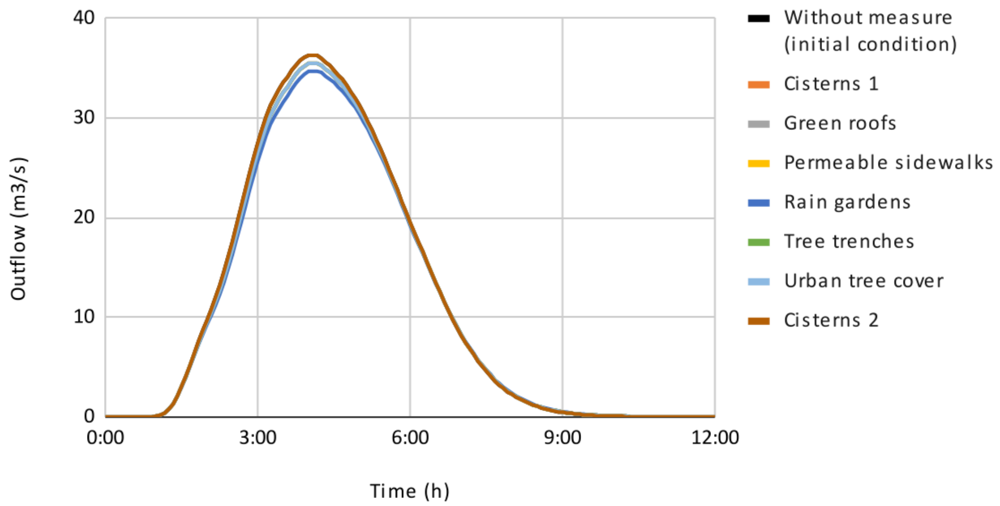


Figure D5. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 3).

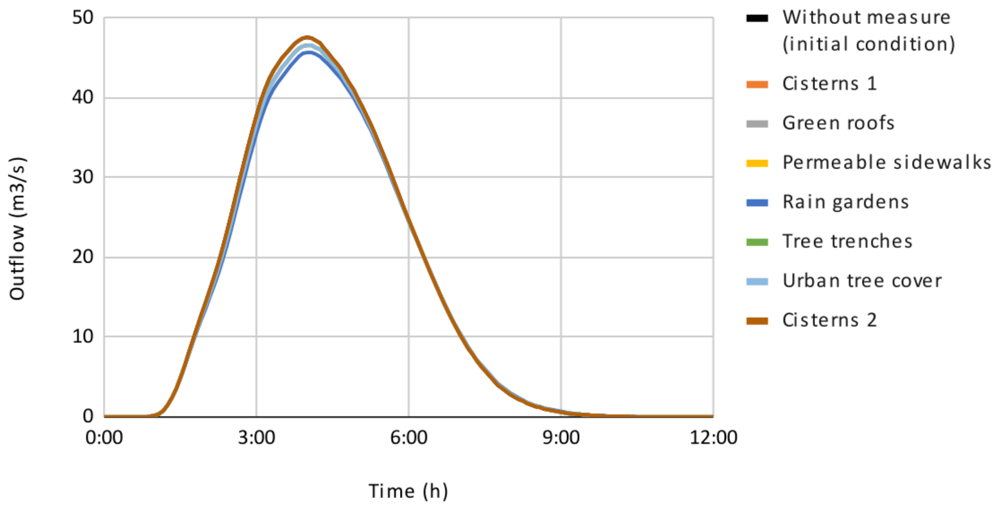


Figure D6. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 3).

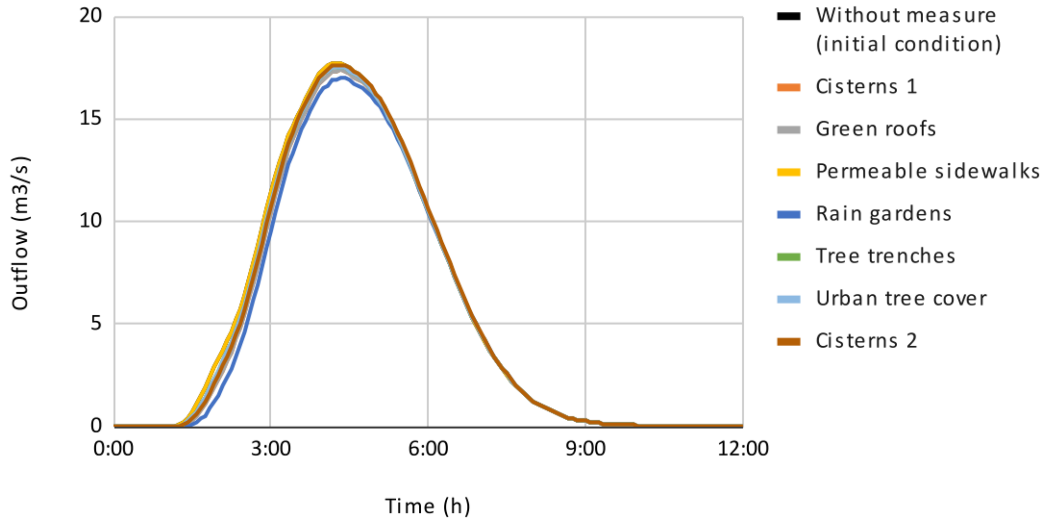


Figure D7. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 4).

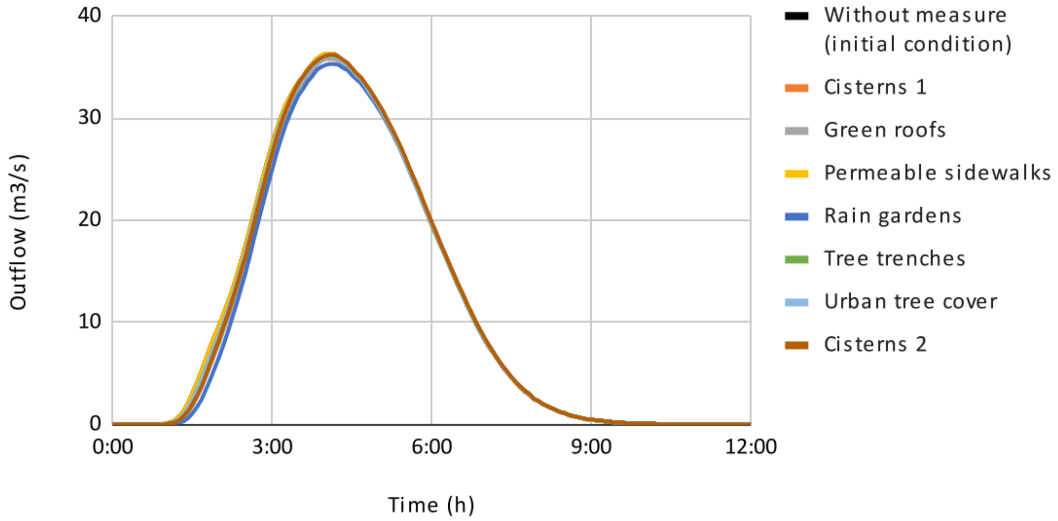


Figure D8. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 4).

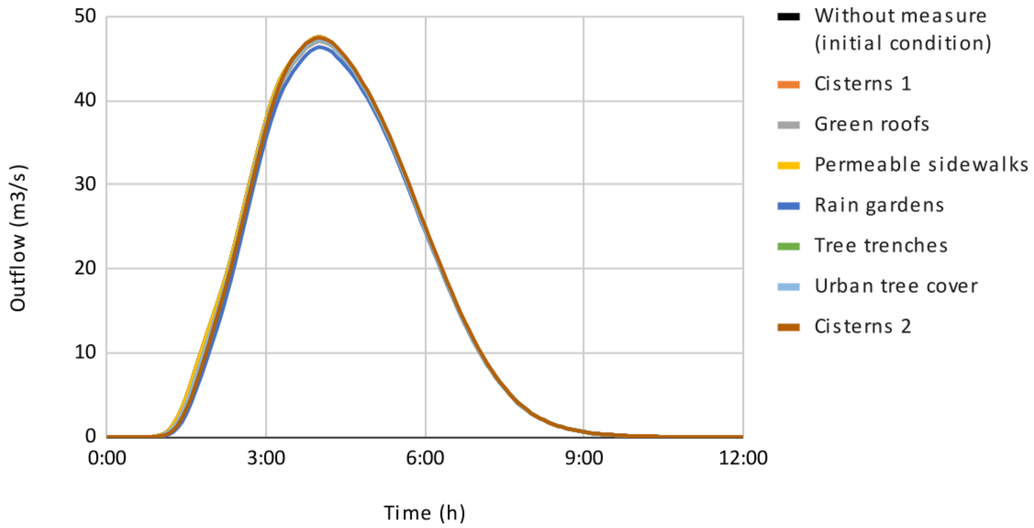


Figure D9. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 4).

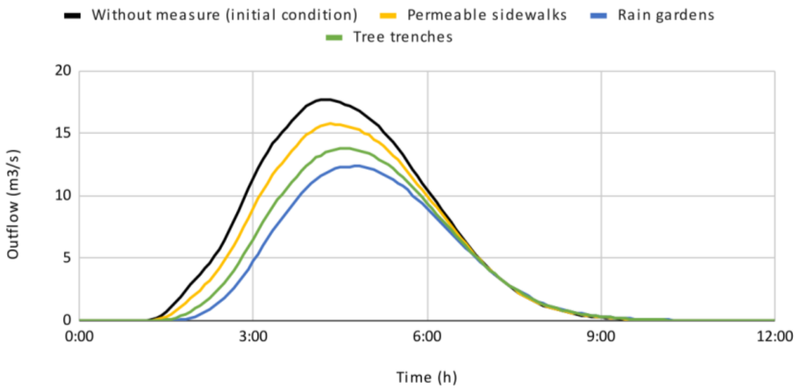


Figure D10. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 5).

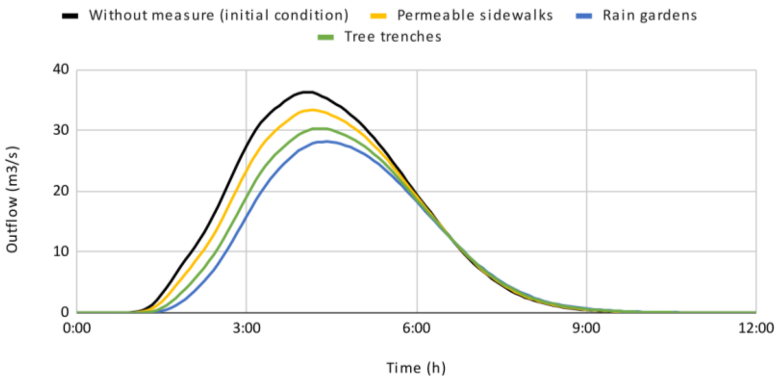


Figure D11. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 5).

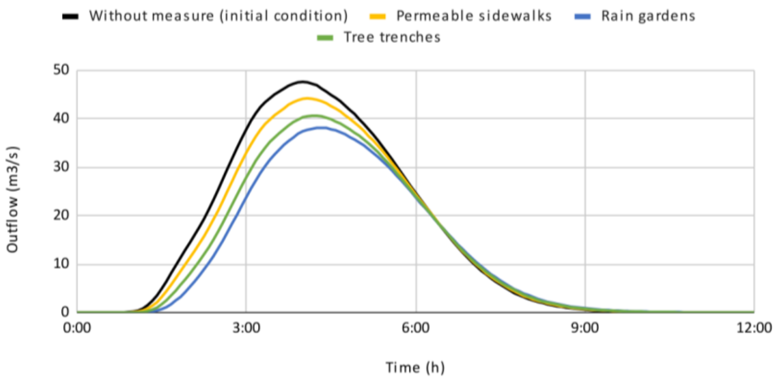


Figure D12. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 5).

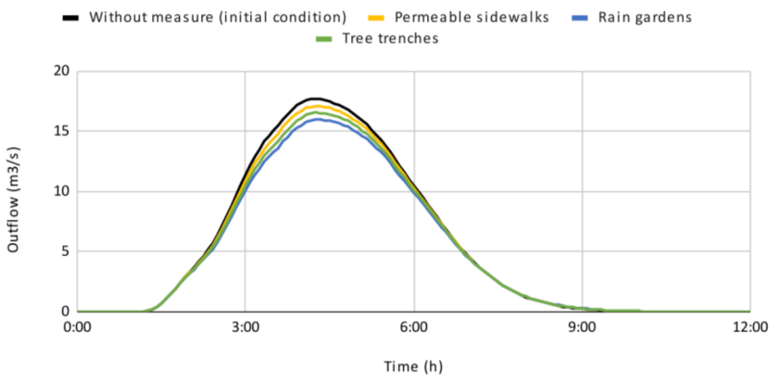


Figure D13. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 6).

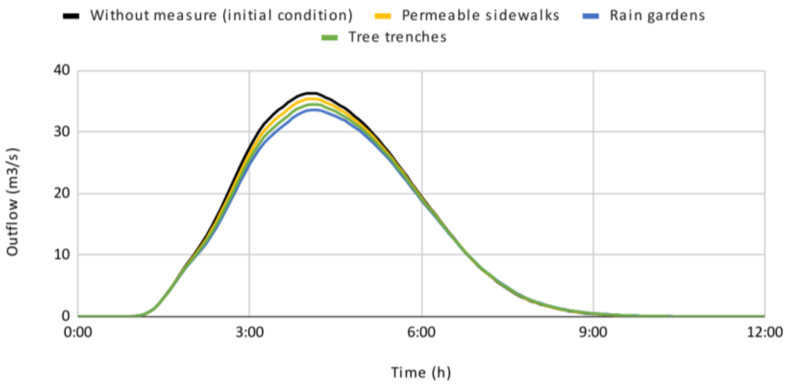


Figure D14. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 6).

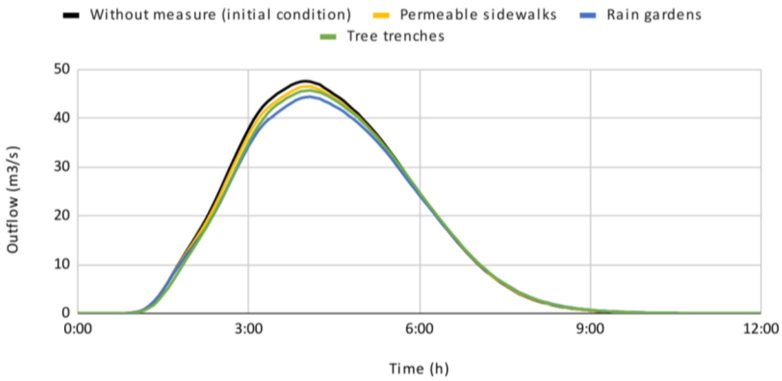


Figure D15. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 6).

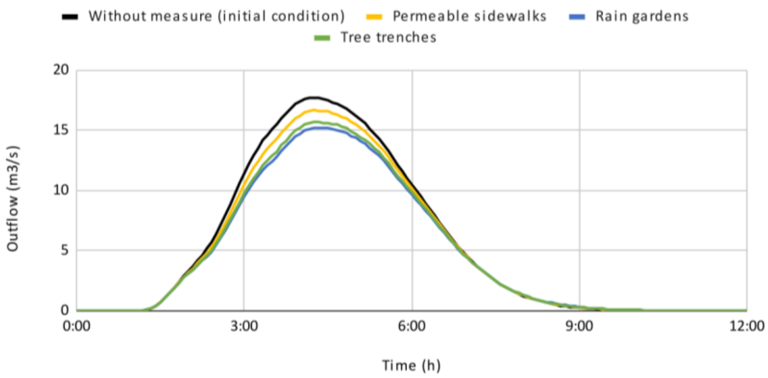


Figure D16. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 7).

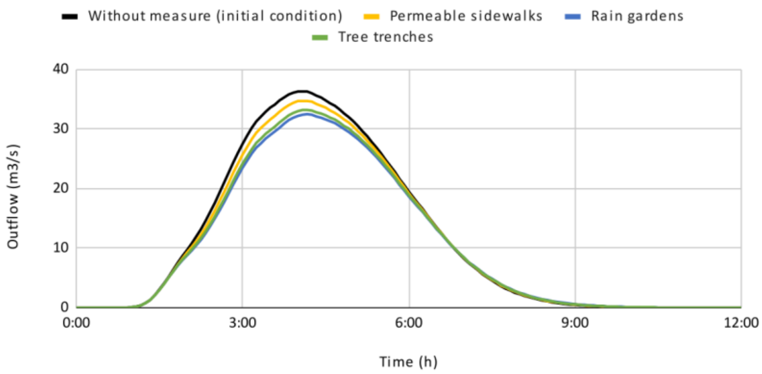


Figure D17. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 7).

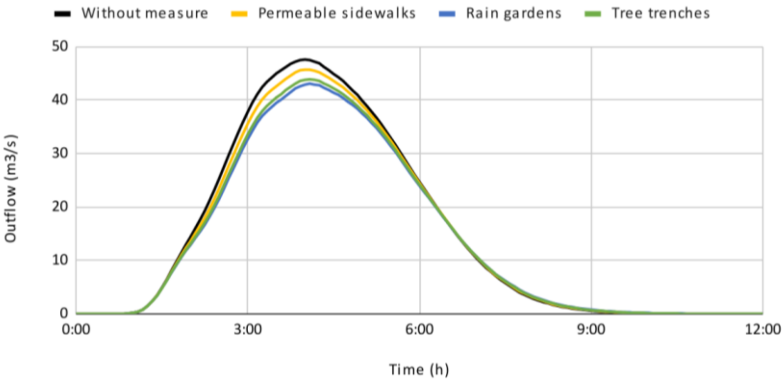


Figure D18. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 7).

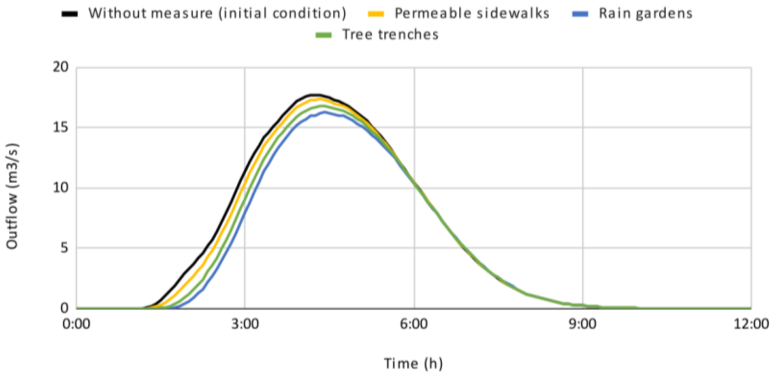


Figure D19. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 2-year return period (scenario 8).

