BASHKIA TIRANË

Adapting our City to a Changing Climate

Vulnerability Assessment and Adaptation Action Plan for Tirana






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BASHKIA TIRANË

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LIST OF ABBREVIATIONS / ACRONYMS

CC	Climate Change
CCA	Climate Change Adaptation
CSC	Climate Service Center
DGoS	General Directory of Services;
DoEm	Department of Emergency
DoEnv	Department of Environment
DoTM	Department of Transport and Mobility
DoUP	Department of Urban Planning
EEA	European Environmental Agency
FC	Future Cities Project
GCM	General Circulation Model
GIZ	Deutsche Gesellschaft für internationale Zusammenarbeit GmbH
IGEWE	Institute for Geoscience, Energy, Water and Environment
IPCC	Intergovernmental Panel on Climate Change
IU	INFRASTRUKTUR & UMWELT Professor Böhm und Partner
LD	Legal Department
MAGICC/ SCENGEN	Model for the Assessment of Greenhouse-gas Induced Climate Change A Regional Climate SCENario GENerator
MGE	Municipality Greenery Enterprises
PB	Planning Board
RWG	Regional Working Group
SEA	Strategic Environmental Assessment
SEAP	Sustainable energy action plan
SG	Steering Group

SHG	Stakeholder Group
SRES	Special Report on Emission Scenarios (by IPCC)
TCPW	Technical Council for Public Works
TD	Tax Department
UHI	Urban Heat Island
UKT	Tirana Water Company
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
VA	Vulnerability Assessment
WG	Working Group
WHO	World Health Organization
WUE	Water Utility Enterprise

Preface - Why adapt?

The Municipality of Tirana, besides being the largest in the country, has always been the frontrunner in the environmental and climate change issues. Each year we notice that the world's climate and weather patterns are changing, global temperatures are rising, rain water distribution is changing in space and time, and much more extreme weather events are happening.

But what does this mean for our city and our citizens? That means a much hotter summer and more frequent heat waves over our city, an increased flow of rain water in our streets and in our main transport nodes and along our riverbanks, and that means also an increased need for cooling during the summer for all the citizens and an increased need for health services to the children and elderly, etc. That means definitely an urgent need to plan our city smartly and an urgent need to change our behaviours.

To better manage these new risks and challenges for the city and its citizens, I am pleased to introduce to you the Tirana Climate Change Adaptation Action Plan.

This document is prepared by using the Climate Compass tool following the example of many other European cities. It provides a vulnerability assessment of the different sectors in the city, evaluates the risks to vulnerable target groups, and proposes feasible adaptation options to be introduced in the already existing city development instruments.

Key to this document is integrating adaptation concepts into the city planning and development. It outlines mostly actions to be taken to manage risks and build climate resilience across essential public infrastructure and services.

We are indeed very grateful to the support of Climate Change Adaptation in Western Balkans project being implemented by GIZ, through which we are preparing ourselves for future climate challenges, ensuring that we do our best to manage the posed risks and adapt to change. It is very important for us that the preparation of this document has passed through a process of capacity building for the City administration, which will ensure us an efficient periodic update of the climate change adaptation measures. An important element in the process has also been the exchange with other European cities and especially the cities of Belgrade and Podgorica that was initiated by the GIZ project.

This is one of the first documents of its kind for a city in the Balkan region, and we take pride and believe that we are trying to act fast and respond to our best knowledge to the increased needs for adaptations to the changing climate.

Furthermore, Tirana Municipality has also been active in pursuing mitigation actions on climate change as well, such as by preparing and implementing its SEAP - Sustainable Energy Action Plan. These two documents together would guide us in providing a better living environment for our citizens and contribute to a sustainable development of the capital.

Lastly let me say that we all play a crucial role in adapting our City to a changing climate and that actions by all of us are needed.

Dr. Nevila Xhindi

Deputy Mayor

Tirana Municipality

1 Objectives and background

1.1 Objectives of a climate change adaptation strategy

Overall objective of the project for Tirana City was to integrate climate change adaptation (CCA) into management and planning processes within the different sectors of the city administration and into cross-cutting activities like spatial planning and strategic project development. Under the patronage of the Major of Tirana, who nominated the city's Directorate of Environmental Policies and Environmental Education for the coordination of the activities in Tirana, a working group of representatives of all relevant directorates and sectors realised a vulnerability assessment and the development of an action plan.

The working group agreed to aim at two indicators:

- City administration approves jointly developed measures on integrating CCA in cities planning and management processes.
- Capacities of selected representatives and decision makers are developed to follow-up implementation of the developed measures after setting up the action plan.

Adaptation to climate change is a continuous long term process that has no real start or end date. Thus the results documented in this report are interim results on the long way to adaptation. They shall allow the city administration to improve the decisions and plans in the light of potential impacts of climate change. The interim results are guidance for the political and administrative work in the city. Actions named in this report are not a "stand-alone policy". They work only in close relation with sector plans and project initiatives. They deliver proposals "how to improve planning and investment decisions regarding the long term challenges of Climate Change". CCA actions cannot be realised as such; they can only be incorporated into the administrative structured planning tasks (and political discussions).

Consequently the purpose of this document is to create and document adaptation options. The target groups are all sectors of municipal planning. They should think of the recommendation whenever plans are set up. They should integrate CCA actions into daily planning and decision making to make Tirana a resilient city. They shall realise those actions first, that are not cost intensive but which can be included in the necessary sector oriented design.

TWO PRINCIPLES are considered:

Adaptation to impacts of climate change in a city …

… needs no new invention of the wheel (we can use many known actions!)
… needs a comprehensive, trustful cooperation of many different disciplines.
… has to be done by hundreds of different actors, in their specific fields, together.
… needs communication, communication, communication! To raise awareness.
… HAS TO BE STARTED with simple measures. NOW!

Don't wait until all answers are clear – they never will be!

Most anticipatory options are not only beneficial for climate change adaptation but also for other sectors such as economic growth. Even if climate change impacts do not occur as expected, the measures will still be beneficial and cost-effective. Such adaptation options are called no-regret measures.
START WITH THEM!

1.2 Situation and developments in Tirana

Tirana is the biggest economical, administrative, political, social and cultural centre of Albania and covers a territory[1] of 42 km². Over the last two decades Tirana has more than doubled its population and grew from 250,000 inhabitants in 1991 to 600,000 in 2008 and 700,000 today - an average demographic growth of 8 percent per annum (SEA, 2013).

The wider Tirana Metropolitan Area includes Albania's most important infrastructure like main roads, railways and gates (Durres port and Tirana International airport).

Regarding the CCA one of the most important factors is the recent and ongoing fast change and growth of the city. Tirana has changed much in the past two decades. The Urban Regulatory Plan adopted in 1990 became quickly irrelevant since it failed to predict and adapt with the rapid democratic and demographic changes. The new freedoms of the democratic changes, such as the right to live wherever someone chooses within the country, caused rapid population growth due to internal migration. The city grew rapidly. At the same time the gradual but steady increase in living standards and consumption for citizens during this period increased the pressure on the existing limited services. Hence, there is intense alteration in land use, converting the unused or agricultural areas on the outskirts of the city into intensely urbanized areas. Estimations for the population of Tirana in 2025 project ca. one million inhabitants (SEA, 2013).

[1] Reference to the existing municipal borders: With the new territorial reform, after 21st of June Municipal boundaries will extend significantly, but the added territory does not have highly urbanized typology, therefore does not influence the findings and recommendations of this document.

Accommodating this population growth resulted in unplanned and concentrated areas especially in suburban surroundings. This has put great pressure on existing infrastructure and services, which have failed to adequately respond to the increasing demands from rapid growth. Despite the existence of several plans, the development of Tirana failed to provide effective and functional services and ensuring environmental sustainability in the city. The existing regulatory plan for Tirana drafted in 1990 was inadequate and unrealistic to answer spatial needs and requirements of economic development.

After a long participatory process, the new Urban Regulatory Plan for Tirana was approved in February 2013. The plan encourages the Municipality to play an active role between the parties to promote the development of the city in cooperation with land owners and to provide opportunities for public service benefit. The plan also aims to integrate and improve the current urban situation by promoting environmentally friendly developments through the creation of some suburban parks, increase green areas within the city, rehabilitation of hot spots, creation of new green areas through urban requalification of former industrial sites, a new complete network for bicycle movement, etc.

Following the new Urban Regulatory Plan, the Municipality of Tirana has also completed several sector plans, such as the Transport Plan, Water and Wastewater Management Plan, Urban Solid Waste Management Plan, etc.

Furthermore, several major development projects have their feasibilities and designs completed and are ready for tendering of civil works such as:

- Tirana Multi-Modal Terminal Passenger (Main Train Station, Bus Terminal, Tram starting station, car parking, bike parking, etc.)
- Tirana Tram with two initial lines
- Urban Solid Waste Recycling and Management
- Tirana Northern Boulevard and River Rehabilitation Project.

This last project is already being implemented (see also case studies and good practice examples in chapter 6).

The planning documents in Table 1 form the main cross-cutting basis for the future development planning (sector plans are not named here).

Table 1: Relevant documents for CCA

Source	Focused policy documents	Quality / Comments
City of Tirana General Directorate of Planning and Territorial Development (Department of Territorial Planning)	Policy document of the Master Plan (approved in 2012)	*Content:* data, analyses, proposals *Language:* Albanian
	Report (Master Plan)	*Content:* documentation and guideline *Language:* Albanian
	General plans of the Master Plan	*Content:* 4 maps (land use, green spaces, road network and city development) *Language:* Albanian
	Local Development Plans	*Content:* 400 detailed plans *Language:* Albanian
	Sector plans	*Content:* expertise about transport, greenery, telecommunication, electricity
Municipality of Tirana (Albanian University Press, February 2013)	Strategic environmental assessment of the regulatory plan of Tirana (Vlerësim strategjik mjedisor i planit rregullues të Tiranës)	Study of L. Selfo, S. Sulce, S. Guri, R. Hanxhari, J. Malltezi *Content:* translation needed *Language:* Albanian

1.3 Integration of Tirana's CCA Action Plan in an international network

The CCA action plan is one of the first climate change related action plans in the Balkans. The activities in Tirana are embedded in a wider international framework to allow an exchange of experiences, to mutually learn from other's approaches and to raise the international political awareness on Western Balkans progress in respect to CCA. It is part of a trilateral cooperation with Belgrade and Podgorica on one hand and aims at integrating the Tirana advanced approach into the European Network "Mayors Adapt".

The work done for Tirana's CCA Action Plan is part of the regional GIZ programme "Climate Change Adaptation in the Western Balkans - CCAWB" that form the framework for the integration of climate change adaptation (CCA) in the management and planning processes in the cities of Tirana, Podgorica and Belgrade. During the project duration from December 2013 to May 2015 a project working group consisting of experts of the City of Tirana, GIZ CCAWB team, German and Albanian experts (consultants) facilitated and coordinated the working process on the vulnerability assessment and development of climate change adaptation measures within the concerned city administration. This included the assessment of the planning and management framework in the city and regular meetings of the city working group that shall further implement CCA in the municipal processes.

During the project life time the project team developed a close contact to the EU initiative Mayors adapt with regard to assess the possibilities and benefits of join the network. Mayors Adapt is an initiative of the European Commission's Directorate General Climate Action. It is launched in the context of the EU Adaptation Strategy and is implemented within the Covenant of Mayors, the flagship European initiative for cities to reduce their greenhouse gas emissions. The main outputs from the project are planned to be included in the European Climate Adaptation Platform CLIMATE-ADAPT, a partnership between the European Commission and the European Environmental Agency (EEA).

Mitigating climate emissions and adapting infrastructure and policies to climate impacts are both crucial elements in building more sustainable cities. Mayors Adapt provides a framework for local authorities to take action on the second of these elements.

2 Methodological approach and process

The working steps, working tools and the responsible project participants are shown in the following Figure 1.

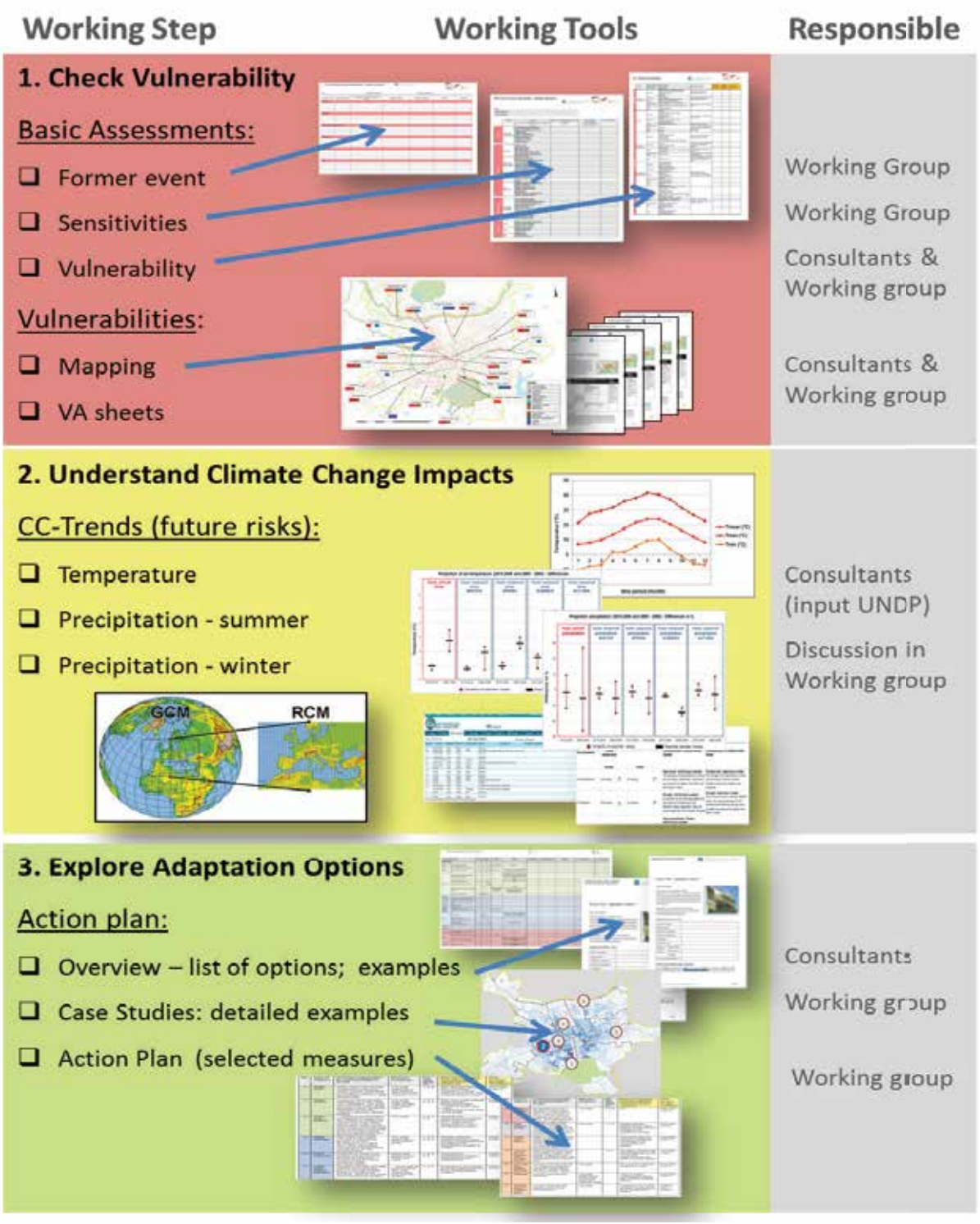


Figure 1: Working steps, tools and responsibilities

This shows clearly the philosophy of an active and participatory process with the relevant actors of the city administration rather than to deliver just an expert driven report at the end of the process, which would then lack ownership. Decision makers have been involved regularly to ensure support on the process along with increased awareness regarding the need to make Tirana a climate resilient city. Based on the experiences of the engaged experts, a number of tools were applied (e.g. from the EU project Future Cities) to guide the actors through the working steps.

The working group was firstly trained on the steps and continuously guided on how to use and fill the assessment tools.

2.1 Working process and involved actors of the City

Climate change adaptation processes have to be interdisciplinary and interactive. Therefore the working process comprises interdisciplinary working group (WG) meetings within representatives of different relevant departments of the city administration. In addition steering group (SG) meetings served to coordinate the working steps, prepare the WG meetings, conclude interim results and therefore to reach the project objectives.

Working group meetings comprised trainings on CCA, work on the vulnerability assessment and the development of an action plan (joint discussions of interim results). During the project time two of the WG meetings were opened to a wider group of stakeholders in order to collect feedback and receive opinions.

The list of all SG and WG / SHG meetings is available in Annex D. As shown in Figure 2, the Steering Group (SG) is part of the Working Group (WG) and the WG is part of the Stakeholder Group (SHG).

Figure 2: Working structure of the CCA project in Tirana

The institutions / departments comprising the CCA Tirana working structure are listed in the following table.

Table 2: Group members of the project in Tirana

Group	Institution of group members
SG	Lead Partner (Directorate of Environmental Policies and Education) Project Team (GIZ) International Consultant (IU) Local expert
WG	Directorate of Environmental Policies and Education Directorate of Projects and Engineering Networks Directorate of Spatial Planning / Department for Local Plans Directorate of Spatial Planning / Department of Standardisation Directorate of Waste Management Directorate of Transport and Mobility Directorate of Economic Development Directorate of Projections and Foreign Investments Other representatives of the municipality of Tirana
SHG	Public Health Institute Agriculture University of Tirana National Agency for Territorial Planning Donors Other Stakeholders

The interdisciplinary working structure of the CCA working group in Tirana forms the basis to mainstream CCA within local governance and urban planning.

2.2 Methodological approach - overview

The methodological approach of integrating CCA in Tirana is related to the working steps of the Adaption Compass of the EU project Future Cities[2]. The Future Cities Compass is a practical adaptation approach which was developed by a partnership of cities from different EU countries, and it is used in several countries (e.g. Germany, UK). Main advantages of this approach are a clear structure, available checklists to structure the working steps and the use of estimations and trends appropriate for the practical daily work. Furthermore it offers a view to the city as a whole (not only on a single sector). The approach can be described with 6 steps that are highly interlinked.

Both the Vulnerability Assessment (VA) and the development of adaptation options are part of this process. The vulnerability assessment contains three working steps - check vulnerability, understand climate change impacts and assess risks and opportunities, see Figure 3.