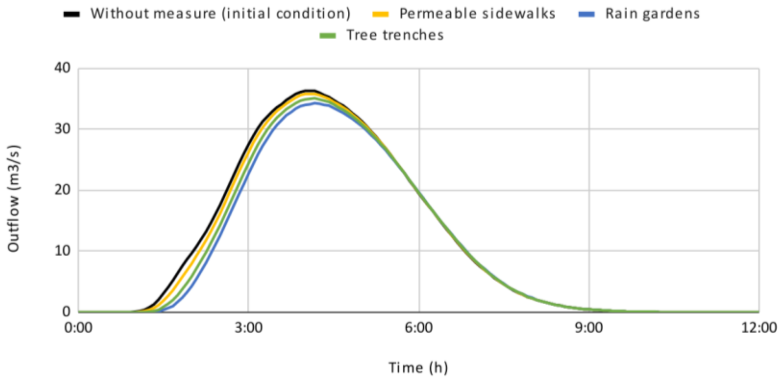


Figure D20. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 10-year return period (scenario 8).

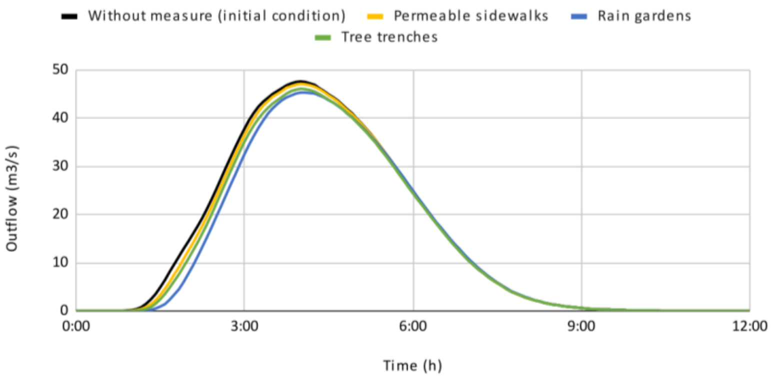


Figure D21. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for the 25-year return period (scenario 8).

APPENDIX E: Code for extracting precipitation data in R.

```
#downloading necessary packages
library(raster);
library(rgdal);
library(astsa);
library(zoo);
library(readxl);
library(exactextractr);
library(sf)
library(ncdf4)
#setting working directory
setwd("C:/climate_data/RCP2.6")
#importing climate change simulation file
tt<-brick("C:/climate_data/RCP2.6/pr_RCP2.6_ICHEC-EC-EARTH_DMI-
HIRHAM5_1981_2100.nc")
#defining the Glinščica River catchment boundaries with the help of the shapefile
cshpC <- readOGR(dsn="C:/climate_data/RCP2.6",layer="Land-use-dissolved")
plot(tt[[1]], xlim=c(455000,462000), ylim=c(99000,106000));plot(cshpC,add=TRUE)
lines(cshpC)
extract(tt[[1]], cshpC)
#creating loop function for extraction of mean precipitation data in each cell in the defined catchment
boundaries
dummy <- matrix(NA,dim(tt)[3],1)
for(i in 1:dim(tt)[3]){
  tt1 <- tt[[i]]
  dummy[i,] <- as.numeric(lapply(extract(tt1,cshpC),mean,na.rm=T))
}
#setting date format
datumi <- as.Date(substring(tt@data@names,2,11),"%Y.%m.%d")
#plotting precipitation vs. date format (period between 1981 and 2100)
plot(datumi,dummy,type="l",ylab="Precipitation")
library(xts)
#extracting mean yearly precipitation data in csv format
write.table(apply.yearly(zoo(dummy,datumi),mean),"C:/climate_data/RCP2.6/RCP2.6_yearly_1.csv")
#extracting mean monthly precipitation data in csv format
write.table(apply.monthly(zoo(dummy,datumi),mean),"C:/climate_data/RCP2.6/RCP2.6_monthly_1.cs
v")
#extracting mean daily precipitation data in csv format
write.table(apply.daily(zoo(dummy,datumi),mean),"C:/climate_data/RCP2.6/RCP2.6_daily_1.csv")
#creating loop function to define maximum precipitation value in each year
dat=rep(NA,length(as.numeric(apply.yearly(zoo(dummy,datumi),max))))
for(k in 1:length(dat)){
  dat[k]=which(dummy==as.numeric(apply.yearly(zoo(dummy,datumi),max))[k])
}
#defining three consecutive precipitation values before maximum precipitation event in each year to
analyze antecedent conditions
datumi[dat]
dat1=dat-4
dat2=dat-1
#creating loop function to sum three consecutive precipitation values before maximum precipitation
event in each year to analyze antecedent conditions
ant=rep(NA,length(as.numeric(apply.yearly(zoo(dummy,datumi),max))))
for(k in 1:length(dat)){
  ant[k]=sum(dummy[dat1[k]:dat2[k]])
```

```
}
ant
#extracting maximum precipitation value in each year in csv format
write.table(apply.yearly(zoo(dummy,datumi),max),"C:/climate_data/RCP2.6/RCP2.6_MAXprec_year
_value_1.csv")
#extracting sum of three consecutive precipitation values before maximum precipitation event in each
year to analyze antecedent conditions
write.table(ant,"C:/climate_data/RCP2.6/RCP2.6_sum_of_three_year_1_new.csv")
```

APPENDIX F: Median precipitation results for every climate change scenario and investigated time period.

Table F1. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 2021-2060 future time period of RCP2.6.

FUTURE 1: 2021-2060												
RCP2.6	**PRECIPITATION DAY 1**			**PRECIPITATION DAY 2**			**PRECIPITATION DAY 3**			**PRECIPITATION DAY 4 MAX**		
year	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**
2021	10.5	16.9	**13.7**	10.5	16.9	**13.7**	10.5	16.9	**13.7**	63.1	55.3	**59.2**
2022	0.7	6.8	**3.7**	0.7	6.8	**3.7**	0.7	6.8	**3.7**	77.8	63.4	**70.6**
2023	7.1	17.9	**12.5**	7.1	17.9	**12.5**	7.1	17.9	**12.5**	67.5	71.7	**69.6**
2024	5.8	3.9	**4.9**	5.8	3.9	**4.9**	5.8	3.9	**4.9**	53.8	54.1	**53.9**
2025	2.5	2.4	**2.4**	2.5	2.4	**2.4**	2.5	2.4	**2.4**	54.2	71.6	**62.9**
2026	0.3	6.8	**3.6**	0.3	6.8	**3.6**	0.3	6.8	**3.6**	105.0	71.1	**88.0**
2027	1.0	5.0	**3.0**	1.0	5.0	**3.0**	1.0	5.0	**3.0**	62.0	52.2	**57.1**
2028	0.1	2.2	**1.2**	0.1	2.2	**1.2**	0.1	2.2	**1.2**	60.4	63.1	**61.8**
2029	0.0	11.0	**5.5**	0.0	11.0	**5.5**	0.0	11.0	**5.5**	72.7	54.3	**63.5**
2030	11.1	20.6	**15.8**	11.1	20.6	**15.8**	11.1	20.6	**15.8**	96.7	74.6	**85.7**
2031	2.9	1.7	**2.3**	2.9	1.7	**2.3**	2.9	1.7	**2.3**	71.0	59.9	**65.5**
2032	1.9	6.1	**4.0**	1.9	6.1	**4.0**	1.9	6.1	**4.0**	85.7	59.1	**72.4**
2033	2.2	0.3	**1.3**	2.2	0.3	**1.3**	2.2	0.3	**1.3**	57.4	71.0	**64.2**
2034	1.7	6.7	**4.2**	1.7	6.7	**4.2**	1.7	6.7	**4.2**	62.5	73.4	**68.0**
2035	0.5	0.0	**0.3**	0.5	0.0	**0.3**	0.5	0.0	**0.3**	50.1	85.2	**67.6**
2036	4.2	11.9	**8.1**	4.2	11.9	**8.1**	4.2	11.9	**8.1**	55.4	57.8	**56.6**
2037	3.7	1.6	**2.7**	3.7	1.6	**2.7**	3.7	1.6	**2.7**	56.7	59.9	**58.3**
2038	5.7	10.6	**8.1**	5.7	10.6	**8.1**	5.7	10.6	**8.1**	59.6	54.5	**57.0**
2039	11.9	6.9	**9.4**	11.9	6.9	**9.4**	11.9	6.9	**9.4**	93.7	119.6	**106.7**
2040	1.5	13.6	**7.5**	1.5	13.6	**7.5**	1.5	13.6	**7.5**	99.2	49.2	**74.2**
2041	4.2	22.1	**13.2**	4.2	22.1	**13.2**	4.2	22.1	**13.2**	66.8	47.5	**57.1**
2042	4.8	0.8	**2.8**	4.8	0.8	**2.8**	4.8	0.8	**2.8**	74.0	54.4	**64.2**
2043	0.1	4.0	**2.0**	0.1	4.0	**2.0**	0.1	4.0	**2.0**	46.9	56.9	**51.9**
2044	0.0	5.3	**2.6**	0.0	5.3	**2.6**	0.0	5.3	**2.6**	49.2	57.7	**53.5**
2045	0.3	6.7	**3.5**	0.3	6.7	**3.5**	0.3	6.7	**3.5**	59.7	63.7	**61.7**
2046	10.1	22.7	**16.4**	10.1	22.7	**16.4**	10.1	22.7	**16.4**	56.8	71.7	**64.3**
2047	0.6	0.7	**0.7**	0.6	0.7	**0.7**	0.6	0.7	**0.7**	56.9	65.1	**61.0**
2048	15.0	3.8	**9.4**	15.0	3.8	**9.4**	15.0	3.8	**9.4**	50.6	58.6	**54.6**
2049	0.1	11.4	**5.7**	0.1	11.4	**5.7**	0.1	11.4	**5.7**	77.1	54.4	**65.8**
2050	19.8	11.2	**15.5**	19.8	11.2	**15.5**	19.8	11.2	**15.5**	98.1	67.3	**82.7**
2051	10.5	0.0	**5.2**	10.5	0.0	**5.2**	10.5	0.0	**5.2**	53.3	57.3	**55.3**
2052	5.0	5.0	**5.0**	5.0	5.0	**5.0**	5.0	5.0	**5.0**	52.1	59.9	**56.0**
2053	4.7	0.8	**2.7**	4.7	0.8	**2.7**	4.7	0.8	**2.7**	61.0	65.0	**63.0**
2054	16.0	5.0	**10.5**	16.0	5.0	**10.5**	16.0	5.0	**10.5**	72.5	64.4	**68.5**
2055	7.9	0.1	**4.0**	7.9	0.1	**4.0**	7.9	0.1	**4.0**	61.8	79.7	**70.8**
2056	11.0	9.4	**10.2**	11.0	9.4	**10.2**	11.0	9.4	**10.2**	50.4	55.7	**53.1**
2057	19.9	18.2	**19.1**	19.9	18.2	**19.1**	19.9	18.2	**19.1**	79.6	55.4	**67.5**
2058	5.6	7.8	**6.7**	5.6	7.8	**6.7**	5.6	7.8	**6.7**	110.5	114.2	**112.4**
2059	18.0	3.0	**10.5**	18.0	3.0	**10.5**	18.0	3.0	**10.5**	43.3	65.4	**54.3**
2060	10.5	1.4	**5.9**	10.5	1.4	**5.9**	10.5	1.4	**5.9**	52.7	59.9	**56.3**
	MEDIAN		**5.1**	**MEDIAN**		**5.1**	**MEDIAN**		**5.1**	**MEDIAN**		**63.3**

Table F2. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 2061-2100 future time period of RCP2.6.

FUTURE 2: 2061-2100												
RCP2.6	**PRECIPITATION DAY 1**			**PRECIPITATION DAY 2**			**PRECIPITATION DAY 3**			**PRECIPITATION DAY 4 MAX**		
year	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**	**Model 1 results [mm/day]**	**Model 2 results [mm/day]**	**Median [mm/day]**
2061	32.4	1.2	**16.8**	32.4	1.2	**16.8**	32.4	1.2	**16.8**	112.6	86.2	**99.4**
2062	0.0	4.4	**2.2**	0.0	4.4	**2.2**	0.0	4.4	**2.2**	67.0	87.9	**77.5**
2063	11.8	33.8	**22.8**	11.8	33.8	**22.8**	11.8	33.8	**22.8**	54.5	88.4	**71.4**
2064	0.5	3.9	**2.2**	0.5	3.9	**2.2**	0.5	3.9	**2.2**	71.7	55.7	**63.7**
2065	0.4	15.6	**8.0**	0.4	15.6	**8.0**	0.4	15.6	**8.0**	44.0	115.7	**79.9**
2066	0.9	2.8	**1.9**	0.9	2.8	**1.9**	0.9	2.8	**1.9**	57.3	62.8	**60.1**
2067	3.5	16.1	**9.8**	3.5	16.1	**9.8**	3.5	16.1	**9.8**	60.2	53.8	**57.0**
2068	2.3	11.3	**6.8**	2.3	11.3	**6.8**	2.3	11.3	**6.8**	57.8	60.3	**59.1**
2069	5.3	3.1	**4.2**	5.3	3.1	**4.2**	5.3	3.1	**4.2**	77.8	55.8	**66.8**
2070	5.5	28.0	**16.7**	5.5	28.0	**16.7**	5.5	28.0	**16.7**	80.9	104.7	**92.8**
2071	38.7	11.4	**25.0**	38.7	11.4	**25.0**	38.7	11.4	**25.0**	76.2	52.8	**64.5**
2072	2.8	10.8	**6.8**	2.8	10.8	**6.8**	2.8	10.8	**6.8**	103.7	65.6	**84.6**
2073	10.8	0.6	**5.7**	10.8	0.6	**5.7**	10.8	0.6	**5.7**	43.9	83.1	**63.5**
2074	7.6	15.0	**11.3**	7.6	15.0	**11.3**	7.6	15.0	**11.3**	63.3	57.4	**60.4**
2075	2.6	19.0	**10.8**	2.6	19.0	**10.8**	2.6	19.0	**10.8**	53.5	58.3	**55.9**
2076	16.6	0.8	**8.7**	16.6	0.8	**8.7**	16.6	0.8	**8.7**	123.8	65.0	**94.4**
2077	11.7	0.0	**5.9**	11.7	0.0	**5.9**	11.7	0.0	**5.9**	54.6	51.5	**53.1**
2078	2.6	4.4	**3.5**	2.6	4.4	**3.5**	2.6	4.4	**3.5**	58.2	44.8	**51.5**
2079	1.3	2.5	**1.9**	1.3	2.5	**1.9**	1.3	2.5	**1.9**	78.3	50.6	**64.5**
2080	6.8	3.8	**5.3**	6.8	3.8	**5.3**	6.8	3.8	**5.3**	61.4	62.8	**62.1**
2081	6.6	3.3	**5.0**	6.6	3.3	**5.0**	6.6	3.3	**5.0**	86.2	60.4	**73.3**
2082	8.8	0.1	**4.5**	8.8	0.1	**4.5**	8.8	0.1	**4.5**	56.3	57.1	**56.7**
2083	0.0	6.6	**3.3**	0.0	6.6	**3.3**	0.0	6.6	**3.3**	45.0	56.1	**50.5**
2084	1.9	20.8	**11.3**	1.9	20.8	**11.3**	1.9	20.8	**11.3**	53.4	53.8	**53.6**
2085	3.0	0.1	**1.5**	3.0	0.1	**1.5**	3.0	0.1	**1.5**	43.9	65.9	**54.9**
2086	1.5	0.5	**1.0**	1.5	0.5	**1.0**	1.5	0.5	**1.0**	93.5	85.4	**89.4**
2087	2.7	0.2	**1.5**	2.7	0.2	**1.5**	2.7	0.2	**1.5**	109.0	79.7	**94.4**
2088	5.4	3.3	**4.3**	5.4	3.3	**4.3**	5.4	3.3	**4.3**	47.3	56.2	**51.7**
2089	1.5	14.8	**8.2**	1.5	14.8	**8.2**	1.5	14.8	**8.2**	48.3	69.7	**59.0**
2090	10.3	12.5	**11.4**	10.3	12.5	**11.4**	10.3	12.5	**11.4**	49.2	94.7	**72.0**
2091	22.3	9.4	**15.8**	22.3	9.4	**15.8**	22.3	9.4	**15.8**	49.3	59.5	**54.4**
2092	1.2	2.5	**1.9**	1.2	2.5	**1.9**	1.2	2.5	**1.9**	59.5	90.3	**74.9**
2093	7.3	1.3	**4.3**	7.3	1.3	**4.3**	7.3	1.3	**4.3**	107.2	56.6	**81.9**
2094	1.0	20.1	**10.6**	1.0	20.1	**10.6**	1.0	20.1	**10.6**	51.3	68.6	**59.9**
2095	6.1	3.3	**4.7**	6.1	3.3	**4.7**	6.1	3.3	**4.7**	50.4	56.4	**53.4**
2096	13.7	0.4	**7.0**	13.7	0.4	**7.0**	13.7	0.4	**7.0**	87.4	94.7	**91.1**
2097	6.1	17.4	**11.7**	6.1	17.4	**11.7**	6.1	17.4	**11.7**	53.4	62.4	**57.9**
2098	0.4	12.7	**6.5**	0.4	12.7	**6.5**	0.4	12.7	**6.5**	53.7	80.6	**67.1**
2099	4.6	3.1	**3.8**	4.6	3.1	**3.8**	4.6	3.1	**3.8**	42.0	67.0	**54.5**
2100	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0	**0.0**	52.7	0.0	**26.4**
	MEDIAN		**5.8**	**MEDIAN**		**5.8**	**MEDIAN**		**5.8**	**MEDIAN**		**62.8**

Table F3. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 1981-2020 past time period of RCP4.5.