[2] see FC, 2013

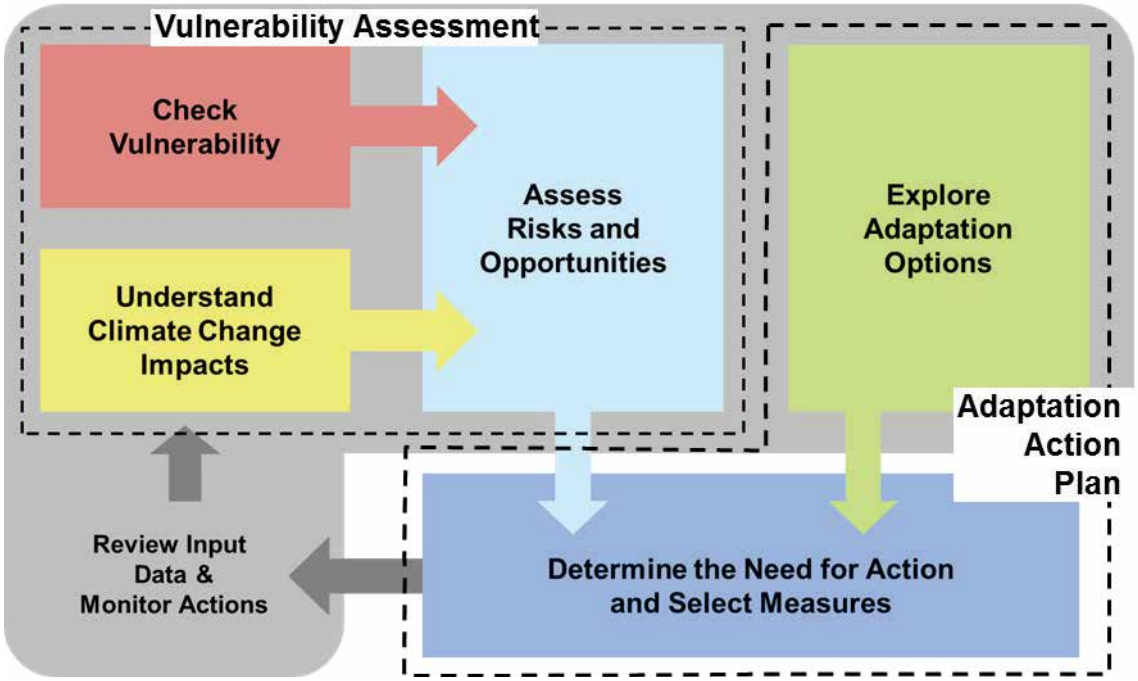


Figure 3: Overview of the methodological approach (FC, 2013)

The development of the adaptation options is composed of two working steps in parallel. On the one hand a general exploration and selection of adaptation measures for the city of Tirana including:

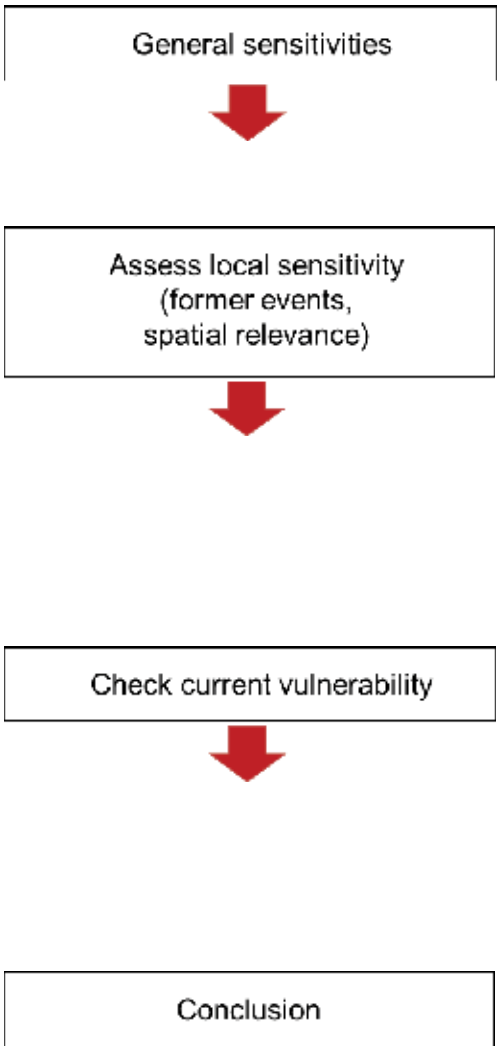
- Explore Adaptation Options and
- Determine the need for action and select Measures.

On the other hand a more specified determination of need for action focused on previously identified case study areas of Tirana.

2.3 Vulnerability Assessment

2.3.1 Check current vulnerability

The local physical features and socioeconomic conditions - called receptors (such as population or infrastructure) - are the starting point for the check of current vulnerability towards extreme weather events (like heat wave or heavy precipitation). The assessment of the current vulnerability of receptors includes the following steps, see Figure 4.



General consideration of receptor sensitivities of Tirana - get to know the receptors and corresponding sensitivities towards weather extremes.

Assess local sensitivities by taking into account former events and identifying the respective spatial relevance. Therefore the WG compiled a list of former extreme weather events that affected the city of Tirana and focus on main affected receptors or locations to identify the spatial relevance.

The vulnerability check combined the assessed sensitivities and exposure of a receptor with the respective capacity to adapt on extreme weather events. The determination of the class of vulnerability (high, medium, low) of the investigated receptors bases on an evaluation matrix, see below

Table 3.

Summary of most predominant weather events as well as most affected receptors in Tirana.

Figure 4: Working steps - check of current vulnerability[3]

The resulting tables “former event” and the table “current vulnerability” can be found in the annexes A and B:

- The table “former events” lists specific events, corresponding consequences, responses taken, affected receptors and locations as a function of different types of extreme events (heat wave, extreme cold, drought, heavy precipitation/floods and storm), see annex A.
- The table “current vulnerability” lists both the general weather sensitivity of the different receptors dependent on the different types of extreme events and detailed information about whom or what is affected. Furthermore the sensitivity / exposure assed by WG and capacity to adapt of the receptors as well as the resulting class of vulnerability are listed, see annex B. For the determination of the class of vulnerability the following matrix is used.

[3] Note: Explanation of technical / methodological terms can be found in the glossary.

Table 3: Matrix to determine the class of vulnerability of receptors

Class of vulnerability		Capacity to adapt		
		Low	Medium	High
Sensitivity/ Exposure	High	High	High	Medium
	Medium	High / Medium	Medium	Medium / Low
	Low / No	Low	Low	Low

The classification of the specific capacity to adapt of a receptor builds on the ability (financially, technologically or socially), willingness and preparedness to cope with weather extremes. For example, in case of a high sensitivity / exposure combined with a low capacity to adapt - the class of vulnerability of a receptor is “high”. In case of a high capacity to adapt – the class of vulnerability is “medium”.

2.3.2 Understand Climate Change Impacts

Climate Change Impacts are by definition of IPCC: Impacts or consequences of climate change on natural or human systems[4]. The results of this methodological step “Understand Climate Change Impacts” are explained in chapter 3.3 “Conclusions: Climate Change trends for Tirana”.

The general definition of climate change is important to understand climate change impacts. Therefore the difference of climate and weather should be clarified. The terms climate and weather describe two very separate circumstances. Climate is the average state of the atmosphere and the underlying land or water, whereas weather describes the day-to-day changes in atmospheric conditions.

Weather can only be predicted for a short time period. Little differences in the starting conditions of meteorological parameters, e.g. the humidity level, can lead to very large differences in the results, even over a short period of time.

Climate on the contrary is described by long-term statistic values, like means, variances, probabilities etc. of meteorological parameters. Long-term in the context of climate change typically means a time span of at least 30 years.

Changes in mean values are calculated by Climate models in order to deduce important trends in global climate. The modelling results available on future climate are no forecast but a pick from the various projections of a future climate situation (ranges and changes of mean values). Climate models that simulate the whole climate on earth are called global climate models. They can deliver data on a horizontal resolution of about 200 x 200 km. Since for

[4] See IPCC, 2007a

many analyses this resolution is not detailed enough, regional climate models have been developed. These regional models use a statistical or dynamic downscaling of the global climate model data and reach horizontal resolutions of 10 x10 km. When considering a city with small scale features and lots of influencing factors to the micro-climate, even regional climate models are not detailed enough. But as uncertainties increase with time and resolution, a further downscaling makes little sense.

The bases for all climate models are assumptions on future development of emissions, demography, society, techniques, economy and ecology. These assumptions are described in scenarios. Most climate models use emission scenarios defined by the Intergovernmental Panel on Climate Change (IPCC).

Based on the available projections climate change trends for Tirana are deduced. The used parameters are air temperature, precipitation, precipitation extremes / intensity and storm / wind. A distinction between trends for summer and winter is necessary as some trends and consequences may differ. Consequences of impacts of CC trends on relevant receptors of Tirana (see VA) can be:

- Reinforcing: The trends are intensifying the respective situation (e.g. it gets hotter in summer) and therefore the vulnerabilities identified will increase in future.
- Indifferent: No changes in the trends are expected; therefore the vulnerabilities identified will not increase in future.
- Balancing: The trends are balancing the respective situation (e.g. it gets warmer in winter and extreme cold becomes less probable) and therefore the vulnerabilities identified will decrease in future.

2.3.3 Assess Future Risks and Opportunities

Change of climate conditions might increase future risks but also may offer future opportunities. The assessment builds on the identified current vulnerability (see chapter 4.1) and the projected climate change trends (see chapter 3.3).

The classes of current vulnerability of receptors in Tirana are combined with the future climate change trends projected. The following evaluation matrix is used:

Table 4: Evaluation matrix of future risks

Future risk		Climate change impact		
		balancing	**indifferent**	**reinforcing**
Current vulnerability	**High**	medium	high	very high
	Medium	low	medium	high
	Low	low	low	medium

The results are summarised in table “future risks and opportunities”, see annex C. The table contains ten columns:

- Receptors, weather sensitivity, potential effects and current vulnerability as worked out in vulnerability assessment - column 1-4;
- Climate change impact for summer and winter - column 5+6;
- Description of Future Risks and Opportunities of Tirana - column 7+10
- Results of Future Risks for summer and winter - column 8+9.

The table creates a basis for deciding which issues should be considered first or looked into more detailed (identified very high and high risks).