PAST: 1981-2020

RCP4.5	PRECIPITATION DAY 1						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	results [mm/day]	Median [mm/day]
1981	12.7	0.7	1.7	5.6	5.4	2.6	**4.0**
1982	2.3	0.1	0.2	22.3	3.7	9.8	**3.0**
1983	14.0	2.7	10.8	0.0	4.3	0.0	**3.5**
1984	4.9	9.3	4.9	21.7	0.2	10.0	**7.1**
1985	0.4	3.3	0.6	0.7	0.3	3.4	**0.6**
1986	0.8	0.5	9.0	1.0	3.8	0.4	**0.9**
1987	5.9	50.4	0.0	21.4	6.4	4.5	**6.2**
1988	11.6	3.2	0.7	6.5	3.4	3.3	**3.4**
1989	10.7	10.8	0.1	0.0	0.2	3.4	**1.8**
1990	22.3	17.3	0.4	0.3	7.6	4.8	**6.2**
1991	7.1	0.8	15.0	16.3	14.5	3.8	**10.8**
1992	1.7	0.5	7.9	14.2	23.2	3.3	**5.6**
1993	2.7	0.7	4.9	1.3	26.3	5.4	**3.8**
1994	4.9	9.3	0.9	0.1	1.3	12.2	**3.1**
1995	11.4	0.9	15.1	19.5	7.3	28.5	**13.2**
1996	10.7	5.2	11.1	1.3	1.6	11.8	**8.0**
1997	7.0	5.9	0.7	9.4	1.4	13.7	**6.5**
1998	6.2	7.4	1.5	1.5	0.2	1.5	**1.5**
1999	28.4	1.3	18.3	1.8	4.6	0.3	**3.2**
2000	1.8	0.1	0.0	2.1	0.1	5.8	**0.9**
2001	0.7	3.6	0.4	13.7	3.4	0.1	**2.1**
2002	6.4	16.9	8.2	2.9	2.4	15.9	**7.3**
2003	6.7	1.3	27.6	0.4	0.1	3.6	**2.4**
2004	17.2	13.7	4.3	6.6	16.1	2.5	**10.1**
2005	7.5	19.6	3.6	13.5	0.3	12.1	**9.8**
2006	15.2	13.6	12.8	6.5	22.3	0.1	**13.2**
2007	0.5	12.2	0.2	7.8	1.9	4.4	**3.1**
2008	0.1	23.2	6.8	4.1	4.1	20.9	**5.4**
2009	3.1	6.0	1.9	0.4	7.9	0.0	**2.5**
2010	7.7	28.6	0.9	14.8	0.6	13.8	**10.7**
2011	16.2	4.1	23.5	0.1	10.6	2.2	**7.3**
2012	2.0	8.8	16.5	23.0	9.6	0.1	**9.2**
2013	1.3	1.9	9.3	12.5	0.3	4.2	**3.0**
2014	18.3	14.6	8.0	0.8	6.8	0.3	**7.4**
2015	0.0	9.7	6.0	0.3	0.0	8.2	**3.2**
2016	11.8	7.6	0.0	0.2	3.5	7.4	**5.5**
2017	0.0	0.0	2.6	6.5	10.8	0.3	**1.5**
2018	13.9	12.4	10.0	8.5	7.8	0.4	**9.3**
2019	0.0	0.0	3.3	0.6	2.8	11.1	**1.7**
2020	0.3	9.4	3.6	7.2	0.6	12.1	**5.4**
	MEDIAN						4.7

RCP4.5	PRECIPITATION DAY 2						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
1981	12.7	0.7	1.7	5.6	5.4	2.6	**4.0**
1982	2.3	0.1	0.2	22.3	3.7	9.8	**3.0**
1983	14.0	2.7	10.8	0.0	4.3	0.0	**3.5**
1984	4.9	9.3	4.9	21.7	0.2	10.0	**7.1**
1985	0.4	3.3	0.6	0.7	0.3	3.4	**0.6**
1986	0.8	0.5	9.0	1.0	3.8	0.4	**0.9**
1987	5.9	50.4	0.0	21.4	6.4	4.5	**6.2**
1988	11.6	3.2	0.7	6.5	3.4	3.3	**3.4**
1989	10.7	10.8	0.1	0.0	0.2	3.4	**1.8**
1990	22.3	17.3	0.4	0.3	7.6	4.8	**6.2**
1991	7.1	0.8	15.0	16.3	14.5	3.8	**10.8**
1992	1.7	0.5	7.9	14.2	23.2	3.3	**5.6**
1993	2.7	0.7	4.9	1.3	26.3	5.4	**3.8**
1994	4.9	9.3	0.9	0.1	1.3	12.2	**3.1**
1995	11.4	0.9	15.1	19.5	7.3	28.5	**13.2**
1996	10.7	5.2	11.1	1.3	1.6	11.8	**8.0**
1997	7.0	5.9	0.7	9.4	1.4	13.7	**6.5**
1998	6.2	7.4	1.5	1.5	0.2	1.5	**1.5**
1999	28.4	1.3	18.3	1.8	4.6	0.3	**3.2**
2000	1.8	0.1	0.0	2.1	0.1	5.8	**0.9**
2001	0.7	3.6	0.4	13.7	3.4	0.1	**2.1**
2002	6.4	16.9	8.2	2.9	2.4	15.9	**7.3**
2003	6.7	1.3	27.6	0.4	0.1	3.6	**2.4**
2004	17.2	13.7	4.3	6.6	16.1	2.5	**10.1**
2005	7.5	19.6	3.6	13.5	0.3	12.1	**9.8**
2006	15.2	13.6	12.8	6.5	22.3	0.1	**13.2**
2007	0.5	12.2	0.2	7.8	1.9	4.4	**3.1**
2008	0.1	23.2	6.8	4.1	4.1	20.9	**5.4**
2009	3.1	6.0	1.9	0.4	7.9	0.0	**2.5**
2010	7.7	28.6	0.9	14.8	0.6	13.8	**10.7**
2011	16.2	4.1	23.5	0.1	10.6	2.2	**7.3**
2012	2.0	8.8	16.5	23.0	9.6	0.1	**9.2**
2013	1.3	1.9	9.3	12.5	0.3	4.2	**3.0**
2014	18.3	14.6	8.0	0.8	6.8	0.3	**7.4**
2015	0.0	9.7	6.0	0.3	0.0	8.2	**3.2**
2016	11.8	7.6	0.0	0.2	3.5	7.4	**5.5**
2017	0.0	0.0	2.6	6.5	10.8	0.3	**1.5**
2018	13.9	12.4	10.0	8.5	7.8	0.4	**9.3**
2019	0.0	0.0	3.3	0.6	2.8	11.1	**1.7**
2020	0.3	9.4	3.6	7.2	0.6	12.1	**5.4**
	MEDIAN						4.7

RCP4.5	PRECIPITATION DAY 3						
year	Model 1 results [mm/day]	results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
1981	12.7	0.7	1.7	5.6	5.4	2.6	**4.0**
1982	2.3	0.1	0.2	22.3	3.7	9.8	**3.0**
1983	14.0	2.7	10.8	0.0	4.3	0.0	**3.5**
1984	4.9	9.3	4.9	21.7	0.2	10.0	**7.1**
1985	0.4	3.3	0.6	0.7	0.3	3.4	**0.6**
1986	0.8	0.5	9.0	1.0	3.8	0.4	**0.9**
1987	5.9	50.4	0.0	21.4	6.4	4.5	**6.2**
1988	11.6	3.2	0.7	6.5	3.4	3.3	**3.4**
1989	10.7	10.8	0.1	0.0	0.2	3.4	**1.8**
1990	22.3	17.3	0.4	0.3	7.6	4.8	**6.2**
1991	7.1	0.8	15.0	16.3	14.5	3.8	**10.8**
1992	1.7	0.5	7.9	14.2	23.2	3.3	**5.6**
1993	2.7	0.7	4.9	1.3	26.3	5.4	**3.8**
1994	4.9	9.3	0.9	0.1	1.3	12.2	**3.1**
1995	11.4	0.9	15.1	19.5	7.3	28.5	**13.2**
1996	10.7	5.2	11.1	1.3	1.6	11.8	**8.0**
1997	7.0	5.9	0.7	9.4	1.4	13.7	**6.5**
1998	6.2	7.4	1.5	1.5	0.2	1.5	**1.5**
1999	28.4	1.3	18.3	1.8	4.6	0.3	**3.2**
2000	1.8	0.1	0.0	2.1	0.1	5.8	**0.9**
2001	0.7	3.6	0.4	13.7	3.4	0.1	**2.1**
2002	6.4	16.9	8.2	2.9	2.4	15.9	**7.3**
2003	6.7	1.3	27.6	0.4	0.1	3.6	**2.4**
2004	17.2	13.7	4.3	6.6	16.1	2.5	**10.1**
2005	7.5	19.6	3.6	13.5	0.3	12.1	**9.8**
2006	15.2	13.6	12.8	6.5	22.3	0.1	**13.2**
2007	0.5	12.2	0.2	7.8	1.9	4.4	**3.1**
2008	0.1	23.2	6.8	4.1	4.1	20.9	**5.4**
2009	3.1	6.0	1.9	0.4	7.9	0.0	**2.5**
2010	7.7	28.6	0.9	14.8	0.6	13.8	**10.7**
2011	16.2	4.1	23.5	0.1	10.6	2.2	**7.3**
2012	2.0	8.8	16.5	23.0	9.6	0.1	**9.2**
2013	1.3	1.9	9.3	12.5	0.3	4.2	**3.0**
2014	18.3	14.6	8.0	0.8	6.8	0.3	**7.4**
2015	0.0	9.7	6.0	0.3	0.0	8.2	**3.2**
2016	11.8	7.6	0.0	0.2	3.5	7.4	**5.5**
2017	0.0	0.0	2.6	6.5	10.8	0.3	**1.5**
2018	13.9	12.4	10.0	8.5	7.8	0.4	**9.3**
2019	0.0	0.0	3.3	0.6	2.8	11.1	**1.7**
2020	0.3	9.4	3.6	7.2	0.6	12.1	**5.4**
	MEDIAN						4.7

RCP4.5	PRECIPITATION DAY 4 MAX						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	results [mm/day]	Median [mm/day]
1981	56.4	49.1	60.2	75.7	52.5	66.2	**58.3**
1982	78.2	49.0	73.7	56.7	59.1	34.3	**57.9**
1983	53.3	48.0	56.2	55.0	45.9	40.4	**50.7**
1984	46.7	84.4	89.2	78.4	81.1	57.2	**79.7**
1985	54.0	56.0	63.5	81.8	51.4	73.8	**59.7**
1986	80.7	55.1	59.1	63.9	49.7	69.0	**61.5**
1987	47.8	64.9	40.7	59.8	58.5	40.3	**53.1**
1988	50.8	64.9	50.8	74.1	75.8	39.8	**57.9**
1989	93.7	59.8	57.2	81.1	55.5	54.6	**58.5**
1990	64.7	63.7	43.4	75.0	86.7	57.3	**64.2**
1991	53.2	66.3	65.3	57.2	93.7	47.0	**61.3**
1992	56.2	57.2	52.6	53.3	59.9	83.5	**56.7**
1993	74.0	42.1	59.2	49.7	68.3	50.2	**54.7**
1994	60.0	51.1	65.9	42.6	63.7	36.0	**55.6**
1995	68.0	66.2	66.3	53.5	67.2	45.7	**66.3**
1996	37.9	73.7	86.0	53.6	59.6	55.3	**57.4**
1997	48.2	80.6	57.5	61.4	45.7	73.6	**59.4**
1998	67.3	59.4	48.3	80.6	64.3	80.9	**65.8**
1999	67.8	64.4	84.2	78.3	63.4	73.7	**70.7**
2000	77.6	67.7	58.8	71.9	62.1	57.5	**64.9**
2001	73.7	70.6	53.7	61.0	65.9	84.4	**68.2**
2002	58.3	73.5	46.3	66.9	67.3	82.4	**67.1**
2003	55.3	55.2	90.7	82.6	54.3	54.9	**55.2**
2004	74.4	49.5	71.0	85.5	60.0	48.0	**65.5**
2005	72.7	43.9	78.2	46.2	62.2	56.6	**59.4**
2006	70.5	93.7	67.3	57.6	62.5	67.3	**67.3**
2007	81.8	52.8	75.0	55.3	81.8	53.4	**65.1**
2008	82.3	81.6	40.4	50.2	40.8	59.3	**54.8**
2009	48.6	81.0	80.6	48.0	73.7	49.5	**61.6**
2010	70.1	114.4	64.7	45.4	77.5	46.2	**67.4**
2011	53.9	40.9	146.1	53.7	53.2	52.0	**53.5**
2012	85.3	84.6	92.8	68.3	50.1	49.1	**76.4**
2013	96.9	50.4	73.6	62.0	53.4	59.9	**60.9**
2014	59.1	53.0	85.1	54.4	80.3	49.5	**56.8**
2015	62.4	183.4	55.5	52.0	91.6	53.8	**59.0**
2016	88.4	51.8	102.9	66.9	67.0	66.6	**66.9**
2017	69.2	68.6	67.4	53.7	91.8	77.3	**68.9**
2018	95.1	78.3	69.0	93.2	66.2	46.7	**73.7**
2019	47.2	48.5	74.7	55.9	74.8	44.6	**52.2**
2020	62.6	91.5	60.9	62.5	45.4	53.0	**61.7**
	MEDIAN						61.1

Table F4. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 2021-2060 future time period of RCP4.5.

FUTURE 1: 2021-2060																												
RCP4.5	PRECIPITATION DAY 1							PRECIPITATION DAY 2							PRECIPITATION DAY 3							PRECIPITATION DAY 4 MAX						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day	Median [mm/day]
2021	3.0	1.4	0.4	0.9	1.5	3.4	**1.4**	3.0	1.4	0.4	0.9	1.5	3.4	**1.4**	3.0	1.4	0.4	0.9	1.5	3.4	**1.4**	101.9	67.6	103.6	64.8	84.3	74.5	**79.4**
2022	9.5	0.0	7.9	15.6	17.3	8.7	**9.1**	9.5	0.0	7.9	15.6	17.3	8.7	**9.1**	9.5	0.0	7.9	15.6	17.3	8.7	**9.1**	56.6	63.6	82.2	54.6	57.4	54.7	**57.0**
2023	12.9	0.7	2.2	1.0	1.5	10.9	**1.9**	12.9	0.7	2.2	1.0	1.5	10.9	**1.9**	12.9	0.7	2.2	1.0	1.5	10.9	**1.9**	121.5	54.5	40.6	54.6	85.8	123.8	**70.2**
2024	0.3	4.0	20.3	14.3	5.9	11.5	**8.7**	0.3	4.0	20.3	14.3	5.9	11.5	**8.7**	0.3	4.0	20.3	14.3	5.9	11.5	**8.7**	54.5	40.7	50.5	64.7	103.1	56.5	**55.5**
2025	25.4	22.6	25.1	4.0	1.1	0.5	**13.3**	25.4	22.6	25.1	4.0	1.1	0.5	**13.3**	25.4	22.6	25.1	4.0	1.1	0.5	**13.3**	50.4	80.8	109.4	32.5	72.0	108.6	**76.4**
2026	3.7	0.0	0.1	12.7	12.7	23.1	**8.2**	3.7	0.0	0.1	12.7	12.7	23.1	**8.2**	3.7	0.0	0.1	12.7	12.7	23.1	**8.2**	68.2	74.2	66.2	46.3	83.0	49.4	**67.2**
2027	0.0	0.8	0.4	10.6	8.6	20.8	**4.7**	0.0	0.8	0.4	10.6	8.6	20.8	**4.7**	0.0	0.8	0.4	10.6	8.6	20.8	**4.7**	63.8	56.0	92.9	58.1	79.9	52.9	**60.9**
2028	12.2	13.2	4.6	0.5	10.1	2.1	**7.3**	12.2	13.2	4.6	0.5	10.1	2.1	**7.3**	12.2	13.2	4.6	0.5	10.1	2.1	**7.3**	73.8	47.0	128.6	79.5	56.3	57.4	**65.6**
2029	17.6	0.3	10.6	9.2	6.2	0.1	**7.7**	17.6	0.3	10.6	9.2	6.2	0.1	**7.7**	17.6	0.3	10.6	9.2	6.2	0.1	**7.7**	78.0	57.7	93.4	68.2	90.7	47.0	**73.1**
2030	38.1	10.3	13.3	0.0	9.7	7.0	**10.0**	38.1	10.3	13.3	0.0	9.7	7.0	**10.0**	38.1	10.3	13.3	0.0	9.7	7.0	**10.0**	89.5	60.7	81.0	64.3	71.8	54.3	**68.1**
2031	22.1	4.5	7.7	7.6	9.9	25.5	**8.8**	22.1	4.5	7.7	7.6	9.9	25.5	**8.8**	22.1	4.5	7.7	7.6	9.9	25.5	**8.8**	98.5	97.4	64.7	70.4	67.6	63.3	**69.0**
2032	7.4	11.2	0.0	0.9	18.5	12.0	**9.3**	7.4	11.2	0.0	0.9	18.5	12.0	**9.3**	7.4	11.2	0.0	0.9	18.5	12.0	**9.3**	77.5	46.7	83.9	54.4	69.2	58.8	**64.0**
2033	1.1	2.2	8.9	20.6	31.7	5.9	**7.4**	1.1	2.2	8.9	20.6	31.7	5.9	**7.4**	1.1	2.2	8.9	20.6	31.7	5.9	**7.4**	97.3	70.8	55.8	67.6	68.8	55.8	**68.2**
2034	20.8	6.1	0.0	14.2	6.8	5.1	**6.5**	20.8	6.1	0.0	14.2	6.8	5.1	**6.5**	20.8	6.1	0.0	14.2	6.8	5.1	**6.5**	57.9	71.4	69.0	58.8	53.8	71.1	**63.9**
2035	0.8	4.0	2.0	22.2	11.5	20.2	**7.7**	0.8	4.0	2.0	22.2	11.5	20.2	**7.7**	0.8	4.0	2.0	22.2	11.5	20.2	**7.7**	60.2	69.4	76.6	54.6	72.2	54.8	**64.8**
2036	0.0	0.9	4.8	22.2	0.1	6.6	**2.8**	0.0	0.9	4.8	22.2	0.1	6.6	**2.8**	0.0	0.9	4.8	22.2	0.1	6.6	**2.8**	59.2	52.1	55.4	62.0	55.7	47.6	**55.5**
2037	1.1	25.0	0.1	15.6	31.1	5.2	**10.4**	1.1	25.0	0.1	15.6	31.1	5.2	**10.4**	1.1	25.0	0.1	15.6	31.1	5.2	**10.4**	70.0	78.8	53.9	76.1	56.7	84.9	**73.0**
2038	4.6	9.3	12.3	1.2	24.0	0.0	**6.9**	4.6	9.3	12.3	1.2	24.0	0.0	**6.9**	4.6	9.3	12.3	1.2	24.0	0.0	**6.9**	107.6	54.6	78.9	44.4	82.4	79.8	**79.3**
2039	17.2	7.9	1.0	0.2	5.1	15.4	**6.5**	17.2	7.9	1.0	0.2	5.1	15.4	**6.5**	17.2	7.9	1.0	0.2	5.1	15.4	**6.5**	67.7	58.8	33.7	45.7	56.4	54.1	**55.3**
2040	14.0	1.7	37.0	30.0	1.1	4.1	**9.1**	14.0	1.7	37.0	30.0	1.1	4.1	**9.1**	14.0	1.7	37.0	30.0	1.1	4.1	**9.1**	103.0	50.4	61.8	50.5	66.1	90.8	**64.0**
2041	6.6	7.5	15.5	10.8	5.1	0.7	**7.0**	6.6	7.5	15.5	10.8	5.1	0.7	**7.0**	6.6	7.5	15.5	10.8	5.1	0.7	**7.0**	128.9	59.4	97.6	71.8	82.2	48.0	**77.0**
2042	7.2	4.6	0.0	0.2	0.1	9.1	**2.4**	7.2	4.6	0.0	0.2	0.1	9.1	**2.4**	7.2	4.6	0.0	0.2	0.1	9.1	**2.4**	79.1	93.8	46.7	50.0	62.4	75.6	**69.0**
2043	18.2	19.9	5.1	11.6	3.8	7.4	**9.5**	18.2	19.9	5.1	11.6	3.8	7.4	**9.5**	18.2	19.9	5.1	11.6	3.8	7.4	**9.5**	66.4	55.5	46.7	81.0	76.8	48.6	**61.0**
2044	4.3	0.1	31.1	5.9	5.8	17.9	**5.9**	4.3	0.1	31.1	5.9	5.8	17.9	**5.9**	4.3	0.1	31.1	5.9	5.8	17.9	**5.9**	54.6	53.8	66.4	76.7	63.2	48.3	**58.9**
2045	6.6	11.1	0.0	7.6	5.6	0.4	**6.1**	6.6	11.1	0.0	7.6	5.6	0.4	**6.1**	6.6	11.1	0.0	7.6	5.6	0.4	**6.1**	51.0	83.5	46.7	49.3	91.2	65.7	**58.3**
2046	30.1	18.7	0.9	6.5	10.5	11.4	**10.9**	30.1	18.7	0.9	6.5	10.5	11.4	**10.9**	30.1	18.7	0.9	6.5	10.5	11.4	**10.9**	47.1	52.5	84.9	76.8	56.6	79.3	**66.7**
2047	4.7	4.0	3.0	9.5	24.7	5.7	**5.2**	4.7	4.0	3.0	9.5	24.7	5.7	**5.2**	4.7	4.0	3.0	9.5	24.7	5.7	**5.2**	62.0	63.7	107.0	66.7	127.5	99.8	**83.2**
2048	23.9	26.9	16.8	15.5	19.4	1.1	**18.1**	23.9	26.9	16.8	15.5	19.4	1.1	**18.1**	23.9	26.9	16.8	15.5	19.4	1.1	**18.1**	57.9	42.0	67.9	45.6	75.9	50.8	**54.3**
2049	2.2	9.4	0.0	15.2	47.6	0.1	**5.8**	2.2	9.4	0.0	15.2	47.6	0.1	**5.8**	2.2	9.4	0.0	15.2	47.6	0.1	**5.8**	93.3	103.6	57.8	79.0	98.3	60.7	**86.1**
2050	17.3	0.4	33.2	10.7	32.5	0.5	**14.0**	17.3	0.4	33.2	10.7	32.5	0.5	**14.0**	17.3	0.4	33.2	10.7	32.5	0.5	**14.0**	119.3	55.8	98.7	59.6	75.0	128.1	**86.9**
2051	11.4	2.1	12.5	15.3	5.8	3.1	**8.6**	11.4	2.1	12.5	15.3	5.8	3.1	**8.6**	11.4	2.1	12.5	15.3	5.8	3.1	**8.6**	75.8	51.2	55.9	56.7	50.9	71.3	**56.3**
2052	8.5	12.1	0.0	4.1	23.7	13.4	**10.3**	8.5	12.1	0.0	4.1	23.7	13.4	**10.3**	8.5	12.1	0.0	4.1	23.7	13.4	**10.3**	78.8	77.8	80.3	63.9	75.9	50.7	**76.9**
2053	6.8	4.6	3.7	1.0	10.2	3.9	**4.3**	6.8	4.6	3.7	1.0	10.2	3.9	**4.3**	6.8	4.6	3.7	1.0	10.2	3.9	**4.3**	84.3	70.6	48.8	79.1	64.8	56.4	**67.7**
2054	5.4	0.1	9.4	0.1	0.0	4.4	**2.3**	5.4	0.1	9.4	0.1	0.0	4.4	**2.3**	5.4	0.1	9.4	0.1	0.0	4.4	**2.3**	86.7	63.5	115.8	134.6	82.3	109.3	**98.0**
2055	34.8	24.7	6.2	3.1	3.6	39.2	**15.5**	34.8	24.7	6.2	3.1	3.6	39.2	**15.5**	34.8	24.7	6.2	3.1	3.6	39.2	**15.5**	107.3	65.7	60.1	96.9	72.7	79.3	**76.0**
2056	0.7	3.6	17.1	25.7	5.3	20.6	**11.2**	0.7	3.6	17.1	25.7	5.3	20.6	**11.2**	0.7	3.6	17.1	25.7	5.3	20.6	**11.2**	50.4	103.3	74.0	50.0	41.4	67.4	**58.9**
2057	22.6	10.6	3.5	0.1	8.9	0.1	**6.2**	22.6	10.6	3.5	0.1	8.9	0.1	**6.2**	22.6	10.6	3.5	0.1	8.9	0.1	**6.2**	104.5	65.2	80.3	65.5	84.1	55.5	**72.9**
2058	12.8	1.3	15.8	3.2	7.2	23.7	**10.0**	12.8	1.3	15.8	3.2	7.2	23.7	**10.0**	12.8	1.3	15.8	3.2	7.2	23.7	**10.0**	53.4	71.8	53.2	110.0	49.8	105.3	**62.6**
2059	0.6	5.0	10.7	11.9	1.5	5.7	**5.4**	0.6	5.0	10.7	11.9	1.5	5.7	**5.4**	0.6	5.0	10.7	11.9	1.5	5.7	**5.4**	67.2	79.3	55.7	109.3	60.9	82.5	**73.3**
2060	3.7	5.7	0.3	11.0	0.1	10.4	**4.7**	3.7	5.7	0.3	11.0	0.1	10.4	**4.7**	3.7	5.7	0.3	11.0	0.1	10.4	**4.7**	96.4	60.8	74.8	75.0	78.6	130.3	**76.8**
	MEDIAN						**7.6**	**MEDIAN**						**7.6**	**MEDIAN**						**7.6**	**MEDIAN**						**67.9**

Table F5. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 1961-2100 future time period of RCP4.5.

FUTURE 2: 2061-2100

RCP4.5	PRECIPITATION DAY 1						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day	Median [mm/day]
2061	10.4	6.5	7.4	0.9	0.1	13.5	**7.0**
2062	3.3	26.1	7.3	7.8	4.8	11.2	**7.5**
2063	12.4	6.8	4.1	6.6	3.8	0.3	**5.4**
2064	15.4	0.1	6.8	3.4	11.1	0.0	**5.1**
2065	16.0	0.5	11.8	0.0	12.6	13.2	**12.2**
2066	7.4	4.7	1.4	0.5	15.3	0.0	**3.1**
2067	15.6	16.0	0.1	0.2	21.2	12.0	**13.8**
2068	28.6	4.9	25.3	5.0	0.9	10.8	**7.9**
2069	1.0	2.3	5.4	2.3	10.5	0.0	**2.3**
2070	8.4	0.1	10.2	39.6	3.0	1.1	**5.7**
2071	12.0	0.0	27.3	28.0	29.9	2.6	**19.6**
2072	1.2	0.3	10.4	0.0	18.4	3.6	**2.4**
2073	7.2	0.1	3.1	3.1	12.2	6.1	**4.6**
2074	9.0	18.8	10.0	4.6	0.1	43.0	**9.5**
2075	44.9	14.1	19.1	0.4	34.1	0.4	**16.6**
2076	10.9	4.5	0.3	4.5	8.8	12.3	**6.7**
2077	6.9	24.4	2.1	0.2	2.1	7.0	**4.5**
2078	0.6	24.4	14.3	28.3	3.7	8.8	**11.5**
2079	2.5	19.5	0.4	0.7	6.1	4.8	**3.7**
2080	8.2	5.8	11.1	39.2	0.4	23.4	**9.6**
2081	5.6	5.0	0.0	15.4	19.4	12.2	**8.9**
2082	20.6	4.2	5.0	9.1	35.2	8.6	**8.8**
2083	1.2	0.0	5.7	19.0	6.2	2.1	**3.9**
2084	3.5	3.6	0.8	5.0	9.7	36.4	**4.3**
2085	9.2	6.3	0.6	3.0	0.4	23.7	**4.7**
2086	14.7	0.0	1.3	23.1	10.6	22.9	**12.6**
2087	1.1	0.4	0.6	1.1	5.7	0.4	**0.8**
2088	0.1	0.5	13.1	7.2	10.1	0.3	**3.9**
2089	16.3	2.2	11.1	2.3	6.4	5.6	**6.0**
2090	4.0	6.1	3.9	18.8	0.0	2.2	**4.0**
2091	10.7	25.4	6.5	2.2	2.0	0.0	**4.4**
2092	15.0	5.9	0.0	24.4	9.9	10.3	**10.1**
2093	4.7	0.0	0.1	10.4	1.5	0.7	**1.1**
2094	16.8	4.8	0.9	7.9	37.7	14.4	**11.1**
2095	8.3	28.5	1.3	1.8	3.4	0.5	**2.6**
2096	17.9	5.8	3.4	5.7	3.2	8.7	**5.8**
2097	7.0	0.3	0.0	21.6	0.3	10.6	**3.7**
2098	17.4	0.0	0.0	5.5	0.0	3.7	**1.9**
2099	0.0	5.3	4.0	1.8	0.0	5.9	**2.9**
2100	6.6	17.8	0.6	10.9	0.0	13.5	**8.8**
	MEDIAN						**5.5**

RCP4.5	PRECIPITATION DAY 2						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2061	10.4	6.5	7.4	0.9	0.1	13.5	**7.0**
2062	3.3	26.1	7.3	7.8	4.8	11.2	**7.5**
2063	12.4	6.8	4.1	6.6	3.8	0.3	**5.4**
2064	15.4	0.1	6.8	3.4	11.1	0.0	**5.1**
2065	16.0	0.5	11.8	0.0	12.6	13.2	**12.2**
2066	7.4	4.7	1.4	0.5	15.3	0.0	**3.1**
2067	15.6	16.0	0.1	0.2	21.2	12.0	**13.8**
2068	28.6	4.9	25.3	5.0	0.9	10.8	**7.9**
2069	1.0	2.3	5.4	2.3	10.5	0.0	**2.3**
2070	8.4	0.1	10.2	39.6	3.0	1.1	**5.7**
2071	12.0	0.0	27.3	28.0	29.9	2.6	**19.6**
2072	1.2	0.3	10.4	0.0	18.4	3.6	**2.4**
2073	7.2	0.1	3.1	3.1	12.2	6.1	**4.6**
2074	9.0	18.8	10.0	4.6	0.1	43.0	**9.5**
2075	44.9	14.1	19.1	0.4	34.1	0.4	**16.6**
2076	10.9	4.5	0.3	4.5	8.8	12.3	**6.7**
2077	6.9	24.4	2.1	0.2	2.1	7.0	**4.5**
2078	0.6	24.4	14.3	28.3	3.7	8.8	**11.5**
2079	2.5	19.5	0.4	0.7	6.1	4.8	**3.7**
2080	8.2	5.8	11.1	39.2	0.4	23.4	**9.6**
2081	5.6	5.0	0.0	15.4	19.4	12.2	**8.9**
2082	20.6	4.2	5.0	9.1	35.2	8.6	**8.8**
2083	1.2	0.0	5.7	19.0	6.2	2.1	**3.9**
2084	3.5	3.6	0.8	5.0	9.7	36.4	**4.3**
2085	9.2	6.3	0.6	3.0	0.4	23.7	**4.7**
2086	14.7	0.0	1.3	23.1	10.6	22.9	**12.6**
2087	1.1	0.4	0.6	1.1	5.7	0.4	**0.8**
2088	0.1	0.5	13.1	7.2	10.1	0.3	**3.9**
2089	16.3	2.2	11.1	2.3	6.4	5.6	**6.0**
2090	4.0	6.1	3.9	18.8	0.0	2.2	**4.0**
2091	10.7	25.4	6.5	2.2	2.0	0.0	**4.4**
2092	15.0	5.9	0.0	24.4	9.9	10.3	**10.1**
2093	4.7	0.0	0.1	10.4	1.5	0.7	**1.1**
2094	16.8	4.8	0.9	7.9	37.7	14.4	**11.1**
2095	8.3	28.5	1.3	1.8	3.4	0.5	**2.6**
2096	17.9	5.8	3.4	5.7	3.2	8.7	**5.8**
2097	7.0	0.3	0.0	21.6	0.3	10.6	**3.7**
2098	17.4	0.0	0.0	5.5	0.0	3.7	**1.9**
2099	0.0	5.3	4.0	1.8	0.0	5.9	**2.9**
2100	6.6	17.8	0.6	10.9	0.0	13.5	**8.8**
	MEDIAN						**5.5**

RCP4.5	PRECIPITATION DAY 3						
year	Model 1 results [mm/day]	Model 2 results [mm/day	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2061	10.4	6.5	7.4	0.9	0.1	13.5	**7.0**
2062	3.3	26.1	7.3	7.8	4.8	11.2	**7.5**
2063	12.4	6.8	4.1	6.6	3.8	0.3	**5.4**
2064	15.4	0.1	6.8	3.4	11.1	0.0	**5.1**
2065	16.0	0.5	11.8	0.0	12.6	13.2	**12.2**
2066	7.4	4.7	1.4	0.5	15.3	0.0	**3.1**
2067	15.6	16.0	0.1	0.2	21.2	12.0	**13.8**
2068	28.6	4.9	25.3	5.0	0.9	10.8	**7.9**
2069	1.0	2.3	5.4	2.3	10.5	0.0	**2.3**
2070	8.4	0.1	10.2	39.6	3.0	1.1	**5.7**
2071	12.0	0.0	27.3	28.0	29.9	2.6	**19.6**
2072	1.2	0.3	10.4	0.0	18.4	3.6	**2.4**
2073	7.2	0.1	3.1	3.1	12.2	6.1	**4.6**
2074	9.0	18.8	10.0	4.6	0.1	43.0	**9.5**
2075	44.9	14.1	19.1	0.4	34.1	0.4	**16.6**
2076	10.9	4.5	0.3	4.5	8.8	12.3	**6.7**
2077	6.9	24.4	2.1	0.2	2.1	7.0	**4.5**
2078	0.6	24.4	14.3	28.3	3.7	8.8	**11.5**
2079	2.5	19.5	0.4	0.7	6.1	4.8	**3.7**
2080	8.2	5.8	11.1	39.2	0.4	23.4	**9.6**
2081	5.6	5.0	0.0	15.4	19.4	12.2	**8.9**
2082	20.6	4.2	5.0	9.1	35.2	8.6	**8.8**
2083	1.2	0.0	5.7	19.0	6.2	2.1	**3.9**
2084	3.5	3.6	0.8	5.0	9.7	36.4	**4.3**
2085	9.2	6.3	0.6	3.0	0.4	23.7	**4.7**
2086	14.7	0.0	1.3	23.1	10.6	22.9	**12.6**
2087	1.1	0.4	0.6	1.1	5.7	0.4	**0.8**
2088	0.1	0.5	13.1	7.2	10.1	0.3	**3.9**
2089	16.3	2.2	11.1	2.3	6.4	5.6	**6.0**
2090	4.0	6.1	3.9	18.8	0.0	2.2	**4.0**
2091	10.7	25.4	6.5	2.2	2.0	0.0	**4.4**
2092	15.0	5.9	0.0	24.4	9.9	10.3	**10.1**
2093	4.7	0.0	0.1	10.4	1.5	0.7	**1.1**
2094	16.8	4.8	0.9	7.9	37.7	14.4	**11.1**
2095	8.3	28.5	1.3	1.8	3.4	0.5	**2.6**
2096	17.9	5.8	3.4	5.7	3.2	8.7	**5.8**
2097	7.0	0.3	0.0	21.6	0.3	10.6	**3.7**
2098	17.4	0.0	0.0	5.5	0.0	3.7	**1.9**
2099	0.0	5.3	4.0	1.8	0.0	5.9	**2.9**
2100	6.6	17.8	0.6	10.9	0.0	13.5	**8.8**
	MEDIAN						**5.5**

RCP4.5	PRECIPITATION DAY 4 MAX						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day	Median [mm/day]
2061	68.8	68.8	57.7	67.7	41.7	46.1	**62.7**
2062	66.3	66.3	87.5	99.7	63.6	60.2	**66.3**
2063	83.3	83.3	50.2	81.4	68.9	90.0	**82.4**
2064	75.8	75.8	75.3	71.8	45.0	70.1	**73.6**
2065	67.4	67.4	59.7	48.4	82.9	67.9	**67.4**
2066	66.5	66.5	112.5	60.0	55.2	108.5	**66.5**
2067	65.9	65.9	62.1	70.7	50.1	53.3	**64.0**
2068	84.1	84.1	71.5	61.1	51.2	56.1	**66.3**
2069	63.9	63.9	49.9	85.3	48.3	70.4	**63.9**
2070	72.0	72.0	66.6	67.3	68.9	67.4	**68.2**
2071	59.6	59.6	72.0	80.7	67.7	49.8	**63.7**
2072	61.3	61.3	50.0	56.2	76.7	63.0	**61.3**
2073	86.8	86.8	71.2	43.6	105.5	132.0	**86.8**
2074	79.1	79.1	72.4	64.5	80.2	71.5	**75.8**
2075	89.0	89.0	81.3	58.4	88.6	140.5	**88.8**
2076	50.4	50.4	53.9	75.9	62.3	63.3	**58.1**
2077	77.2	77.2	97.3	83.4	92.4	84.7	**84.0**
2078	65.9	65.9	61.9	78.0	58.7	118.0	**65.9**
2079	85.4	85.4	63.8	113.0	55.6	77.0	**81.2**
2080	80.0	80.0	111.2	105.3	57.0	50.0	**80.0**
2081	71.4	71.4	61.0	75.9	59.9	78.8	**71.4**
2082	85.8	85.8	79.5	76.5	106.6	58.3	**82.6**
2083	60.9	60.9	59.8	51.8	107.0	62.3	**60.9**
2084	83.8	83.8	56.7	64.1	64.3	62.5	**64.2**
2085	101.4	101.4	97.7	56.3	67.7	67.8	**82.7**
2086	47.9	47.9	93.6	74.4	65.1	71.1	**68.1**
2087	84.6	84.6	79.8	59.9	38.0	55.8	**69.8**
2088	50.7	50.7	58.7	101.7	54.1	52.3	**53.2**
2089	103.1	103.1	117.5	52.5	87.9	58.2	**95.5**
2090	52.2	52.2	60.1	72.7	76.1	58.4	**59.3**
2091	64.7	64.7	62.7	71.1	67.7	41.8	**64.7**
2092	60.3	60.3	83.4	75.2	49.8	60.2	**60.3**
2093	95.8	95.8	132.1	69.5	69.1	62.4	**82.7**
2094	53.6	53.6	42.2	48.2	63.7	80.1	**53.6**
2095	90.4	90.4	125.5	83.0	81.9	88.8	**89.6**
2096	79.1	79.1	76.5	48.9	58.9	60.9	**68.7**
2097	66.6	66.6	82.7	82.0	63.9	103.7	**74.3**
2098	87.7	87.7	75.1	51.5	62.8	94.2	**81.4**
2099	45.1	45.1	54.6	76.6	0.0	72.8	**49.9**
2100	56.4	56.4	58.5	60.9	0.0	60.2	**57.4**
	MEDIAN						**67.8**

Table F6. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 1981-2020 past time period of RCP8.5.