Note: "risks" and "uncertainties" of CC projections:

In this approach "risk" is the combination of the class of current vulnerability (high, medium, low) and the climate change impact (balancing, indifferent, reinforcing - as concluded from climate change trends). Risks are categorised in the classes very high, high, medium and low. In classical risk approaches the term risk is defined as the combination of the probability of occurrence and the magnitude of the consequence or hazard. In the method used here, the probability of occurrence is not evaluated because the climate change impact is based on tendencies and qualitative descriptions. The uncertainties of climate change projections are, at least for some climate parameters, very high (uncertainties from scenarios, from models or sampling uncertainty).

Nevertheless, the results of climate projections can be valuable background information for regional and local adaptation decisions. The decisions though should always be taken on the basis of a variety of information, like vulnerability assessments or general spatial planning needs, development plans etc. Most adaptation options are not only beneficial for climate change adaptation but also for other sectors, e.g. economic growth. Even if climate change impacts do not occur as expected the measures are though beneficial and cost-effective.

2.4 Development of Adaptation Options

As previously mentioned, the development of adaptation options within this project consists of two parallel steps that are explained in the following sub-chapters.

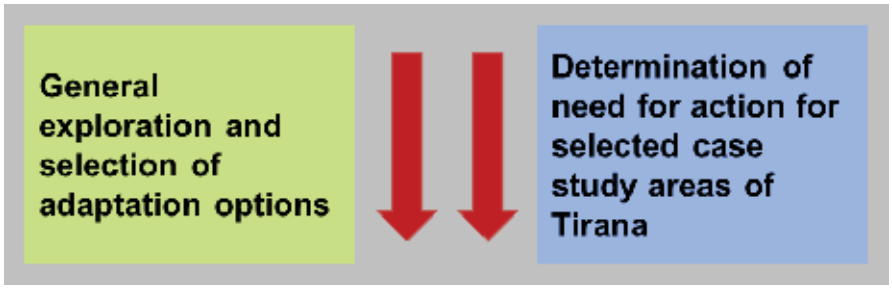


Figure 5: Development of adaption options - two steps in parallel

2.4.1 Exploration and selection of adaption measures

Based on a general catalogue of adaption option (compilation of structural and non-structural adaption measures) both measures that are already taken into account in the city of Tirana and additional potential measures to face future risks are identified.

Table 5: Categories of adaption (and mitigation) options

Structural measures	Green structures
	Water system
	Urban structure
	Building design
Non-structural measures (e.g. awareness raising, restrictions, etc.)	
Mitigation measures with a close link to adaptation (e.g. renewable energy measures)	

The exploration and selection process comprised the following working steps:

- Selection of general measures referring to the results of the vulnerability assessment (most important future risks of specific vulnerable locations in Tirana) and check relevant ongoing or planned projects to realise specific measures.
- Estimation of the respective time horizon, responsibility within the city administration and priority of each measure. In this regard preconditions, bottlenecks, cross-sectoral synergies or dependencies have been taken into account.

2.4.2 Exemplary focused evaluations (Case Studies)

For a detailed evaluation of vulnerabilities and corresponding adaption options specific areas of Tirana are elaborated. The evaluation process consisted of the following main working steps:

- Case study area selection: Based on the VA results the working group selected five areas in Tirana that are highly vulnerable with respect to climate change impacts.
- Case study assessments: The assessment was conducted with the aid of fact sheets to characterize the selected areas, summarize the main vulnerabilities and identify and exemplify possible adaptation measures taking account of already ongoing projects.
- Maps of the areas: The urban situation, green structures, urban texture of buildings, etc. are visualized by satellite images or specific extracts of the Master Plan of Tirana (2013)

Taking into account the respective character of each area the results obtained can be used for assessments of further areas of the city.

3 Climate Change trends for Tirana area

In this chapter the results shown are based on the available data for Tirana. Due to existing gaps in data availability, the compilation of relevant climate data is not complete. For this reason, further investigation (e.g. within future studies) are needed and pointed out later in the report.

3.1 Observed climate developments

The content of this chapter is based on data provided by Prof. Kolaneci (expert of Institute for Geoscience, Energy, Water and Environment (IGEWE)). A compilation of basic climate parameters of Tirana is shown in the following table.

Table 6: Basic climatic parameters 1951-1980 in Tirana (Kolaneci, 2015)

Feature	Location: Tirana
Mean annual temperature	15.1 ºC
Highest mean daily temperature in summer	29.9 ºC
Highest absolute temperature recorded	42.2 ºC
Lowest mean daily temperature in winter	6.7 ºC
Lowest absolute temperature recorded	-10.4 ºC
Mean annual rainfall	1270 mm
Highest annual rainfall	1770 mm
Lowest annual rainfall	773 mm
Average annual relative humidity	70 %
The average relative humidity in summer	63 %
The average relative humidity in winter	73 %
Average number of days with precipitation ≥ 0.1 mm	129 d
Average number of days with precipitation ≥ 1 mm	100 d
Average number of days with precipitation ≥ 5 mm	64 d
Average number of days with precipitation ≥ 10mm	45 d

Air temperature

Tirana is strongly influenced by the Adriatic Sea and is characterized as a mild Mediterranean climate. The average monthly temperatures as well as the extreme (absolute maximal and minimal daily) temperature monthly recorded in Tirana are provided in the table and also in the chart below.

Table 7: Monthly (mean, max, min) air temperature 1951-1980 (Kolaneci, 2015)

Months	1	2	3	4	5	6	7	8	9	10	11	12	Av.
T_{mean} (°C)	6.9	7.9	9.9	13.3	17.7	21.6	23.8	23.8	20.6	16.1	11.8	8.2	15.1
T_{max} (°C)	21.3	27.7	29.6	31.7	35.8	37.9	41.5	40.3	37.0	31.4	26.9	22.5	
T_{min} (°C)	-10.4	-7.6	-7.0	0.0	1.8	5.6	9.4	10.0	3.8	-1.3	-6.1	-6.9	

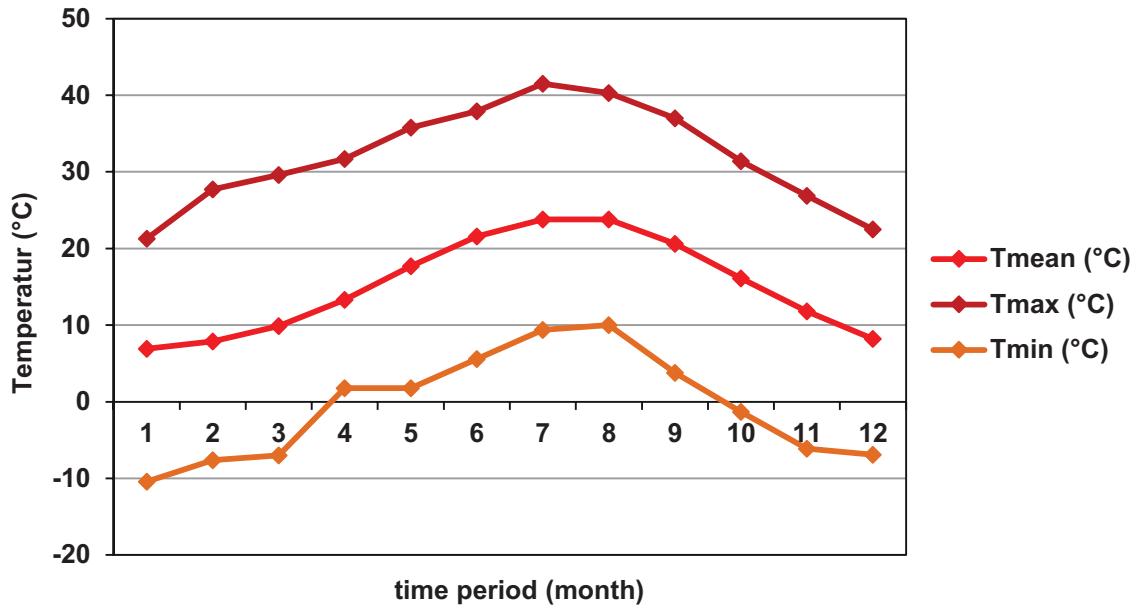


Figure 6: Monthly (mean, max, min) air temperature 1951-1980 (Kolaneci, 2015)

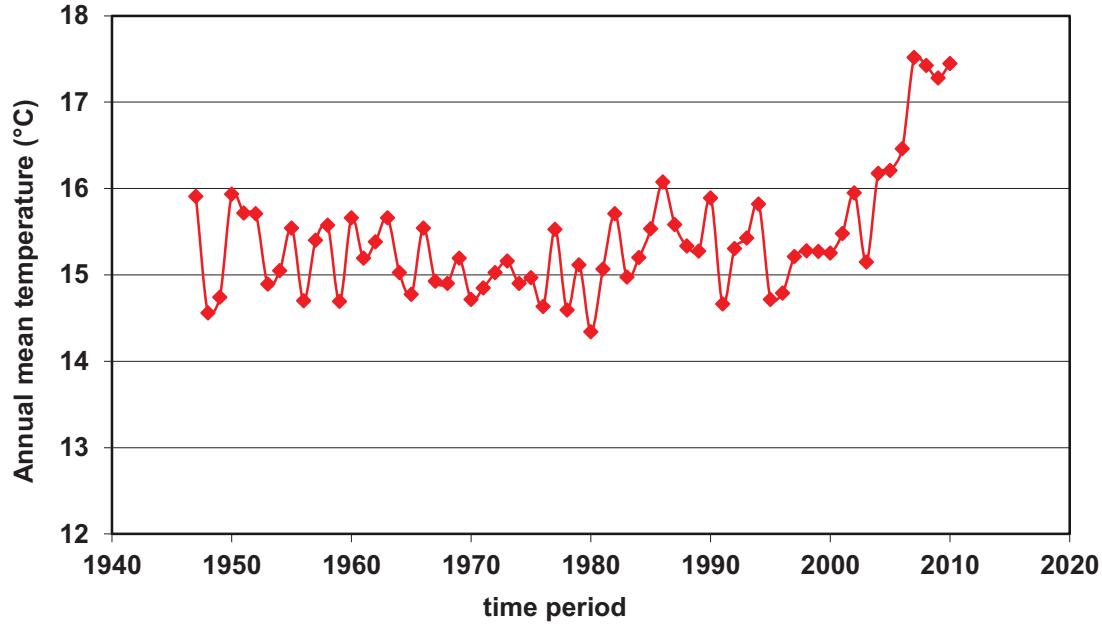


Figure 7: Annual mean temperature in Tirana (1947-2010) (Kolaneci, 2015)

The lowest mean monthly temperature is recorded in January (6.9 ºC), while the highest mean monthly temperatures are recorded in July and August (23.8 ºC). The mean annual temperatures amounts 15.1 °C. Recent trends in Tirana have shown a substantial growth in annual mean temperature during the last 10 years.