RCP8.5	PAST: 1981-2020																											
	PRECIPITATION DAY 1							PRECIPITATION DAY 2							PRECIPITATION DAY 3							PRECIPITATION DAY 4 MAX						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
1981	1.5	5.4	2.8	6.0	0.7	12.8	**4.1**	1.5	5.4	2.8	6.0	0.7	12.8	**4.1**	1.5	5.4	2.8	6.0	0.7	12.8	**4.1**	60.2	77.7	66.6	55.4	49.1	58.0	**59.1**
1982	0.1	22.4	10.1	4.0	3.5	2.1	**3.8**	0.1	22.4	10.1	4.0	3.5	2.1	**3.8**	0.1	22.4	10.1	4.0	3.5	2.1	**3.8**	73.7	56.8	34.2	59.0	48.6	74.3	**57.9**
1983	10.6	0.0	16.3	4.1	2.8	2.1	**3.4**	10.6	0.0	16.3	4.1	2.8	2.1	**3.4**	10.6	0.0	16.3	4.1	2.8	2.1	**3.4**	57.5	55.0	49.2	45.4	51.3	54.1	**52.7**
1984	5.3	21.7	10.6	0.2	9.0	0.1	**7.2**	5.3	21.7	10.6	0.2	9.0	0.1	**7.2**	5.3	21.7	10.6	0.2	9.0	0.1	**7.2**	93.5	84.2	55.5	81.1	84.4	48.3	**82.6**
1985	20.1	0.7	3.6	0.4	3.0	0.6	**1.9**	20.1	0.7	3.6	0.4	3.0	0.6	**1.9**	20.1	0.7	3.6	0.4	3.0	0.6	**1.9**	74.5	81.8	73.8	61.4	56.6	53.7	**67.6**
1986	9.6	1.0	0.6	4.1	0.5	0.7	**0.9**	9.6	1.0	0.6	4.1	0.5	0.7	**0.9**	9.6	1.0	0.6	4.1	0.5	0.7	**0.9**	54.5	63.9	69.0	49.6	55.7	78.6	**59.8**
1987	21.8	21.7	15.3	5.7	51.5	6.3	**18.5**	21.8	21.7	15.3	5.7	51.5	6.3	**18.5**	21.8	21.7	15.3	5.7	51.5	6.3	**18.5**	39.6	59.8	40.8	59.7	65.4	52.4	**56.0**
1988	0.6	6.5	2.9	3.7	2.6	8.4	**3.3**	0.6	6.5	2.9	3.7	2.6	8.4	**3.3**	0.6	6.5	2.9	3.7	2.6	8.4	**3.3**	52.9	74.2	40.4	75.6	63.1	48.3	**58.0**
1989	0.1	0.0	3.9	0.2	11.8	10.0	**2.0**	0.1	0.0	3.9	0.2	11.8	10.0	**2.0**	0.1	0.0	3.9	0.2	11.8	10.0	**2.0**	56.9	81.1	56.3	60.3	61.6	76.7	**61.0**
1990	0.3	0.3	5.5	8.2	17.1	23.6	**6.8**	0.3	0.3	5.5	8.2	17.1	23.6	**6.8**	0.3	0.3	5.5	8.2	17.1	23.6	**6.8**	44.8	67.9	57.9	86.7	63.3	72.9	**65.6**
1991	14.4	16.4	4.0	14.4	0.6	7.2	**10.8**	14.4	16.4	4.0	14.4	0.6	7.2	**10.8**	14.4	16.4	4.0	14.4	0.6	7.2	**10.8**	64.6	57.3	46.3	93.7	66.3	53.8	**61.0**
1992	7.6	14.2	3.8	19.9	0.5	2.1	**5.7**	7.6	14.2	3.8	19.9	0.5	2.1	**5.7**	7.6	14.2	3.8	19.9	0.5	2.1	**5.7**	52.3	53.4	83.6	60.2	57.7	56.5	**57.1**
1993	0.7	1.2	6.0	27.4	0.7	2.6	**1.9**	0.7	1.2	6.0	27.4	0.7	2.6	**1.9**	0.7	1.2	6.0	27.4	0.7	2.6	**1.9**	64.8	49.4	50.3	67.8	42.9	75.3	**57.5**
1994	0.9	0.1	3.1	1.5	8.9	4.4	**2.3**	0.9	0.1	3.1	1.5	8.9	4.4	**2.3**	0.9	0.1	3.1	1.5	8.9	4.4	**2.3**	65.9	42.7	37.7	73.7	51.2	58.4	**54.8**
1995	15.0	19.4	28.2	7.6	1.5	12.0	**13.5**	15.0	19.4	28.2	7.6	1.5	12.0	**13.5**	15.0	19.4	28.2	7.6	1.5	12.0	**13.5**	72.0	54.1	45.4	68.2	81.1	75.6	**70.1**
1996	11.0	1.3	12.4	1.6	5.1	11.4	**8.0**	11.0	1.3	12.4	1.6	5.1	11.4	**8.0**	11.0	1.3	12.4	1.6	5.1	11.4	**8.0**	86.6	52.8	55.9	59.6	73.7	39.7	**57.7**
1997	0.6	9.3	13.8	1.8	6.1	7.3	**6.7**	0.6	9.3	13.8	1.8	6.1	7.3	**6.7**	0.6	9.3	13.8	1.8	6.1	7.3	**6.7**	57.7	60.8	74.9	46.4	80.6	45.9	**59.3**
1998	1.4	1.5	1.6	0.2	6.1	6.4	**1.5**	1.4	1.5	1.6	0.2	6.1	6.4	**1.5**	1.4	1.5	1.6	0.2	6.1	6.4	**1.5**	48.0	80.6	81.1	73.5	72.2	67.1	**72.9**
1999	18.9	1.7	0.3	5.4	1.2	31.9	**3.6**	18.9	1.7	0.3	5.4	1.2	31.9	**3.6**	18.9	1.7	0.3	5.4	1.2	31.9	**3.6**	84.4	77.7	73.7	68.9	68.4	79.4	**75.7**
2000	20.8	2.1	5.7	0.1	0.1	1.8	**2.0**	20.8	2.1	5.7	0.1	0.1	1.8	**2.0**	20.8	2.1	5.7	0.1	0.1	1.8	**2.0**	60.4	74.7	52.9	61.9	64.6	77.2	**63.3**
2001	0.5	13.7	0.1	3.7	3.5	0.8	**2.2**	0.5	13.7	0.1	3.7	3.5	0.8	**2.2**	0.5	13.7	0.1	3.7	3.5	0.8	**2.2**	49.7	60.3	84.4	64.3	66.3	73.7	**65.3**
2002	8.2	2.9	16.2	2.7	16.4	6.1	**7.1**	8.2	2.9	16.2	2.7	16.4	6.1	**7.1**	8.2	2.9	16.2	2.7	16.4	6.1	**7.1**	47.7	66.9	82.4	67.3	73.0	58.3	**67.1**
2003	27.7	0.4	4.0	0.1	1.3	0.9	**1.1**	27.7	0.4	4.0	0.1	1.3	0.9	**1.1**	27.7	0.4	4.0	0.1	1.3	0.9	**1.1**	83.0	82.7	54.0	54.9	54.9	57.7	**56.3**
2004	4.5	6.5	2.6	16.0	14.1	18.0	**10.3**	4.5	6.5	2.6	16.0	14.1	18.0	**10.3**	4.5	6.5	2.6	16.0	14.1	18.0	**10.3**	61.4	85.6	49.1	60.0	50.9	84.4	**60.7**
2005	3.7	13.2	11.9	0.3	18.9	7.6	**9.8**	3.7	13.2	11.9	0.3	18.9	7.6	**9.8**	3.7	13.2	11.9	0.3	18.9	7.6	**9.8**	75.7	46.2	55.6	64.9	42.0	81.0	**60.3**
2006	0.0	6.5	5.5	6.8	1.9	5.5	**5.5**	0.0	6.5	5.5	6.8	1.9	5.5	**5.5**	0.0	6.5	5.5	6.8	1.9	5.5	**5.5**	81.8	57.6	64.9	57.0	69.2	57.8	**61.4**
2007	1.4	7.7	2.4	6.0	6.8	9.8	**6.4**	1.4	7.7	2.4	6.0	6.8	9.8	**6.4**	1.4	7.7	2.4	6.0	6.8	9.8	**6.4**	59.6	54.4	52.8	60.0	93.7	80.6	**59.8**
2008	0.4	4.1	6.5	15.6	8.8	0.0	**5.3**	0.4	4.1	6.5	15.6	8.8	0.0	**5.3**	0.4	4.1	6.5	15.6	8.8	0.0	**5.3**	60.8	50.1	67.1	50.6	57.6	55.2	**56.4**
2009	5.0	0.4	5.5	2.6	24.3	13.4	**5.2**	5.0	0.4	5.5	2.6	24.3	13.4	**5.2**	5.0	0.4	5.5	2.6	24.3	13.4	**5.2**	55.8	48.0	71.6	43.8	83.3	80.6	**63.7**
2010	15.8	20.8	9.2	6.4	2.1	14.2	**11.7**	15.8	20.8	9.2	6.4	2.1	14.2	**11.7**	15.8	20.8	9.2	6.4	2.1	14.2	**11.7**	117.2	112.3	65.7	57.6	63.5	86.6	**76.2**
2011	17.9	0.9	0.2	21.7	3.1	12.9	**8.0**	17.9	0.9	0.2	21.7	3.1	12.9	**8.0**	17.9	0.9	0.2	21.7	3.1	12.9	**8.0**	88.9	39.8	49.1	72.7	45.8	62.6	**55.9**
2012	5.2	15.7	11.6	8.9	7.8	9.4	**9.1**	5.2	15.7	11.6	8.9	7.8	9.4	**9.1**	5.2	15.7	11.6	8.9	7.8	9.4	**9.1**	51.7	46.7	56.3	66.2	75.3	75.0	**61.3**
2013	11.3	14.2	0.0	2.0	23.5	28.0	**12.8**	11.3	14.2	0.0	2.0	23.5	28.0	**12.8**	11.3	14.2	0.0	2.0	23.5	28.0	**12.8**	73.8	48.5	84.7	61.6	90.2	109.9	**79.3**
2014	0.7	11.1	21.4	8.5	24.6	20.9	**16.0**	0.7	11.1	21.4	8.5	24.6	20.9	**16.0**	0.7	11.1	21.4	8.5	24.6	20.9	**16.0**	51.2	56.3	54.6	65.1	93.9	58.1	**57.2**
2015	0.3	17.0	12.6	0.0	0.1	24.9	**6.4**	0.3	17.0	12.6	0.0	0.1	24.9	**6.4**	0.3	17.0	12.6	0.0	0.1	24.9	**6.4**	67.1	118.1	85.2	77.2	114.0	103.3	**94.2**
2016	27.8	0.2	16.1	0.8	4.9	12.6	**8.8**	27.8	0.2	16.1	0.8	4.9	12.6	**8.8**	27.8	0.2	16.1	0.8	4.9	12.6	**8.8**	81.0	57.4	52.8	107.5	116.0	71.2	**76.1**
2017	6.7	6.2	0.0	23.5	1.8	12.6	**6.5**	6.7	6.2	0.0	23.5	1.8	12.6	**6.5**	6.7	6.2	0.0	23.5	1.8	12.6	**6.5**	47.0	102.5	63.2	64.9	55.4	52.1	**59.3**
2018	1.6	3.5	17.3	10.2	9.4	19.1	**9.8**	1.6	3.5	17.3	10.2	9.4	19.1	**9.8**	1.6	3.5	17.3	10.2	9.4	19.1	**9.8**	104.3	67.4	130.6	58.5	48.6	95.2	**81.3**
2019	12.5	11.5	0.9	3.4	1.4	5.3	**4.4**	12.5	11.5	0.9	3.4	1.4	5.3	**4.4**	12.5	11.5	0.9	3.4	1.4	5.3	**4.4**	68.7	72.7	69.3	52.4	57.4	85.4	**69.0**
2020	0.6	3.7	1.0	18.6	0.1	0.6	**0.8**	0.6	3.7	1.0	18.6	0.1	0.6	**0.8**	0.6	3.7	1.0	18.6	0.1	0.6	**0.8**	44.7	76.3	70.6	89.5	92.7	89.3	**82.8**
	MEDIAN						**6.0**	**MEDIAN**						**6.0**	**MEDIAN**						**6.0**	**MEDIAN**						**61.0**

Table F7. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 2021-2060 future time period of RCP8.5.

FUTURE 1: 2021-2060

RCP8.5	PRECIPITATION DAY 1						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2021	5.2	10.9	23.1	5.8	0.4	14.1	8.3
2022	8.6	0.9	0.5	2.7	20.9	41.6	5.6
2023	21.7	14.6	1.1	5.2	0.9	1.8	3.5
2024	0.1	8.7	32.5	6.7	0.8	0.5	3.8
2025	35.6	18.2	5.3	4.6	0.5	8.3	6.8
2026	7.2	3.4	1.4	1.9	7.6	26.8	5.3
2027	1.0	2.0	5.2	4.6	19.5	20.0	4.9
2028	0.0	0.1	6.9	8.5	0.7	5.6	3.2
2029	14.5	0.2	25.5	15.2	7.6	1.4	11.0
2030	19.2	1.8	3.9	0.0	5.6	5.6	4.7
2031	6.6	0.0	37.9	0.1	15.0	3.2	4.9
2032	11.3	5.3	6.6	11.3	0.0	4.0	5.9
2033	7.1	5.8	2.5	9.9	8.9	0.5	6.4
2034	13.6	5.5	14.7	14.0	1.9	0.8	9.6
2035	11.7	2.5	0.0	0.0	10.4	0.6	1.5
2036	22.8	17.1	8.2	18.0	19.7	5.2	17.6
2037	14.7	36.8	7.7	12.8	1.7	42.5	13.7
2038	3.9	12.9	0.0	13.9	3.1	0.0	3.5
2039	12.5	0.0	4.8	20.6	0.6	16.2	8.6
2040	0.6	2.7	0.2	6.4	8.5	0.4	1.6
2041	0.6	0.3	10.6	0.8	0.6	1.4	0.7
2042	1.3	0.9	1.7	0.2	3.5	1.4	1.4
2043	3.0	16.3	4.2	4.2	0.1	0.7	3.6
2044	4.3	0.1	24.4	14.4	17.4	0.4	9.4
2045	0.9	10.0	3.2	0.0	0.4	0.4	0.6
2046	2.3	1.0	1.3	0.1	8.3	11.5	1.8
2047	4.9	21.2	13.5	0.0	6.9	2.0	5.9
2048	7.1	4.1	20.0	0.1	0.1	12.5	5.6
2049	9.2	2.3	0.0	6.5	7.0	9.4	6.7
2050	6.3	2.3	14.9	18.2	11.4	0.5	8.8
2051	0.4	0.5	0.0	8.8	0.2	21.2	0.4
2052	7.5	0.0	8.7	1.3	1.3	10.8	4.4
2053	8.5	8.3	5.3	0.8	20.5	0.4	6.8
2054	7.7	6.0	15.2	18.9	9.8	25.7	12.5
2055	0.0	2.3	0.1	6.4	1.9	23.3	2.1
2056	3.2	9.9	17.4	1.0	0.0	0.7	2.1
2057	18.6	2.6	0.8	5.0	0.0	0.1	1.7
2058	15.4	0.0	8.4	4.4	0.0	6.3	5.3
2059	18.4	10.7	8.1	1.6	0.0	3.8	5.9
2060	5.1	0.0	12.3	10.5	45.9	1.7	7.8
	MEDIAN						5.3

RCP8.5	PRECIPITATION DAY 2						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2021	5.2	10.9	23.1	5.8	0.4	14.1	8.3
2022	8.6	0.9	0.5	2.7	20.9	41.6	5.6
2023	21.7	14.6	1.1	5.2	0.9	1.8	3.5
2024	0.1	8.7	32.5	6.7	0.8	0.5	3.8
2025	35.6	18.2	5.3	4.6	0.5	8.3	6.8
2026	7.2	3.4	1.4	1.9	7.6	26.8	5.3
2027	1.0	2.0	5.2	4.6	19.5	20.0	4.9
2028	0.0	0.1	6.9	8.5	0.7	5.6	3.2
2029	14.5	0.2	25.5	15.2	7.6	1.4	11.0
2030	19.2	1.8	3.9	0.0	5.6	5.6	4.7
2031	6.6	0.0	37.9	0.1	15.0	3.2	4.9
2032	11.3	5.3	6.6	11.3	0.0	4.0	5.9
2033	7.1	5.8	2.5	9.9	8.9	0.5	6.4
2034	13.6	5.5	14.7	14.0	1.9	0.8	9.6
2035	11.7	2.5	0.0	0.0	10.4	0.6	1.5
2036	22.8	17.1	8.2	18.0	19.7	5.2	17.6
2037	14.7	36.8	7.7	12.8	1.7	42.5	13.7
2038	3.9	12.9	0.0	13.9	3.1	0.0	3.5
2039	12.5	0.0	4.8	20.6	0.6	16.2	8.6
2040	0.6	2.7	0.2	6.4	8.5	0.4	1.6
2041	0.6	0.3	10.6	0.8	0.6	1.4	0.7
2042	1.3	0.9	1.7	0.2	3.5	1.4	1.4
2043	3.0	16.3	4.2	4.2	0.1	0.7	3.6
2044	4.3	0.1	24.4	14.4	17.4	0.4	9.4
2045	0.9	10.0	3.2	0.0	0.4	0.4	0.6
2046	2.3	1.0	1.3	0.1	8.3	11.5	1.8
2047	4.9	21.2	13.5	0.0	6.9	2.0	5.9
2048	7.1	4.1	20.0	0.1	0.1	12.5	5.6
2049	9.2	2.3	0.0	6.5	7.0	9.4	6.7
2050	6.3	2.3	14.9	18.2	11.4	0.5	8.8
2051	0.4	0.5	0.0	8.8	0.2	21.2	0.4
2052	7.5	0.0	8.7	1.3	1.3	10.8	4.4
2053	8.5	8.3	5.3	0.8	20.5	0.4	6.8
2054	7.7	6.0	15.2	18.9	9.8	25.7	12.5
2055	0.0	2.3	0.1	6.4	1.9	23.3	2.1
2056	3.2	9.9	17.4	1.0	0.0	0.7	2.1
2057	18.6	2.6	0.8	5.0	0.0	0.1	1.7
2058	15.4	0.0	8.4	4.4	0.0	6.3	5.3
2059	18.4	10.7	8.1	1.6	0.0	3.8	5.9
2060	5.1	0.0	12.3	10.5	45.9	1.7	7.8
	MEDIAN						5.3