Precipitation

The location of Tirana in a plain relief surrounded by hills and Dajti Mountain in the Northeast and its close proximity to the Adriatic Sea allows for a wet climate. The average annual rainfall in Tirana is considered about 1200 mm, see Table 8.

Table 8: Average monthly and annual rainfall1951-1990 (Kolaneci, 2015)

Months	1	2	3	4	5	6	7	8	9	10	11	12	annual
Rainfall [mm]	135	126	113	102	92	63	38	45	84	111	162	141	1210

The maximal annual rainfall recorded has been 1770 mm while the minimal recorded has been 770 mm. The highest rainfall is expected late fall and early winter (November and December with respectively 162 and 141 mm) while the driest month is July (38 mm).

The daily rainfall quantities also vary. The table below provides the frequency of occurrence of small rainfall such as: 0.1 mm, 1.0 mm, 5 mm dhe 10 mm.

Table 9: Frequency of occurrence of rainfalls in Tirana 1951-1990 (Kolaneci, 2015)

Rainfall	≥ 0.1mm	≥ 1mm	≥ 5mm	≥ 10mm
Number of days	129	100	64	45

The maximal daily rainfall recorded in Tirana has been 237.4 mm. The highest daily rainfall figures ever recorded (until 2007) in Tirana are provided in the table below.

Table 10: Maximal daily rainfalls in Tirana according to different months 1951-1990 (Kolaneci, 2015)

Months	1	2	3	4	5	6	7	8	9	10	11	12	Max.
Rainfall [mm]	85	89	65	77	123	103	59	79	98	237	194	130	237

The data provided by IGEWE (Institute for Geoscience, Energy, Water and Environment) in Tirana are available until 2007. The average yearly rainfalls in Tirana indicate a clear decreasing trend from about 1200 mm to close to 1000 mm recently.

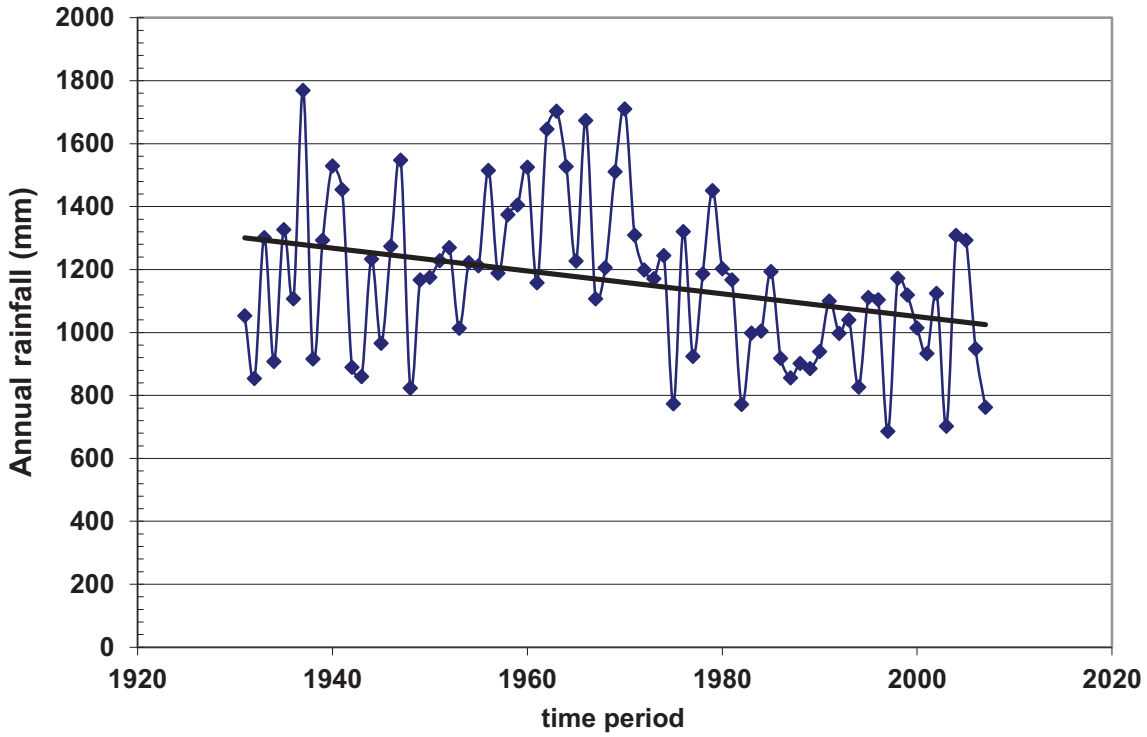


Figure 8: Annual rainfall of Tirana (1931-2007) (Kolaneci, 2015)

Wind

Albania is characterised by a Mediterranean climate. The south-western part is mainly under the influence of the warm air masses from the Adriatic and Ionian seas the north-eastern part is mainly under the influence of continental air masses. Observed mean values are taken from literature and available global data sets and are averaged over the whole country (CSC, 2012):

- Annual mean wind speed (10 m above surface): 3 m/s
- Intensity of storm events: 11.5 m/s.

3.2 Climate Change Scenarios

Within this chapter the results of climate projections regarding the climate parameters temperature and precipitation for Tirana are summarised. The content is based on the data provided by UNDP that is currently working out the draft of the 3rd National Communication of Albania to the UNFCCC (UNDP, 2015).

Extract of UNDP paper on modelling activities performed in Albania[5] (UNDP, 2015)

The Climate Change scenarios for temperature and precipitation of Tirana are developed by using the model MAGICC/SCENGEN. In order to use a range of SRES scenarios with a variety of assumptions to capture the range of uncertainties associated with driving forces and emissions, the global model MAGICC is run by using the following scenarios from different SRES families: A1BAIM, A2ASF, B1IMA, B2MES, A1T-MES, A1FI-MI.

To develop the climate scenarios the change fields, scaled in SCENGEN by the global-mean temperature change derived from MAGICC, are used. The changes are generated for each emission scenario up to the year 2100, by using a multi-model average. The justifications for use of a multi-model average are two-fold. First, multi-model averages are less spatially noisy. Second, by many measures of skill, multi-model averages are often better than any individual model at simulating present-day climate.

A climate-change projection is the change between a model simulation of present climate (period 1961-90 is considered as climatic baseline) and the model climate projection for a period in the future, under a specific emissions scenario. The changes in annual and seasonal patterns of temperature and precipitation are generated for every ten years starting with 2020 up to 2100.It is to be noted that the time horizon means that the model is run for a period of 30 years, e.g. for the year 2050 the running time is from 2035 to 2065. The likely changes temperature and precipitation are calculated.

*The seasonal and annual expected changes in temperature and precipitation patterns for Albania, developed by using the mentioned methodology have a low resolution (50*50 km), that is not appropriate for adaptation. Given that a statistical downscaling process up to 1*1 km, taking into account the topography, is carried out for different parts of Albanian territory as per project focus.*

[5] Edited by Prof. Dr. Eglantina Bruci, V&A Technical Coordinator, UNDP Climate Change Programme

Temperature

The mean annual and mean seasonal air temperature is expected to increase (relatively higher increase in summer compared to winter). Furthermore, the number and duration of extreme events per year are also expected to increase.

Table 11: Projection of average air temperature change in Tirana related to 1961-1990 (UNDP, 2015)

Change of		2015 – 2045		2065 – 2095	
mean annual temperature (°C)		1.0	(0.7 -1.2)	2.8	(2.0 - 3.5)
mean seasonal temperature (°C)	winter	0.8	(0.7 - 0.9)	2.0	(1.7 - 2.3)
	spring	1.0	(0.8 - 1.1)	2.6	(2.2 - 3.0)
	summer	1.6	(0.8 - 1.8)	4.3	(3.8 - 4.9)
	autumn	1.0	(0.9 - 1.1)	2.8	(2.7 - 3.0)

Values in bracket refer to the expected variability around expected average values (UNDP, 2015).

The shown data give the following picture for the projected temperatures and the variety resulting from different scenarios and different models.

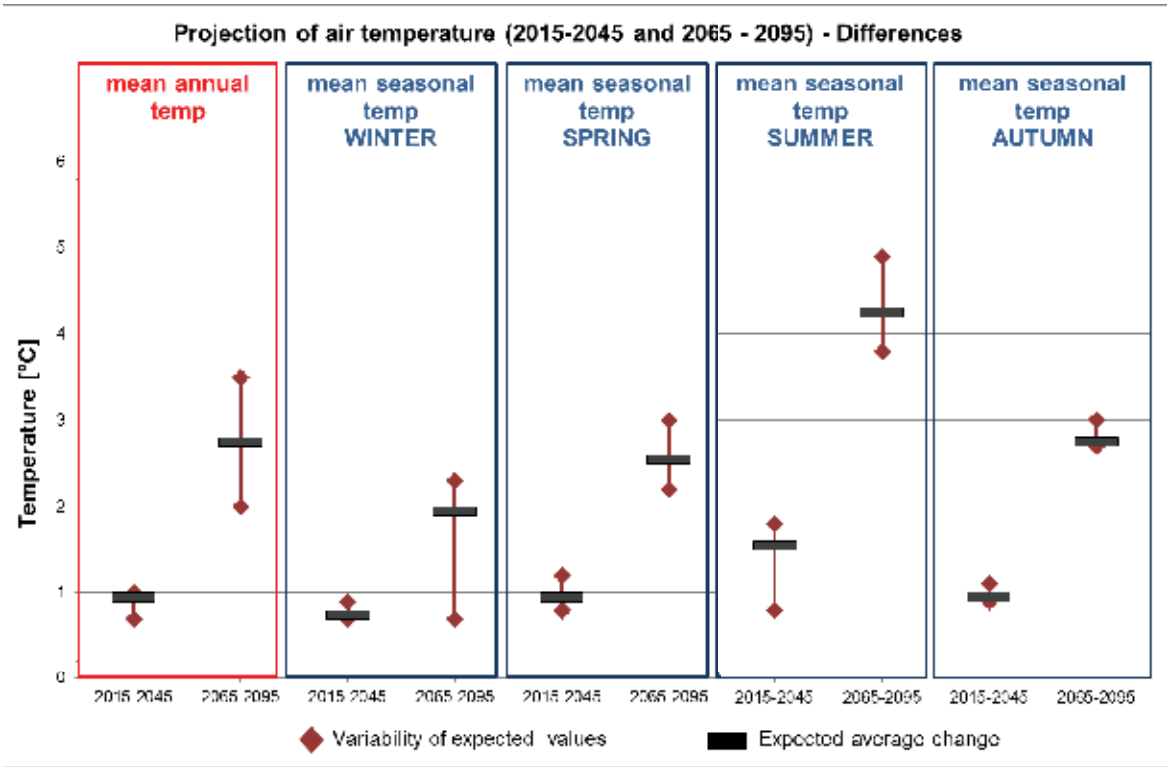


Figure 9: Projected Air Temperature (2015-2045 and 2065 – 2095)

Precipitation

The mean annual and mean seasonal precipitation is expected to decrease (most noticeable in summer). Furthermore an increase of precipitation intensity is expected (UNDP, 2015).

Table 12: Projection of average precipitation change in Tirana related to 1961-1990 (UNDP, 2015)

Change of		2015 – 2045		2065 – 2095	
mean annual precipitation (%)		-3.8	(-35.4 - +27.7)	-14.4	(-78.6 - +81.1)
mean seasonal precipitation (%)	winter	-6.0	(-15.9 - +4.0)	-14.3	(-44.7 - +16.1)
	spring	-2.5	(-11.9 - +7.0)	-14.3	(-45.1 - +16.6)
	summer	-10.4	(-12.8 - -7.9)	-41.9	(-49.2 - -34.5)
	autumn	0.5	(-10.1 - +11.1)	-6.9	(-38.1 - +25.2)

Values in brackets refer to the expected variability around expected average values. Positive values might refer to an increased frequency of heavy rain events and negative values might refer to an increased frequency of drought events (UNDP, 2015).

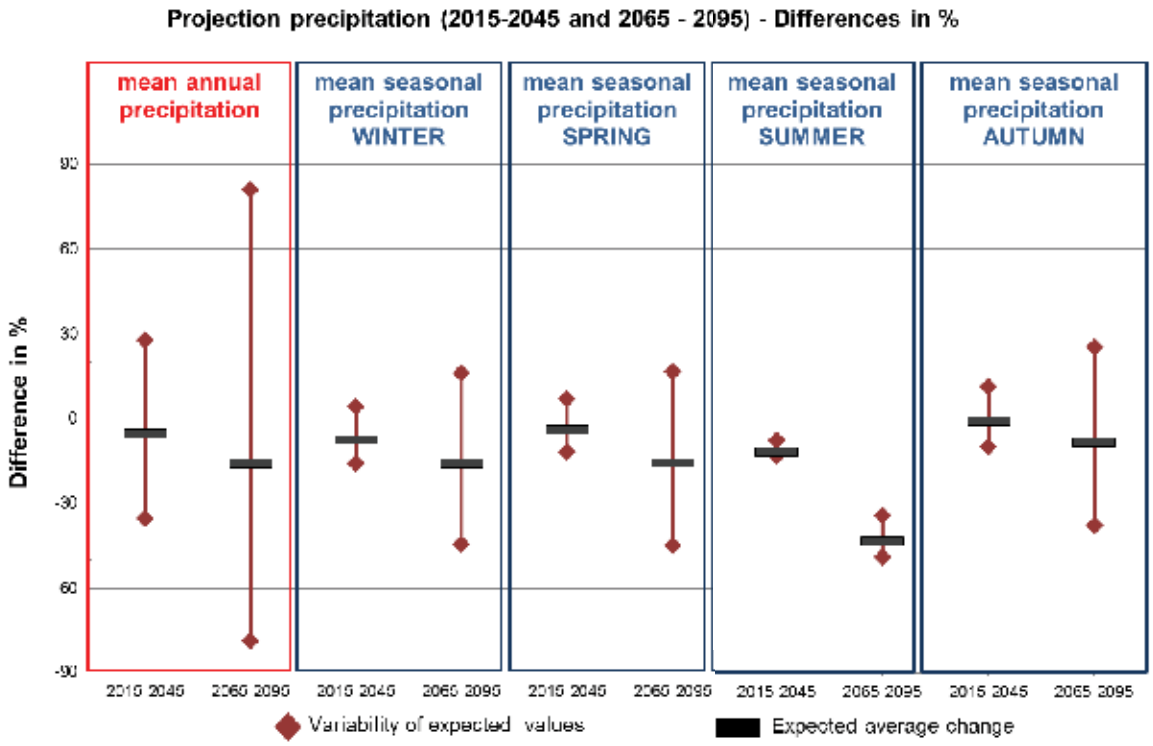


Figure 10: Projected Differences in precipitation (2015-2045 and 2065 – 2095)

The values and figures show that almost no significant trend can be identified for future precipitation. The variety of results depending on the used scenarios and models is in most cases far higher than the projected absolute change. Only decreasing precipitation in summer can be assessed as a tendency for the next decades. No or no significant changes in the other seasons seem to be reasonable at the moment. However, the variety of these data is too large to name significant trends. The model's resolution of 1x1 km (UNDP, 2015) might be one reason for the high variety.

Regarding the trend of mean number of consecutive days with precipitation < 1 mm UNDP is still working to improve and upgrade the modelling of extremes in temperature and precipitation (UNDP has not detected this kind of result so far). UNDP intends to use another software (SimCLIM) to model extremes, as MAGICC/SCENGEN does not provide this opportunity. Currently general statements based on global climate projections by IPCC are available, see below.

Note: Precipitation Extremes and Droughts (IPCC, 2007b):

"Intensity of precipitation events is projected to increase, particularly in tropical and high latitude areas that experience increases in mean precipitation. Even in areas where mean precipitation decreases (most subtropical and mid-latitude regions), precipitation intensity is projected to increase but there would be longer periods between rainfall events. There is a tendency for drying of the mid-continental areas during summer, indicating a greater risk of droughts in those regions. Precipitation extremes increase more than does the mean in most tropical and mid- and high-latitude areas."

Wind

For Tirana there are no projections of change in annual mean wind or intensity of storm events available. Therefore, appropriate future scenario analyses are recommended. National projections for Albania are investigated by the Climate Service Center Germany for the end of the century based on regional model simulations (CSC, 2012)[6]:

[6] The Climate-Fact-Sheet of the Climate Service Center Germany (CSC) provides an overview of projected possible changes for selected climate parameters, at the national or regional level. The Climate-Fact-Sheets are generated on the basis of the best currently available multi-model ensembles of regional and/or global climate models. Accordingly, the Climate-Fact-Sheets provide a first impression of the magnitude of potential future climate change averaged over a given country/region. As such, the information presented in the Fact-Sheets, does not contain information on the finer local scale changes that may occur, and which may be of more interest, in for example, impact or adaptation studies.

- Wind speed: *"The median projection of change in annual mean wind speed is for a minimal decrease of 2 percent by 2100, with a full range of projected changes from -4 to +1 percent (confidence in these figures is low). The change in the annual mean wind speed can be considered to be weak."*
- Storm events: *"The median projection for the intensity of storm events does not show a change by 2100. The median projection for the frequency of storm events is for a minimal decrease of 2 percent by 2100, with a full range of projected changes from -25 to +15 percent (confidence in these figures is low). The change in the intensity and frequency of storm events can be considered to be weak."*

3.3 Conclusions: Climate Change trends for Tirana

Based on the existing database and the available projections the following conclusions for climate change impacts for Tirana can be drawn.

Heat / cold (temperature)
The projection of change in annual mean temperature is for an increase of ca. 1°C by 2045 and another 2,8°C by 2095, with a full range of projected changes from 2 to 3,5°C. Confidence in these figures is high, also since the trends are supported by the CSC-Albania projections. The change in temperature can be considered to be strong. Especially the mean seasonal temperature in summer is projected to increase 1-2°C by 2045 and another 4-5°C by 2095. This would be a very strong change. For the other seasons the increase of ca. 1 °C by 2045 and another 1-3°C is less than in summer but anyway is an important change.

Heat waves / cold spells
In summer time, the observed impacts and vulnerabilities will be reinforced due to expected rising air temperatures and increasing number of hot days. Heat waves are expected to last longer and to occur more often. The average air temperatures in winter are expected to increase. Extreme cold periods are less probable. In combination with expected decreasing trend of mean precipitation (see below), this might lead to milder winters and drier summer.