RCP8.5	PRECIPITATION DAY 3						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2021	5.2	10.9	23.1	5.8	0.4	14.1	8.3
2022	8.6	0.9	0.5	2.7	20.9	41.6	5.6
2023	21.7	14.6	1.1	5.2	0.9	1.8	3.5
2024	0.1	8.7	32.5	6.7	0.8	0.5	3.8
2025	35.6	18.2	5.3	4.6	0.5	8.3	6.8
2026	7.2	3.4	1.4	1.9	7.6	26.8	5.3
2027	1.0	2.0	5.2	4.6	19.5	20.0	4.9
2028	0.0	0.1	6.9	8.5	0.7	5.6	3.2
2029	14.5	0.2	25.5	15.2	7.6	1.4	11.0
2030	19.2	1.8	3.9	0.0	5.6	5.6	4.7
2031	6.6	0.0	37.9	0.1	15.0	3.2	4.9
2032	11.3	5.3	6.6	11.3	0.0	4.0	5.9
2033	7.1	5.8	2.5	9.9	8.9	0.5	6.4
2034	13.6	5.5	14.7	14.0	1.9	0.8	9.6
2035	11.7	2.5	0.0	0.0	10.4	0.6	1.5
2036	22.8	17.1	8.2	18.0	19.7	5.2	17.6
2037	14.7	36.8	7.7	12.8	1.7	42.5	13.7
2038	3.9	12.9	0.0	13.9	3.1	0.0	3.5
2039	12.5	0.0	4.8	20.6	0.6	16.2	8.6
2040	0.6	2.7	0.2	6.4	8.5	0.4	1.6
2041	0.6	0.3	10.6	0.8	0.6	1.4	0.7
2042	1.3	0.9	1.7	0.2	3.5	1.4	1.4
2043	3.0	16.3	4.2	4.2	0.1	0.7	3.6
2044	4.3	0.1	24.4	14.4	17.4	0.4	9.4
2045	0.9	10.0	3.2	0.0	0.4	0.4	0.6
2046	2.3	1.0	1.3	0.1	8.3	11.5	1.8
2047	4.9	21.2	13.5	0.0	6.9	2.0	5.9
2048	7.1	4.1	20.0	0.1	0.1	12.5	5.6
2049	9.2	2.3	0.0	6.5	7.0	9.4	6.7
2050	6.3	2.3	14.9	18.2	11.4	0.5	8.8
2051	0.4	0.5	0.0	8.8	0.2	21.2	0.4
2052	7.5	0.0	8.7	1.3	1.3	10.8	4.4
2053	8.5	8.3	5.3	0.8	20.5	0.4	6.8
2054	7.7	6.0	15.2	18.9	9.8	25.7	12.5
2055	0.0	2.3	0.1	6.4	1.9	23.3	2.1
2056	3.2	9.9	17.4	1.0	0.0	0.7	2.1
2057	18.6	2.6	0.8	5.0	0.0	0.1	1.7
2058	15.4	0.0	8.4	4.4	0.0	6.3	5.3
2059	18.4	10.7	8.1	1.6	0.0	3.8	5.9
2060	5.1	0.0	12.3	10.5	45.9	1.7	7.8
	MEDIAN						5.3

RCP8.5	PRECIPITATION DAY 4 MAX						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2021	84.3	40.8	83.5	67.0	73.6	103.5	78.6
2022	89.9	72.5	58.6	62.1	40.2	125.2	67.3
2023	85.1	57.6	60.7	87.9	46.3	63.6	62.2
2024	82.2	44.5	79.9	38.5	58.6	90.2	69.3
2025	90.0	59.1	58.3	60.7	47.5	66.3	59.9
2026	41.1	61.9	80.2	59.2	54.8	96.9	60.5
2027	72.5	75.1	63.8	46.6	83.0	87.1	73.8
2028	51.6	78.1	51.5	54.1	149.5	68.3	61.2
2029	80.6	63.3	49.1	61.3	84.9	63.3	63.3
2030	89.9	79.8	48.0	72.4	70.2	89.4	76.1
2031	66.6	62.8	57.5	65.2	48.6	50.5	60.1
2032	68.3	61.9	57.0	72.7	74.2	56.4	65.1
2033	109.5	61.8	69.2	71.0	75.5	50.4	70.1
2034	41.2	69.2	52.2	56.7	55.9	74.8	56.3
2035	68.5	90.5	77.7	66.7	45.2	70.5	69.5
2036	86.1	71.6	69.5	54.8	99.3	71.5	71.5
2037	91.7	51.6	45.8	70.1	106.8	130.0	80.9
2038	79.9	61.7	38.8	63.9	62.2	98.3	63.0
2039	77.7	76.0	67.2	69.4	48.1	123.7	72.7
2040	59.9	52.8	63.5	67.6	51.0	70.5	61.7
2041	58.4	75.4	53.2	118.0	71.9	62.5	67.2
2042	80.8	84.5	56.9	57.7	129.9	46.4	69.3
2043	91.9	125.1	56.9	96.4	114.5	80.3	94.1
2044	82.6	66.3	113.6	87.7	86.1	73.7	84.4
2045	92.6	42.2	75.9	75.9	85.3	111.9	80.6
2046	64.9	121.4	42.7	45.1	49.1	71.4	57.0
2047	72.0	64.5	101.9	62.8	48.4	82.3	68.3
2048	68.6	82.1	55.7	59.9	51.2	67.0	63.5
2049	107.3	100.3	80.6	101.9	45.6	76.2	90.4
2050	87.2	111.6	63.9	100.8	94.3	86.7	90.8
2051	38.9	44.4	87.2	63.6	125.0	59.1	61.3
2052	52.8	44.0	86.4	93.4	64.5	88.8	75.4
2053	92.5	52.1	100.5	84.9	69.8	108.7	88.7
2054	65.9	82.0	60.2	78.8	120.3	56.0	72.4
2055	75.5	55.5	61.6	76.1	42.5	71.7	66.7
2056	68.4	127.2	48.4	73.0	70.1	83.7	71.6
2057	58.6	90.2	80.2	78.1	71.4	103.7	79.2
2058	123.0	70.8	52.0	84.0	60.2	122.2	77.4
2059	118.9	70.4	93.0	80.6	84.5	86.4	85.4
2060	73.1	96.2	96.0	126.2	83.3	41.2	89.6
	MEDIAN						69.8

Table F8. 4-days precipitation event (3-days antecedent rainfall and maximum precipitation) obtained for the 2061-2100 future time period of RCP8.5.

FUTURE 2: 2061-2100																												
RCP8.5	PRECIPITATION DAY 1							PRECIPITATION DAY 2							PRECIPITATION DAY 3							PRECIPITATION DAY 4 MAX						
year	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]	Model 1 results [mm/day]	Model 2 results [mm/day]	Model 3 results [mm/day]	Model 4 results [mm/day]	Model 5 results [mm/day]	Model 6 results [mm/day]	Median [mm/day]
2061	0.8	4.3	7.0	5.4	25.8	19.5	**6.2**	0.8	4.3	7.0	5.4	25.8	19.5	**6.2**	0.8	4.3	7.0	5.4	25.8	19.5	**6.2**	81.0	54.1	55.9	54.8	73.7	78.7	**64.8**
2062	0.2	23.2	13.5	6.6	0.2	1.7	**4.1**	0.2	23.2	13.5	6.6	0.2	1.7	**4.1**	0.2	23.2	13.5	6.6	0.2	1.7	**4.1**	58.0	97.8	45.3	87.2	83.5	93.9	**85.4**
2063	12.5	6.9	7.2	2.4	13.1	10.5	**8.9**	12.5	6.9	7.2	2.4	13.1	10.5	**8.9**	12.5	6.9	7.2	2.4	13.1	10.5	**8.9**	95.9	92.0	61.1	74.6	68.6	67.4	**71.6**
2064	2.7	4.3	14.6	7.2	1.3	7.4	**5.8**	2.7	4.3	14.6	7.2	1.3	7.4	**5.8**	2.7	4.3	14.6	7.2	1.3	7.4	**5.8**	60.3	62.7	77.4	76.0	85.7	49.0	**69.3**
2065	5.1	7.6	7.7	3.4	12.5	5.3	**6.5**	5.1	7.6	7.7	3.4	12.5	5.3	**6.5**	5.1	7.6	7.7	3.4	12.5	5.3	**6.5**	119.8	73.0	97.7	67.8	43.7	63.5	**70.4**
2066	9.1	4.8	0.0	16.6	18.7	2.5	**6.9**	9.1	4.8	0.0	16.6	18.7	2.5	**6.9**	9.1	4.8	0.0	16.6	18.7	2.5	**6.9**	81.8	101.1	79.3	75.8	66.1	103.2	**80.5**
2067	4.3	13.3	2.1	5.5	0.6	2.4	**3.4**	4.3	13.3	2.1	5.5	0.6	2.4	**3.4**	4.3	13.3	2.1	5.5	0.6	2.4	**3.4**	98.1	109.0	91.4	87.4	59.2	72.2	**89.4**
2068	0.4	18.6	0.1	0.7	4.2	28.4	**2.5**	0.4	18.6	0.1	0.7	4.2	28.4	**2.5**	0.4	18.6	0.1	0.7	4.2	28.4	**2.5**	49.1	57.1	73.7	74.0	70.0	70.2	**70.1**
2069	11.6	8.6	0.0	3.3	35.3	1.3	**5.9**	11.6	8.6	0.0	3.3	35.3	1.3	**5.9**	11.6	8.6	0.0	3.3	35.3	1.3	**5.9**	71.6	66.4	98.1	62.9	75.3	94.7	**73.4**
2070	10.4	38.1	37.2	26.1	6.1	6.1	**18.3**	10.4	38.1	37.2	26.1	6.1	6.1	**18.3**	10.4	38.1	37.2	26.1	6.1	6.1	**18.3**	71.2	82.7	58.2	55.2	97.8	84.2	**76.9**
2071	0.3	4.4	10.0	7.7	17.2	9.8	**8.8**	0.3	4.4	10.0	7.7	17.2	9.8	**8.8**	0.3	4.4	10.0	7.7	17.2	9.8	**8.8**	74.6	70.2	62.0	54.3	60.1	50.6	**61.0**
2072	0.7	0.5	17.5	16.6	3.0	1.1	**2.0**	0.7	0.5	17.5	16.6	3.0	1.1	**2.0**	0.7	0.5	17.5	16.6	3.0	1.1	**2.0**	60.8	87.1	141.6	58.4	115.3	59.9	**73.9**
2073	16.8	1.2	0.4	3.9	23.2	13.2	**8.5**	16.8	1.2	0.4	3.9	23.2	13.2	**8.5**	16.8	1.2	0.4	3.9	23.2	13.2	**8.5**	51.7	78.8	63.9	76.4	73.1	88.9	**74.7**
2074	1.9	0.0	12.7	0.2	0.1	1.7	**1.0**	1.9	0.0	12.7	0.2	0.1	1.7	**1.0**	1.9	0.0	12.7	0.2	0.1	1.7	**1.0**	76.5	65.4	66.5	54.2	107.9	104.0	**71.5**
2075	11.9	0.9	0.0	29.4	0.0	10.6	**5.7**	11.9	0.9	0.0	29.4	0.0	10.6	**5.7**	11.9	0.9	0.0	29.4	0.0	10.6	**5.7**	99.7	60.6	99.8	95.5	94.2	48.9	**94.9**
2076	14.0	3.6	0.7	15.4	7.1	6.5	**6.8**	14.0	3.6	0.7	15.4	7.1	6.5	**6.8**	14.0	3.6	0.7	15.4	7.1	6.5	**6.8**	57.8	57.0	96.8	79.0	82.1	75.5	**77.3**
2077	9.9	14.7	18.7	8.1	25.6	18.4	**16.6**	9.9	14.7	18.7	8.1	25.6	18.4	**16.6**	9.9	14.7	18.7	8.1	25.6	18.4	**16.6**	82.8	66.2	57.3	67.3	87.1	94.6	**75.0**
2078	0.3	0.0	10.0	0.0	0.6	0.8	**0.4**	0.3	0.0	10.0	0.0	0.6	0.8	**0.4**	0.3	0.0	10.0	0.0	0.6	0.8	**0.4**	65.0	124.3	60.8	122.8	85.6	73.2	**79.4**
2079	19.8	15.6	1.4	6.1	0.1	0.0	**3.8**	19.8	15.6	1.4	6.1	0.1	0.0	**3.8**	19.8	15.6	1.4	6.1	0.1	0.0	**3.8**	87.4	92.6	70.8	88.9	53.7	68.1	**79.1**
2080	5.7	9.7	16.3	22.9	19.4	2.0	**13.0**	5.7	9.7	16.3	22.9	19.4	2.0	**13.0**	5.7	9.7	16.3	22.9	19.4	2.0	**13.0**	75.6	94.9	61.6	51.3	56.1	118.8	**68.6**
2081	0.7	0.3	10.6	1.7	10.6	2.2	**2.0**	0.7	0.3	10.6	1.7	10.6	2.2	**2.0**	0.7	0.3	10.6	1.7	10.6	2.2	**2.0**	121.1	72.9	61.2	69.6	67.8	74.8	**71.3**
2082	17.6	21.6	5.7	11.7	4.6	34.0	**14.6**	17.6	21.6	5.7	11.7	4.6	34.0	**14.6**	17.6	21.6	5.7	11.7	4.6	34.0	**14.6**	122.6	83.5	52.6	58.8	127.7	53.4	**71.1**
2083	8.3	6.9	5.8	47.1	14.5	1.2	**7.6**	8.3	6.9	5.8	47.1	14.5	1.2	**7.6**	8.3	6.9	5.8	47.1	14.5	1.2	**7.6**	56.8	188.8	54.7	100.7	60.9	76.4	**68.7**
2084	12.9	28.2	4.7	18.7	33.1	17.9	**18.3**	12.9	28.2	4.7	18.7	33.1	17.9	**18.3**	12.9	28.2	4.7	18.7	33.1	17.9	**18.3**	78.6	108.0	98.3	79.6	71.3	109.6	**89.0**
2085	9.7	11.8	2.1	2.3	0.0	8.8	**5.5**	9.7	11.8	2.1	2.3	0.0	8.8	**5.5**	9.7	11.8	2.1	2.3	0.0	8.8	**5.5**	69.7	83.4	99.6	79.6	81.1	92.3	**82.2**
2086	19.3	6.6	0.8	0.1	7.8	5.9	**6.3**	19.3	6.6	0.8	0.1	7.8	5.9	**6.3**	19.3	6.6	0.8	0.1	7.8	5.9	**6.3**	62.1	63.0	56.0	73.3	76.8	80.1	**68.2**
2087	24.3	13.5	21.4	1.7	0.0	13.1	**13.3**	24.3	13.5	21.4	1.7	0.0	13.1	**13.3**	24.3	13.5	21.4	1.7	0.0	13.1	**13.3**	86.2	83.8	84.3	58.0	43.8	82.6	**83.2**
2088	12.8	0.1	0.0	13.4	0.6	1.1	**0.9**	12.8	0.1	0.0	13.4	0.6	1.1	**0.9**	12.8	0.1	0.0	13.4	0.6	1.1	**0.9**	89.0	74.5	105.7	72.3	53.6	61.0	**73.4**
2089	7.2	1.5	25.2	1.3	0.0	3.7	**2.6**	7.2	1.5	25.2	1.3	0.0	3.7	**2.6**	7.2	1.5	25.2	1.3	0.0	3.7	**2.6**	83.5	89.9	89.9	78.2	69.9	48.0	**80.9**
2090	34.1	12.0	11.7	16.0	0.6	0.6	**11.8**	34.1	12.0	11.7	16.0	0.6	0.6	**11.8**	34.1	12.0	11.7	16.0	0.6	0.6	**11.8**	96.3	71.9	79.0	63.5	98.9	59.7	**75.5**
2091	0.1	17.5	7.0	0.6	0.0	0.7	**0.7**	0.1	17.5	7.0	0.6	0.0	0.7	**0.7**	0.1	17.5	7.0	0.6	0.0	0.7	**0.7**	107.9	110.0	92.3	66.6	185.2	75.9	**100.1**
2092	9.0	10.8	30.0	0.2	1.0	0.7	**5.0**	9.0	10.8	30.0	0.2	1.0	0.7	**5.0**	9.0	10.8	30.0	0.2	1.0	0.7	**5.0**	63.6	109.5	130.4	46.4	47.7	129.9	**86.5**
2093	0.0	17.6	7.8	1.7	2.4	0.1	**2.0**	0.0	17.6	7.8	1.7	2.4	0.1	**2.0**	0.0	17.6	7.8	1.7	2.4	0.1	**2.0**	87.9	72.2	70.0	87.3	88.6	83.6	**85.5**
2094	1.0	9.0	0.0	9.3	6.3	16.0	**7.6**	1.0	9.0	0.0	9.3	6.3	16.0	**7.6**	1.0	9.0	0.0	9.3	6.3	16.0	**7.6**	55.3	52.7	113.3	110.5	110.0	100.9	**105.5**
2095	9.4	12.2	0.8	0.0	17.6	10.4	**9.9**	9.4	12.2	0.8	0.0	17.6	10.4	**9.9**	9.4	12.2	0.8	0.0	17.6	10.4	**9.9**	96.4	85.0	87.1	98.0	66.0	56.6	**86.0**
2096	47.8	0.0	11.4	0.0	6.6	12.6	**9.0**	47.8	0.0	11.4	0.0	6.6	12.6	**9.0**	47.8	0.0	11.4	0.0	6.6	12.6	**9.0**	80.1	51.4	79.4	86.3	117.6	91.9	**83.2**
2097	14.2	2.4	18.9	1.7	16.0	0.2	**8.3**	14.2	2.4	18.9	1.7	16.0	0.2	**8.3**	14.2	2.4	18.9	1.7	16.0	0.2	**8.3**	49.2	73.8	100.9	91.2	95.3	80.7	**85.9**
2098	1.4	0.0	19.7	6.2	0.1	0.0	**0.7**	1.4	0.0	19.7	6.2	0.1	0.0	**0.7**	1.4	0.0	19.7	6.2	0.1	0.0	**0.7**	55.7	63.3	138.3	91.2	133.4	84.1	**87.7**
2099	2.7	16.8	0.7	21.8	3.0	1.1	**2.8**	2.7	16.8	0.7	21.8	3.0	1.1	**2.8**	2.7	16.8	0.7	21.8	3.0	1.1	**2.8**	63.2	237.4	99.9	104.8	99.4	56.3	**99.6**
2100	0.0	5.2	0.1	0.0	12.4	0.1	**0.1**	0.0	5.2	0.1	0.0	12.4	0.1	**0.1**	0.0	5.2	0.1	0.0	12.4	0.1	**0.1**	129.6	72.4	153.1	0.0	72.7	101.1	**86.9**
	MEDIAN						**6.0**	**MEDIAN**						**6.0**	**MEDIAN**						**6.0**	**MEDIAN**						**78.2**

APPENDIX G: Results of the hydrological modelling using climate change scenarios.