Precipitation
The projections for future precipitation trends are not very significant (see data and interpretation above). However there is an expected decreasing trend for summers. In combination with higher air temperatures and thus higher evaporation rates the consequent could be longer and more frequent droughts. Also, during autumn and winter a deficit is expected more frequently, although these consequences are not as intensive as in summer. The consequences for droughts are reinforcing the current risks in summer and spring. In contrast, the consequences for droughts are expected to be indifferent during winter and autumn, due to higher groundwater level (groundwater recharge). Overall the signals for changes in precipitation have to be considered not very strong, with some uncertainty but with clear decreasing trends for the summer months.

Heavy precipitation / number of days with heavy precipitation

The precipitation regime is expected to become more extreme with higher intensities on relatively more days, although UNDP is still working to improve and upgrade the modelling regarding the trend of mean number of consecutive days with precipitation < 1 mm (UNDP, 2015). Generally the global projections of IPPC confirm these expectations, see note below.

Wind

For Tirana there are no projections of change in annual mean wind or intensity of storm events available. IPCC data and a summary of CSC for Albania consider a weak change in the intensity and frequency of storm events and a low confidence in these data.

Table 13: Conclusions for climate change impacts for Tirana area for period 2071-2100

Key parameter	Summer	Winter	Consequences for weather events – spring/summer		Consequences for weather events – autumn/winter	
Air temperatures and number of hot days	Increasing	Increasing	Heat waves - reinforcing in summer	↗	Cold - balancing in winter	↘
Precipitation	Decreasing	Decreasing	Drought - reinforcing in summer	↗	Drought – indifferent in winter	→
Heavy precipitation / number of days with heavy precipitation [7]	Increasing	Increasing	Heavy precipitation / Floods - increase in intensity on relatively more days: reinforcing in summer	↗	Heavy precipitation / Floods - increase in intensity on relatively more days: reinforcing in winter	↗
Storm/Wind	*No data available*					

[7] Expected consequences for heavy precipitation and number of days with heavy precipitation (based on IPCC, 2014). UNDP is still working to improve and upgrade the modelling of extremes in temperature and precipitation (UNDP, 2015).

4 Results of the vulnerability assessment of Tirana

The results of the VA of Tirana are explained within the following sub-chapters. Based on the current vulnerabilities identified (chapter 4.1) and the expected impacts of climate change trends (chapter 3.3) both future risks and opportunities are evaluated (chapter 4.2).

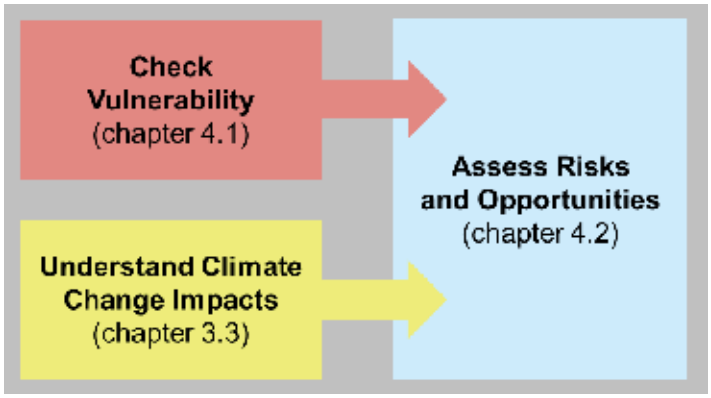


Figure 11: Overview - Vulnerability Assessment

4.1 Current vulnerability of Tirana

As described in chapter 2.3.1 the check of current vulnerability comprises several steps. The assessment of local sensitivities includes a compilation of former events with regard to identify the respective spatial relevance. Therefore the WG compiled a list of former extreme weather events that affected the city of Tirana.

➔ Based on the information documented Tirana has to face mainly impacts of heat waves and heavy precipitation / floods during the last decades. In annex A a full list of documented former events in Tirana is provided.

The current vulnerabilities result from the sensitivities and exposure of the receptors assessed by the WG combined with the respective capacity to adapt on extreme weather events. The determination of the class of vulnerability (high, medium, low) of the investigated receptors bases on the matrix in Table 3 (chapter 2.3.1). The whole list of receptors determined - sensitivity / exposure, capacity to adapt and resulting class of vulnerability dependent on different extreme events - can be found in annex B. An overview of the identified classes of current vulnerability regarding extreme weather events is illustrated in the following table.

Table 14: Evaluated classes of vulnerability for different receptors of Tirana

Receptors	Heat wave	Extreme cold	Drought	Heavy precipi-tation/ Floods	Storm
Public health / vulnerable groups	high	medium	medium	low	medium
Transport	medium	medium	medium	high	medium
Electricity services	medium	medium	medium	high	high
Water supply and sanitation services	high	medium	high	high	medium
Social infrastructure	high	medium	high	low	low
Building stock and materials	high	medium	medium	medium	medium
Tourism	low	medium	medium	medium	low
Small scale industry	medium	medium	medium	high	low
Retail	medium	low	medium	medium	low
Green spaces	high	medium	high	medium	medium
Water resources and quality	high	n/a[8]	high	medium	medium
Air quality	high	n/a	high	n/a	n/a
Agriculture	n/a	n/a	n/a	n/a	n/a
Forestry	medium	medium	high	medium	medium
Biodiversity / eco-systems	medium	medium	medium	low	low

Heat wave and drought in summer as well as heavy precipitation are the most predominant weather events causing problems in Tirana. Most affected receptors and exemplary locations, for which high vulnerabilities were identified, are shown in the following table. The examples of potentially vulnerable areas or hot spots are also shown in the vulnerability-map. It has to be understood, that based on the available data base and due to missing temperature maps an absolute assessment or classification of vulnerabilities cannot be shown. The map just shows locations of potentially vulnerable areas regarding the different possible impacts of climate change. It (together with the assessments documented in this report) gives examples and indicates in which areas of the city CC shall be taken into consideration when planning or building new developments. In the map provided below potential vulnerable areas and objects are shone (Figure 12).

[8] Explanation: n/a – not applicable

Table 15: Examples for potentially vulnerable hot spots for different receptors

Receptors	Heat / Heat wave	Drought	Heavy precipitation / Floods	Storm
Public health / vulnerable groups	Especially in densely built areas, e.g.: Komuna e Parisit, Don Bosko area			
Transport			Some roads / bridges at or along Tirana River (mainly solved) and Lana River; Don Bosko Street; in future potentially also the Ring-Road-Project	
Electricity services			Power sub-stations, e.g. Pallati i Kongreseve, Rr.Siri Kodra, Selitë area	
Water supply and sanitation services	Especially in south-western parts of Tirana; water supply quantity and quality problems, e.g. Komuna e Parisit		Flooding and blocking of sewage systems; especially in northern and eastern parts of Tirana; e.g. Tirana and Lana River, Don Bosko street.	
Social infrastructure	Mainly in areas with high building density (single objects of social infrastructure; see map)			
Building stock and materials **(see also "Health")**	Especially in densely built areas, e.g. Komuna e Parisit); big squares with dark surfaces (asphalt / concrete surfaces). e.g. Mother Theresa Square and Ataturk Square			
Tourism				
Small scale industry	Small scale industry mainly connected to construction industry (industries with need for cooling or high water consumption; distribution networks), e.g. Porcelani area, Ish Ndermarrja Gjeologjike area, Josif Pashko area, Ish NSHRAK area, Kombinati (beer brewery) and Ish Frigoriferi area		Especially in new Tirana area (in combination with overflow of retention lake), Josif Pashko and Don Bosko areas.	
Retail				
Green spaces	Especially Tirana lake park, parks nearby city center, future development area in the northern part of Tirana			
Water resources and quality	Groundwater resources city wide and surface water (river, lake)			
Air quality	Heat aggravates the negative impacts of dense traffic, especially main entry nodes in Tirana as well as main arteries like Rr. e Durrësit, Rr. e Kavajës, Rr. e Elbasanit, Ataturk Square Crossroad, Rilindja Square Crossroad			
Agriculture	n/a	n/a	n/a	n/a
Forestry		Depending on species (less relevant within urban area of Tirana), only for forest in southern part - Tirana lake park		
Biodiversity / eco-systems				