Table G1. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, green roofs).

GREEN ROOFS RCP2.6 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.8	4.6	2.8	4.8	2.8	4.7
Glin in Grad	3.2	5.6	3.2	5.8	3.2	5.7
Reach-1	1.4	4.6	2.8	4.8	2.8	4.7
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	4.5	8.3	4.3	8.7	0.0	8.6

Table G2. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, green roofs).

GREEN ROOFS RCP2.6 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.4	1.4	2.5	1.4	2.5
Glin in Grad	1.1	1.8	1.1	1.9	1.1	1.8
Reach-1	1.4	2.4	1.4	2.5	1.4	2.5
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G3. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, green roofs).

GREEN ROOFS RCP2.6 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	1.1	1.6	1.1	1.7	1.1	1.6
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G4. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, green roofs).

GREEN ROOFS RCP2.6 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.2	1.1	2.3	1.1	2.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	8.3	4.3	8.7	0.0	8.6

Table G5. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, green roofs).

GREEN ROOFS RCP4.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	5.0	1.2	4.2	2.5	4.5
Glin in Grad	3.4	6.0	2.8	5.1	2.9	5.4
Reach-1	1.5	5.0	2.5	4.2	1.3	4.5
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	9.0	4.0	7.7	4.0	8.2

Table G6. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, green roofs).

GREEN ROOFS RCP4.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.6	1.2	2.2	1.3	2.4
Glin in Grad	1.1	2.0	0.9	1.7	1.0	1.8
Reach-1	1.5	2.6	1.2	2.2	1.3	2.4
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G7. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, green roofs).

GREEN ROOFS RCP4.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	1.7	0.9	1.5	1.0	1.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G8. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, green roofs).

GREEN ROOFS RCP4.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.4	0.9	2.0	1.0	2.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	9.0	4.0	7.7	4.0	8.2

Table G9. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, green roofs).

GREEN ROOFS RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	4.8	2.4	4.4	1.1	4.0
Glin in Grad	3.3	5.8	2.8	5.4	2.4	4.9
Reach-1	2.9	4.8	2.5	4.4	2.1	4.0
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	4.5	8.6	4.0	8.1	3.4	7.3

Table G10. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, green roofs).

GREEN ROOFS RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.5	1.2	2.4	1.1	2.1
Glin in Grad	1.1	1.9	0.9	1.8	0.8	1.6
Reach-1	1.4	2.5	1.2	2.4	1.1	2.1
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G11. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, green roofs).

GREEN ROOFS RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	1.1	1.7	0.9	1.5	0.8	1.4
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G12. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, green roofs).

GREEN ROOFS RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.2	0.9	2.1	0.8	1.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	8.6	4.0	8.1	3.4	7.3

Table G13. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	2.2	2.7	2.1	2.8	2.1	2.8
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	4.2	4.3	4.4	0.0	4.4

Table G14. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G15. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	1.1	1.6	1.1	1.7	1.1	1.6
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G16. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	1.1	1.2	1.1	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.2	4.3	4.4	0.0	4.4

Table G17. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 5, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.0	13.1	8.3	13.6	8.3	13.4
Glin in Grad	8.6	14.9	8.5	15.5	8.5	15.2
Reach-1	7.1	13.1	7.0	13.6	7.0	13.4
149121	5.3	9.2	5.3	9.6	5.3	9.5
149122	9.1	17.3	11.8	18.0	9.1	17.7
149123	9.1	20.0	13.0	20.8	9.1	20.5

Table G18. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 6, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.8	4.8	2.8	5.0	2.8	4.9
Glin in Grad	2.2	3.6	2.1	3.7	2.1	3.6
Reach-1	1.4	4.8	2.8	5.0	2.8	4.9
149121	5.3	9.2	5.3	9.6	5.3	9.5
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G19. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 7, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.2	8.3	5.6	8.6	5.6	8.5
Glin in Grad	4.3	6.1	4.3	6.4	4.3	6.3
Reach-1	4.3	8.3	4.2	8.6	4.2	8.5
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	9.1	17.3	11.8	18.0	9.1	17.7
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G20. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 8, tree trenches).

TREE TRENCHES RCP2.6 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	3.2	5.2	3.2	5.4	3.2	5.3
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	9.1	20.0	13.0	20.8	9.1	20.5

Table G21. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	2.9	0.9	2.5	1.0	2.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	4.6	0.0	3.9	4.0	4.1

Table G22. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G23. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	1.7	0.9	1.5	1.0	1.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G24. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.2	0.9	1.0	0.0	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.6	0.0	3.9	4.0	4.1

Table G25. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 5, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	8.8	14.1	6.2	12.1	7.6	12.8
Glin in Grad	9.0	16.1	7.5	13.7	7.8	14.6
Reach-1	7.5	14.1	7.4	12.1	6.4	12.8
149121	5.6	10.0	4.5	8.5	4.8	9.0
149122	12.5	18.7	7.9	16.0	10.8	17.0
149123	9.5	21.5	8.0	18.6	12.0	19.7

Table G26. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 6, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	5.2	2.5	4.4	2.5	4.8
Glin in Grad	2.2	3.8	1.9	3.3	1.9	3.5
Reach-1	3.0	5.2	2.5	4.4	2.6	4.8
149121	5.6	10.0	4.5	8.5	4.8	9.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G27. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 7, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	8.9	3.7	7.6	3.8	8.1
Glin in Grad	4.5	6.6	2.8	5.7	3.9	6.0
Reach-1	4.5	8.9	3.7	7.6	3.8	8.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	12.5	18.7	7.9	16.0	10.8	17.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G28. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 8, tree trenches).

TREE TRENCHES RCP4.5 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.2	5.6	1.9	4.7	1.9	5.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	9.5	21.5	8.0	18.6	12.0	19.7

Table G29. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	2.2	2.8	1.9	2.6	0.8	2.3
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	4.5	4.4	0.0	4.1	0.0	3.7

Table G30. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G31. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	1.1	1.7	0.9	1.5	0.8	1.4
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G32. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	0.9	1.0	0.0	0.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	4.4	0.0	4.1	0.0	3.7

Table G33. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 5, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	7.2	13.6	7.3	12.7	5.3	11.5
Glin in Grad	8.8	15.4	8.4	14.4	6.5	13.1
Reach-1	7.2	13.6	6.2	12.7	6.3	11.5
149121	5.4	9.6	4.5	8.9	3.9	8.1
149122	9.4	17.9	7.9	16.8	6.8	15.2
149123	13.6	20.7	8.0	19.4	6.9	17.7

Table G34. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 6, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	5.0	2.4	4.7	2.1	4.2
Glin in Grad	2.2	3.7	1.9	3.5	1.6	3.2
Reach-1	2.9	5.0	2.5	4.7	2.1	4.2
149121	5.4	9.6	4.5	8.9	3.9	8.1
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G35. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 7, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.3	8.6	4.9	8.0	3.2	7.2
Glin in Grad	4.4	6.4	3.7	5.9	3.2	5.4
Reach-1	4.3	8.6	3.7	8.0	4.2	7.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	9.4	17.9	7.9	16.8	6.8	15.2
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G36. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 8, tree trenches).

TREE TRENCHES RCP8.5 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	3.3	5.4	2.8	5.0	1.6	4.5
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	13.6	20.7	8.0	19.4	6.9	17.7

Table G37. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.2	6.7	4.2	7.0	4.2	6.9
Glin in Grad	5.4	9.1	5.3	9.5	5.3	9.4
Reach-1	2.9	6.7	4.2	7.0	2.8	6.9
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	6.1	8.9	5.9	9.3	3.0	9.1
149123	9.1	16.2	8.7	16.9	4.5	16.6

Table G38. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.4	1.4	2.5	1.4	2.5
Glin in Grad	1.1	1.8	1.1	1.9	1.1	1.8
Reach-1	1.4	2.4	1.4	2.5	1.4	2.5
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G39. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.8	4.3	2.8	4.5	2.8	4.4
Glin in Grad	2.2	3.1	2.1	3.3	2.1	3.2
Reach-1	1.4	4.3	1.4	4.5	1.4	4.4
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	6.1	8.9	5.9	9.3	3.0	9.1
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G40. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.2	4.2	2.1	4.4	2.1	4.3
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	9.1	16.2	8.7	16.9	4.5	16.6

Table G41. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 5, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	9.9	17.3	11.1	18.0	11.1	17.8
Glin in Grad	11.8	20.8	12.8	21.6	12.8	21.3
Reach-1	10.0	17.3	9.9	18.0	9.9	17.7
149121	7.9	13.6	7.9	14.2	7.9	14.0
149122	12.1	21.3	14.7	22.2	12.1	21.9
149123	18.2	30.7	17.4	31.8	13.6	31.4

Table G42. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 6, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.2	7.1	4.2	7.4	4.2	7.3
Glin in Grad	3.2	5.3	3.2	5.5	3.2	5.4
Reach-1	2.9	7.1	4.2	7.4	4.2	7.3
149121	7.9	13.6	7.9	14.2	7.9	14.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G43. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 7, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	5.6	10.2	6.9	10.6	5.6	10.4
Glin in Grad	5.4	7.5	5.3	7.9	5.3	7.7
Reach-1	5.7	10.2	5.6	10.6	5.6	10.4
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	12.1	21.3	14.7	22.2	12.1	21.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G44. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 8, rain gardens).

RAIN GARDENS RCP2.6 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	4.3	7.9	4.3	8.3	4.3	8.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	18.2	30.7	17.4	31.8	13.6	31.4

Table G45. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	7.3	2.5	6.2	3.8	6.6
Glin in Grad	5.6	10.0	4.7	8.4	4.9	9.0
Reach-1	3.0	7.3	3.7	6.2	2.6	6.6
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	6.3	9.6	5.3	8.2	5.4	8.7
149123	4.8	17.5	8.0	15.0	8.0	15.9

Table G46. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.6	1.2	2.2	1.3	2.4
Glin in Grad	1.1	2.0	0.9	1.7	1.0	1.8
Reach-1	1.5	2.6	1.2	2.2	1.3	2.4
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G47. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	4.6	1.2	3.9	2.5	4.2
Glin in Grad	2.2	3.4	1.9	2.9	1.9	3.1
Reach-1	1.5	4.6	2.5	3.9	1.3	4.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	6.3	9.6	5.3	8.2	5.4	8.7
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G48. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.2	4.6	1.9	3.8	1.9	4.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.8	17.5	8.0	15.0	8.0	15.9

Table G49. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 5, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	10.3	18.7	8.6	16.0	10.1	17.0
Glin in Grad	13.5	22.4	10.4	19.2	11.7	20.4
Reach-1	10.4	18.7	8.6	16.0	9.0	17.0
149121	8.3	14.8	6.8	12.6	7.1	13.4
149122	15.6	23.0	10.5	19.8	13.5	21.0
149123	19.0	32.9	16.0	28.6	16.0	30.2

Table G50. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 6, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	7.7	3.7	6.6	3.8	7.0
Glin in Grad	3.4	5.7	2.8	4.9	2.9	5.2
Reach-1	4.5	7.7	3.7	6.6	3.8	7.0
149121	8.3	14.8	6.8	12.6	7.1	13.4
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G51. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 7, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	5.9	11.0	4.9	9.4	5.1	10.0
Glin in Grad	4.5	8.1	3.8	7.0	3.9	7.4
Reach-1	6.0	11.0	4.9	9.4	5.1	10.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	15.6	23.0	10.5	19.8	13.5	21.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G52. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 8, rain gardens).

RAIN GARDENS RCP4.5 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	4.5	8.6	3.8	7.3	3.9	7.8
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	19.0	32.9	16.0	28.6	16.0	30.2

Table G53. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	7.0	3.7	6.5	2.1	5.8
Glin in Grad	5.5	9.5	4.7	8.8	4.0	8.0
Reach-1	4.3	7.0	3.7	6.5	3.2	5.8
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	3.1	9.2	5.3	8.6	2.3	7.8
149123	9.1	16.8	8.0	15.7	6.9	14.3

Table G54. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.5	1.2	2.4	1.1	2.1
Glin in Grad	1.1	1.9	0.9	1.8	0.8	1.6
Reach-1	1.4	2.5	1.2	2.4	1.1	2.1
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G55. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	4.4	2.4	4.1	1.1	3.7
Glin in Grad	2.2	3.3	1.9	3.0	1.6	2.8
Reach-1	2.9	4.4	1.2	4.1	2.1	3.7
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	9.2	5.3	8.6	2.3	7.8
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G56. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	2.2	4.4	1.9	4.0	1.6	3.6
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	9.1	16.8	8.0	15.7	6.9	14.3

Table G57. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 5, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	10.1	17.9	9.8	16.8	7.4	15.2
Glin in Grad	12.1	21.5	11.2	20.1	9.7	18.3
Reach-1	10.1	17.9	9.9	16.8	8.4	15.2
149121	8.1	14.1	6.8	13.2	5.9	12.0
149122	12.5	22.1	10.5	20.7	9.1	18.8
149123	18.2	31.7	16.0	29.8	13.8	27.4

Table G58. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 6, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.3	7.4	3.7	6.9	3.2	6.3
Glin in Grad	3.3	5.5	3.7	5.1	2.4	4.7
Reach-1	4.3	7.4	3.7	6.9	3.2	6.3
149121	8.1	14.1	6.8	13.2	5.9	12.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G59. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 7, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	5.8	10.5	6.1	9.9	4.2	8.9
Glin in Grad	5.5	7.8	4.7	7.3	4.0	6.7
Reach-1	5.8	10.5	4.9	9.9	5.3	8.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	12.5	22.1	10.5	20.7	9.1	18.8
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G60. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 8, rain gardens).

RAIN GARDENS RCP8.5 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	4.4	8.2	3.7	7.7	3.2	6.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	18.2	31.7	16.0	29.8	13.8	27.4

Table G61. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	1.1	1.6	1.1	1.7	1.1	1.6
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G62. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G63. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	1.1	1.6	1.1	1.7	1.1	1.6
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G64. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G65. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 5, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.2	6.7	4.2	7.0	4.2	6.9
Glin in Grad	4.3	7.1	4.3	7.4	4.3	7.3
Reach-1	2.9	6.7	4.2	7.0	2.8	6.9
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	6.1	8.9	5.9	9.3	3.0	9.1
149123	4.5	8.3	4.3	8.7	0.0	8.6

Table G66. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 6, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.4	1.4	2.5	1.4	2.5
Glin in Grad	1.1	1.8	1.1	1.9	1.1	1.8
Reach-1	1.4	2.4	1.4	2.5	1.4	2.5
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G67. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 7, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.8	4.3	2.8	4.5	2.8	4.4
Glin in Grad	2.2	3.1	2.1	3.3	2.1	3.2
Reach-1	1.4	4.3	1.4	4.5	1.4	4.4
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	6.1	8.9	5.9	9.3	3.0	9.1
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G68. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 8, permeable sidewalks).

PERMEABLE SIDEWALKS RCP2.6 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.2	1.1	2.3	1.1	2.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	8.3	4.3	8.7	0.0	8.6

Table G69. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	1.7	0.9	1.5	1.0	1.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G70. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G71. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	1.7	0.9	1.5	1.0	1.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G72. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G73. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 5, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	4.4	7.3	2.5	6.2	3.8	6.6
Glin in Grad	4.5	7.7	3.8	6.5	3.9	7.0
Reach-1	3.0	7.3	3.7	6.2	2.6	6.6
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	6.3	9.6	5.3	8.2	5.4	8.7
149123	0.0	9.0	4.0	7.7	4.0	8.2

Table G74. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 6, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.6	1.2	2.2	1.3	2.4
Glin in Grad	1.1	2.0	0.9	1.7	1.0	1.8
Reach-1	1.5	2.6	1.2	2.2	1.3	2.4
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G75. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 7, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	4.6	1.2	3.9	2.5	4.2
Glin in Grad	2.2	3.4	1.9	2.9	1.9	3.1
Reach-1	1.5	4.6	2.5	3.9	1.3	4.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	6.3	9.6	5.3	8.2	5.4	8.7
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G76. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 8, permeable sidewalks).

PERMEABLE SIDEWALKS RCP4.5 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.4	0.9	2.0	1.0	2.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	9.0	4.0	7.7	4.0	8.2

Table G77. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	1.1	1.7	0.9	1.5	0.8	1.4
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G78. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G79. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	1.1	1.7	0.9	1.5	0.8	1.4
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G80. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G81. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 5, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 5						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	7.0	3.7	6.5	2.1	5.8
Glin in Grad	4.4	7.4	3.7	6.9	3.2	6.2
Reach-1	4.3	7.0	3.7	6.5	3.2	5.8
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	3.1	9.2	5.3	8.6	2.3	7.8
149123	4.5	8.6	4.0	8.1	3.4	7.3

Table G82. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 6, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 6						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.5	1.2	2.4	1.1	2.1
Glin in Grad	1.1	1.9	0.9	1.8	0.8	1.6
Reach-1	1.4	2.5	1.2	2.4	1.1	2.1
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G83. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 7, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 7						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	4.4	2.4	4.1	1.1	3.7
Glin in Grad	2.2	3.3	1.9	3.0	1.6	2.8
Reach-1	2.9	4.4	1.2	4.1	2.1	3.7
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	9.2	5.3	8.6	2.3	7.8
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G84. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 8, permeable sidewalks).

PERMEABLE SIDEWALKS RCP8.5 SCENARIO 8						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.2	0.9	2.1	0.8	1.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	8.6	4.0	8.1	3.4	7.3

Table G85. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, urban tree cover).

URBAN TREE COVER RCP2.6 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.8	4.6	2.8	4.8	2.8	4.7
Glin in Grad	3.2	4.5	3.2	4.7	3.2	4.6
Reach-1	1.4	4.6	2.8	4.8	2.8	4.7
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	4.2	4.3	4.4	0.0	4.4

Table G86. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, urban tree cover).

URBAN TREE COVER RCP2.6 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.4	1.4	2.5	1.4	2.5
Glin in Grad	1.1	1.8	1.1	1.9	1.1	1.8
Reach-1	1.4	2.4	1.4	2.5	1.4	2.5
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G87. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, urban tree cover).

URBAN TREE COVER RCP2.6 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	1.1	1.6	1.1	1.7	1.1	1.6
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G88. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, urban tree cover).

URBAN TREE COVER RCP2.6 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	1.1	1.2	1.1	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.2	4.3	4.4	0.0	4.4

Table G89. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, urban tree cover).

URBAN TREE COVER RCP4.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	5.0	1.2	4.2	2.5	4.5
Glin in Grad	2.2	4.9	1.9	4.1	1.9	4.4
Reach-1	1.5	5.0	2.5	4.2	1.3	4.5
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	4.6	0.0	3.9	4.0	4.1

Table G90. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, urban tree cover).

URBAN TREE COVER RCP4.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.6	1.2	2.2	1.3	2.4
Glin in Grad	1.1	2.0	0.9	1.7	1.0	1.8
Reach-1	1.5	2.6	1.2	2.2	1.3	2.4
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G91. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, urban tree cover).

URBAN TREE COVER RCP4.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	1.7	0.9	1.5	1.0	1.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G92. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, urban tree cover).

URBAN TREE COVER RCP4.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.2	0.9	1.0	0.0	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.6	0.0	3.9	4.0	4.1

Table G93. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, urban tree cover).

URBAN TREE COVER RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	4.8	2.4	4.4	1.1	4.0
Glin in Grad	3.3	4.7	2.8	4.3	1.6	3.9
Reach-1	2.9	4.8	2.5	4.4	2.1	4.0
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	4.5	4.4	0.0	4.1	0.0	3.7

Table G94. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, urban tree cover).

URBAN TREE COVER RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.5	1.2	2.4	1.1	2.1
Glin in Grad	1.1	1.9	0.9	1.8	0.8	1.6
Reach-1	1.4	2.5	1.2	2.4	1.1	2.1
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G95. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, urban tree cover).

URBAN TREE COVER RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	1.1	1.7	0.9	1.5	0.8	1.4
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G96. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, urban tree cover).

URBAN TREE COVER RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	0.9	1.0	0.0	0.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	4.4	0.0	4.1	0.0	3.7

Table G97. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, cisterns 1).

STORMWATER CISTERNS 1 RCP2.6 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.8	4.6	2.8	4.8	2.8	4.7
Glin in Grad	3.2	5.6	3.2	5.8	3.2	5.7
Reach-1	1.4	4.6	2.8	4.8	2.8	4.7
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	4.5	8.3	4.3	8.7	0.0	8.6

Table G98. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, cisterns 1).

STORMWATER CISTERNS 1 RCP2.6 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.4	1.4	2.5	1.4	2.5
Glin in Grad	1.1	1.8	1.1	1.9	1.1	1.8
Reach-1	1.4	2.4	1.4	2.5	1.4	2.5
149121	2.6	4.7	2.6	4.9	2.6	4.8
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G99. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, cisterns 1).

STORMWATER CISTERNS 1 RCP2.6 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.1	1.4	2.2	1.4	2.2
Glin in Grad	1.1	1.6	1.1	1.7	1.1	1.6
Reach-1	0.0	2.1	1.4	2.2	1.4	2.2
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.0	4.5	2.9	4.7	0.0	4.6
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G100. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, cisterns 1).

STORMWATER CISTERNS 1 RCP2.6 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.2	1.1	2.3	1.1	2.2
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	8.3	4.3	8.7	0.0	8.6

Table G101. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, cisterns 1).

STORMWATER CISTERNS 1 RCP4.5 SCENARIO 1						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	2.9	5.0	1.2	4.2	2.5	4.5
Glin in Grad	3.4	6.0	2.8	5.1	2.9	5.4
Reach-1	1.5	5.0	2.5	4.2	1.3	4.5
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	9.0	4.0	7.7	4.0	8.2

Table G102. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, cisterns 1).

STORMWATER CISTERNS 1 RCP4.5 SCENARIO 2						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.6	1.2	2.2	1.3	2.4
Glin in Grad	1.1	2.0	0.9	1.7	1.0	1.8
Reach-1	1.5	2.6	1.2	2.2	1.3	2.4
149121	2.8	5.1	2.3	4.3	2.4	4.6
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G103. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, cisterns 1).

STORMWATER CISTERNS 1 RCP4.5 SCENARIO 3						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.5	2.3	0.0	2.0	1.3	2.1
Glin in Grad	1.1	1.7	0.9	1.5	1.0	1.6
Reach-1	0.0	2.3	1.2	2.0	0.0	2.1
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	3.1	4.9	2.6	4.2	2.7	4.4
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G104. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, cisterns 1).

STORMWATER CISTERNS 1 RCP4.5 SCENARIO 4						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.4	0.9	2.0	1.0	2.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	9.0	4.0	7.7	4.0	8.2

Table G105. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, cisterns 1).

STORMWATER CISTERNS 1 RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	4.8	2.4	4.4	1.1	4.0
Glin in Grad	3.3	5.8	2.8	5.4	2.4	4.9
Reach-1	2.9	4.8	2.5	4.4	2.1	4.0
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	4.5	8.6	4.0	8.1	3.4	7.3

Table G106. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, cisterns 1).

STORMWATER CISTERNS 1 RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	1.4	2.5	1.2	2.4	1.1	2.1
Glin in Grad	1.1	1.9	0.9	1.8	0.8	1.6
Reach-1	1.4	2.5	1.2	2.4	1.1	2.1
149121	2.7	4.9	2.3	4.5	2.0	4.1
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G107. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, cisterns 1).

STORMWATER CISTERNS 1 RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	2.2	1.2	2.1	0.0	1.9
Glin in Grad	1.1	1.7	0.9	1.5	0.8	1.4
Reach-1	1.4	2.2	1.2	2.1	1.1	1.9
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	4.7	2.6	4.4	2.3	3.9
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G108. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, cisterns 1).

STORMWATER CISTERNS 1 RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	2.2	0.9	2.1	0.8	1.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	8.6	4.0	8.1	3.4	7.3

Table G109. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 1, cisterns 2).

STORMWATER CISTERNS 2 RCP2.6 SCENARIO 1						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	1.1	1.2	1.1	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.2	4.3	4.4	0.0	4.4

Table G110. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 2, cisterns 2).

STORMWATER CISTERNS 2 RCP2.6 SCENARIO 2						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G111. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 3, cisterns 2).

STORMWATER CISTERNS 2 RCP2.6 SCENARIO 3						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G112. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP2.6, scenario 4, cisterns 2).

STORMWATER CISTERNS 2 RCP2.6 SCENARIO 4						
	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
DIFFERENCE %	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	1.1	1.2	1.1	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.2	4.3	4.4	0.0	4.4

Table G113. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 1, cisterns 2).

STORMWATER CISTERNS 2 RCP4.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.2	0.9	1.0	0.0	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.6	0.0	3.9	4.0	4.1

Table G114. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 2, cisterns 2).

STORMWATER CISTERNS 2 RCP4.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G115. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 3, cisterns 2).

STORMWATER CISTERNS 2 RCP4.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G116. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP4.5, scenario 4, cisterns 2).

STORMWATER CISTERNS 2 RCP4.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.2	0.9	1.0	0.0	1.1
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	4.6	0.0	3.9	4.0	4.1

Table G117. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 1, cisterns 2).

STORMWATER CISTERNS 2 RCP8.5 SCENARIO 1						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	0.9	1.0	0.0	0.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	4.4	0.0	4.1	0.0	3.7

Table G118. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 2, cisterns 2).

STORMWATER CISTERNS 2 RCP8.5 SCENARIO 2						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G119. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 3, cisterns 2).

STORMWATER CISTERNS 2 RCP8.5 SCENARIO 3						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	0.0	0.0	0.0	0.0	0.0	0.0
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	0.0	0.0	0.0	0.0	0.0	0.0

Table G120. Modelling results at different hydrologic elements of the model using climate change scenarios (RCP8.5, scenario 4, cisterns 2).

STORMWATER CISTERNS 2 RCP8.5 SCENARIO 4						
DIFFERENCE %	past: 1981-2020		near-future: 2021-2060		far-future: 2061-2100	
	Peak discharge %	Volume %	Peak discharge %	Volume %	Peak discharge %	Volume %
sotocje PR in GLIN	0.0	0.0	0.0	0.0	0.0	0.0
Glin in Grad	1.1	1.1	0.9	1.0	0.0	0.9
Reach-1	0.0	0.0	0.0	0.0	0.0	0.0
149121	0.0	0.0	0.0	0.0	0.0	0.0
149122	0.0	0.0	0.0	0.0	0.0	0.0
149123	4.5	4.4	0.0	4.1	0.0	3.7

APPENDIX H: Discharge graphs (total outflow) at the outflow ("Glin in Grad") section of the model for RCP2.6, RCP4.5 and RCP8.5, near-future and far-future time periods, scenario 1 (using climate change scenarios).

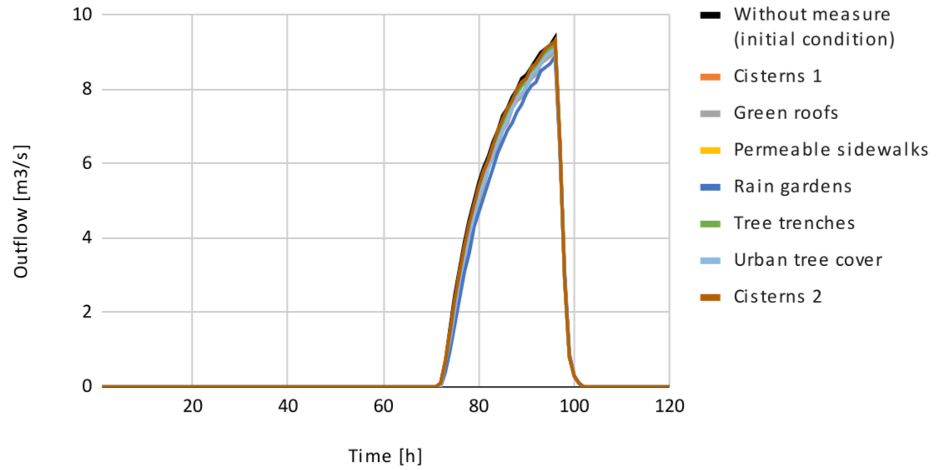


Figure H1. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP2.6 (near-future time period, scenario 1).

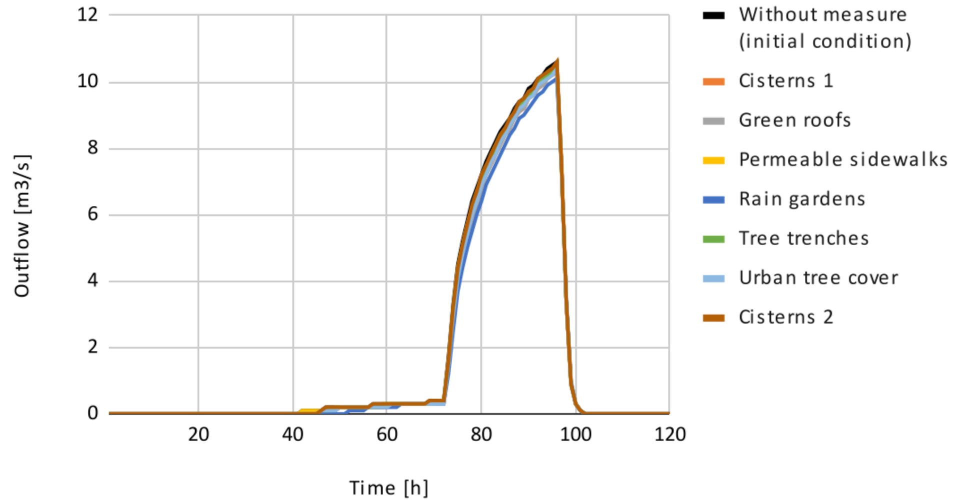


Figure H2. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP4.5 (near-future time period, scenario 1).

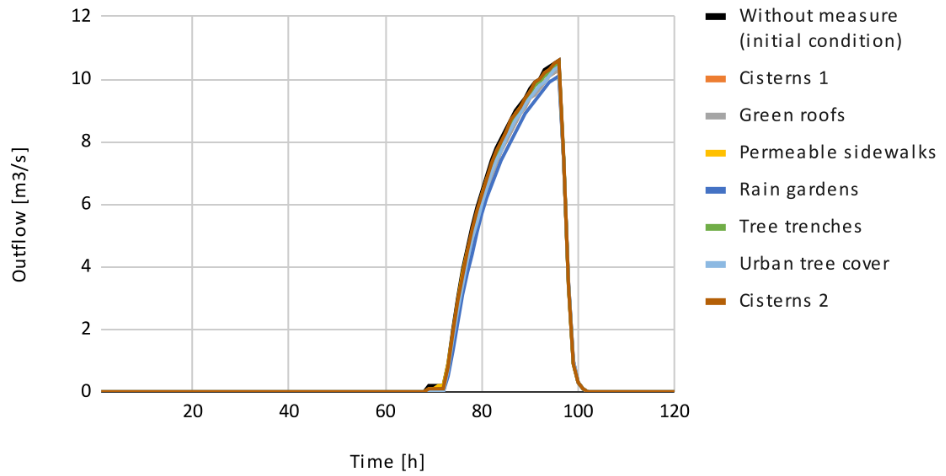


Figure H3. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP8.5 (near-future time period, scenario 1).

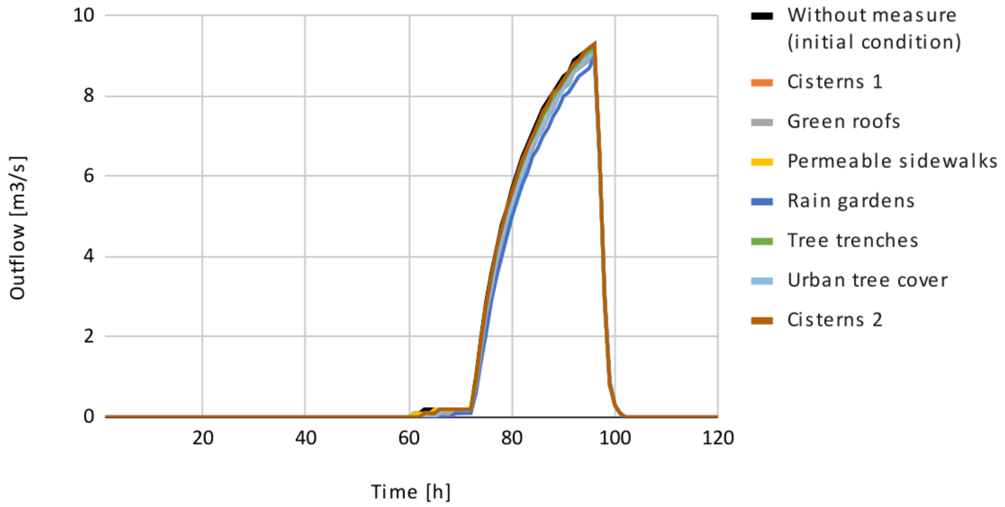


Figure H4. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP2.6 (far-future time period, scenario 1).

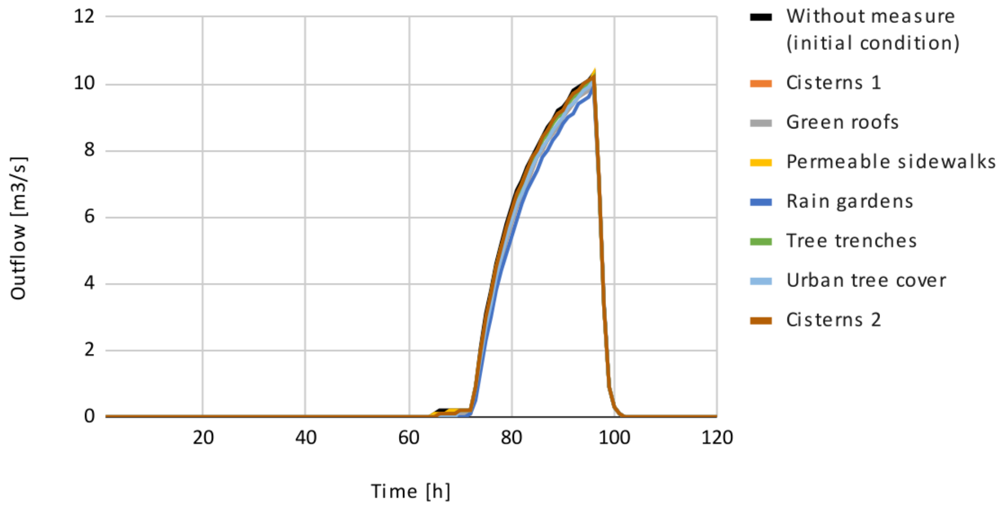


Figure H5. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP4.5 (far-future time period, scenario 1).

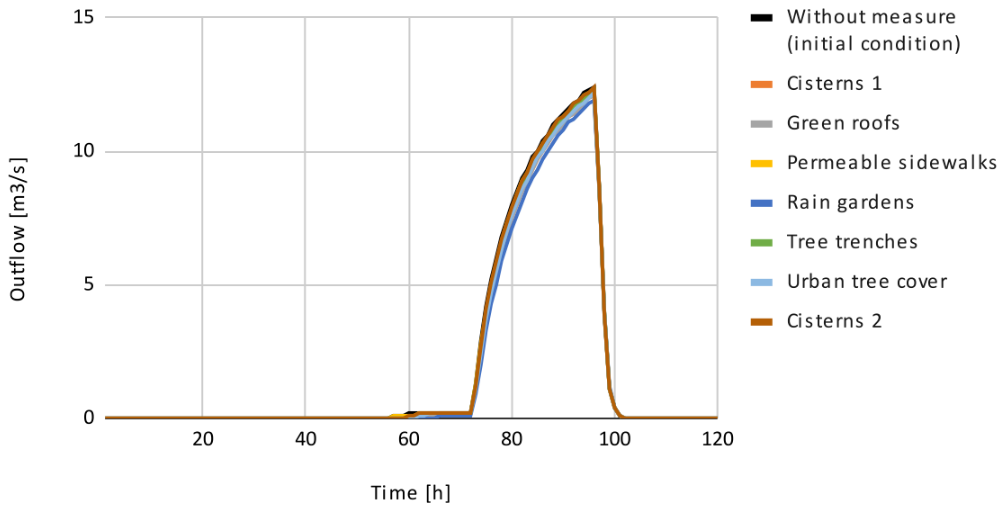


Figure H6. Discharge [m3/s] at the outflow ("Glin in Grad") section of the model for RCP8.5 (far-future time period, scenario 1).