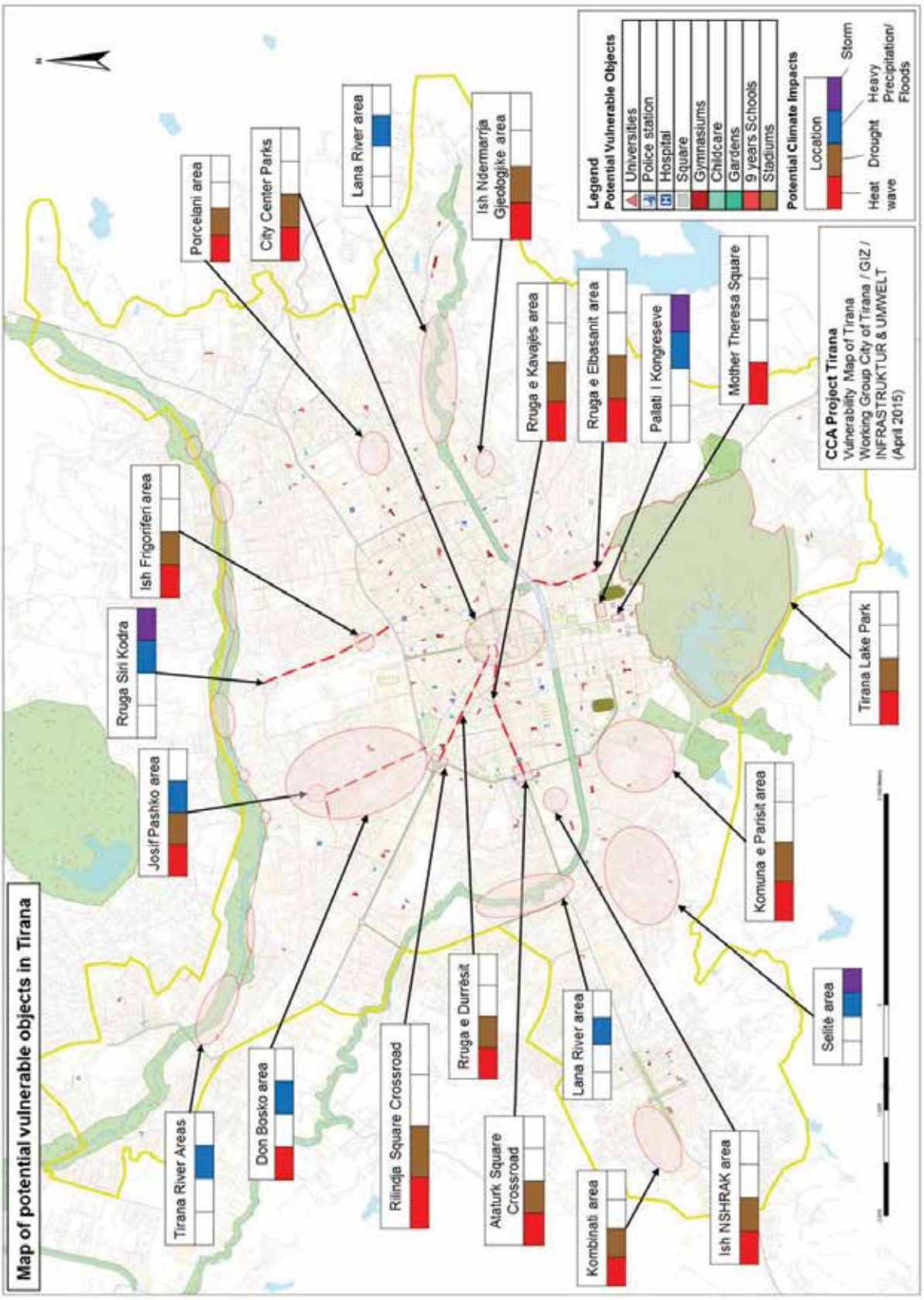


Figure 12: Potential vulnerable areas and objects (not comprehensive); source: CCA Working Group City of Tirana / GIZ/ INFRASTRUKTUR & UMWELT 2015

4.2 Assessed future risks and opportunities

The assessment of future risks and opportunities builds on the identified class of current vulnerability of receptors and the impact of climate change trends (reinforcing, indifferent or balancing effects). The identified potential consequences for weather events in Tirana are:

- Heat waves - reinforcing in summer and balancing in winter
- Drought - reinforcing in summer and indifferent in winter[9]
- Heavy precipitation (intensity and no. of days with heavy precipitation) - reinforcing in summer and winter
- Storm - no data available

The evaluated potential future risks and opportunities for the considered receptors are listed in annex C. In the following those future risks that are classified “very high” are explained and specified dependent on the respective CC impact (air temperatures / number of hot days, precipitation, heavy precipitation / number of days with heavy precipitation as well as Storm / Wind).

[9] Lack of historic data availability and lack of an effective drought early warning system (based on a simple indicator of precipitation) does not allow conducting a proper assessment of future risks and opportunities, cp. chapter 3.

Table 16: Future Risks and Opportunities

Receptors	High future risks in summer		... in summer AND winter
	Heat / Heat wave	Drought	Heavy precipitation / Floods
Public health / vulnerable groups	Reinforcement of heat stress, increasing spread of new vector-born and infectious diseases and altered allergic patterns		
Transport			Increase of damages and costs for protection / rebuilding measures, less mobility
Electricity services			Increasing number of damages / failures on production and distribution facilities
Water supply and sanitation services	Increasing water demand (decreasing availability of water) and maintenance costs as well as increasing spread of diseases and water quality problems (due to lower water levels and heavy concentration of components)		Increasing number of damages and maintenance costs, reinforcement of water quality problems, increasing number of floods (due to lack of sewerage systems capacity)
Social infra-structure	Higher stress at hospitals (more people with respiratory problems etc.), increasing necessity for cooling (e.g. hospitals, schools, kindergarten etc.)		
Building stock and materials *(see also "Health")*	Increasing number of damages (e.g. on asphalt), reinforcement of heat island effect, increasing maintenance costs and need for cooling.		
Tourism			
Small scale industry			Increasing number of damages (stocks / equipment) or loss of business continuity
Retail			
Green spaces	Increasing number of dying plants and forest fires as well as increasing maintenance costs (mainly watering)		
Water resources and quality	Reduction of water quality (e.g. eutrophication), less groundwater recharge, increasing evaporation / low water flow, water shortage		
Air quality	Increasing spread of diseases, reinforcement of smog (increasing concentration of air pollutants and allergens), increasing costs for mitigation measures (e.g. street washing by water tank vehicles)		
Agriculture			
Forestry		Increasing damages / dying of trees, loss of drought sensitive species	
Biodiversity / eco-systems			

Legend: Very high risks from heat / heat waves / drought; Very high risks from precipitation / heavy rain; Future opportunities (see below)

Future opportunities:

In contrast, future opportunities regarding different receptors in Tirana may also arise due to impacts of climate trends. For example, the increasing trend of air temperature leads to a balancing effect regarding extreme cold during winter time. But also other CC impact might lead to specific future opportunities (like heat waves, droughts or heavy precipitation).

A) Extreme cold in winter (balancing):

- Public health / vulnerable groups: Decrease of typical illnesses due to warmer temperatures in winter;
- Electricity services: Decreasing energy demand for heating;
- Water supply and sanitation services: Decreasing number of damages on sanitation infrastructure (piping) due to freeze;
- Social infrastructure: Fewer patients in hospitals, decreasing maintenance cost;
- Building stock and materials: Decreasing number of damages due to freeze or snow and decreasing maintenance costs;
- Tourism: Decreasing damages on touristic infrastructure;
- Small scale industry: Decreasing heating costs;
- Forestry: Better conditions for specific species;
- Biodiversity / ecosystems: Better conditions for specific species.

B) Heat waves in summer (reinforcing):

- Transport: Changes in behaviour pattern, e.g. increasing using of bikes;
- Electricity services: Altered load peaks or demand, eco-friendly energy business thrive;
- Retail: Change in buying behaviour, sale of different assortment of goods, new market opportunities.

C) Droughts in summer (reinforcing):

- Public health / vulnerable groups: Decrease of rheumatism disease;
- Building stock and materials: Less humility problems (moss, fungi).

D) Heat waves and droughts in summer (reinforcing):

- Forestry: Growing of new species, better conditions for specific species, ground formation (trees that need aridity), thrive of drought resistant species:
- Biodiversity / ecosystems: Growing of new species, better conditions for specific heat resistant species.

E) Heavy precipitation in

- Air quality: Decrease costs of street cleaning;
- Biodiversity / ecosystems: Establishment of new habitat (e.g. in flood plains) like temporary ponds.

The future risks and opportunities listed above are not a completed list. Further risks or opportunities may arise within future investigations and monitoring processes, on the one hand caused by climate change and on the other hand caused by changing circumstances regarding different receptors (like population growth, urbanisation, blocking of ventilation paths, etc.). Especially climate change impacts caused by heavy wind and storms should be considered within future investigations (no reliable data for Tirana could be compiled within this project, but falling of trees was reported in several cases).

5 Adaptation Action Plan

5.1 Aims of adaptation and adaptation action plan for Tirana

The integration of climate change adaptation in the management and planning processes of the city administrations of Tirana includes the development of an action plan. Main general aims that are used within an action plan development are:

- Achieving pro-active adaptation to avoid higher costs;
- Enhancing the resilience against climate change impacts;
- Avoiding negative impacts of hotter and drier summers: Public health, air quality, water supply, green spaces - with view to the rapid growth;
- Avoiding negative impacts of heavy rain events / flooding: Areas along Tirana and Lana river;
- Coping with uncertainties of climate projections: Aiming for no-regret respective low-regret measures.

The action plan refers to both the results of the Vulnerability Assessment and the already ongoing projects of the municipality. The focus is on optimisation of existing processes in the light of CCA needs, rather than development of new processes. The key objective is the improvement of existing procedures (both sectoral as well as interdisciplinary) and the installation of guidance systems (mechanisms) and coordination units. Important is the improvement of awareness for CCA in all relevant departments and processes of urban development and planning.

When developing adaptation option in the processes of the project three steps were taken in close relation to each other:

1. Evaluation of general adaptation options regarding the identified most existing and future risks for the vulnerable sectors, objects and areas as results of the vulnerability assessment.

2. Exemplary survey of selected representative situations (case studies) and development of exemplary solutions or adaptation options (see chapter 5.2).

3. Development of an action plan summarising all potential adaptation options for the different fields and sectors (see chapter 5.3).

The examples shall not to be understood as detailed planning for the respective areas but as examples in which measures and options, partly transferred from other adaptation projects, demonstrate the adaptation options. One example could be used for many different comparable situations in Tirana. If the solutions will be realised in practise, further evaluation and planning in details is necessary.

5.2 Case studies: Exemplary assessments and adaptation options

5.2.1 Approach of exemplary detailed assessments in Case Study Areas

To develop exemplary detailed vulnerability assessments and to develop exemplary measures and solutions for climate change adaptation some case study areas were selected, evaluated and discussed for solutions. A focus was on urban planning and development processes, in which projects are ongoing or planned in near future. The areas cover different hot spots and different vulnerabilities to function as exemplary and transferable cases.

Four case study areas and three good practice examples were selected (see following table). The three good practise examples sections document and describe examples for adaptation options in ongoing developments in Tirana: the Tirana River project, the Northern Boulevard project and the Magnet project.

The selected case study areas are shown in the following map:

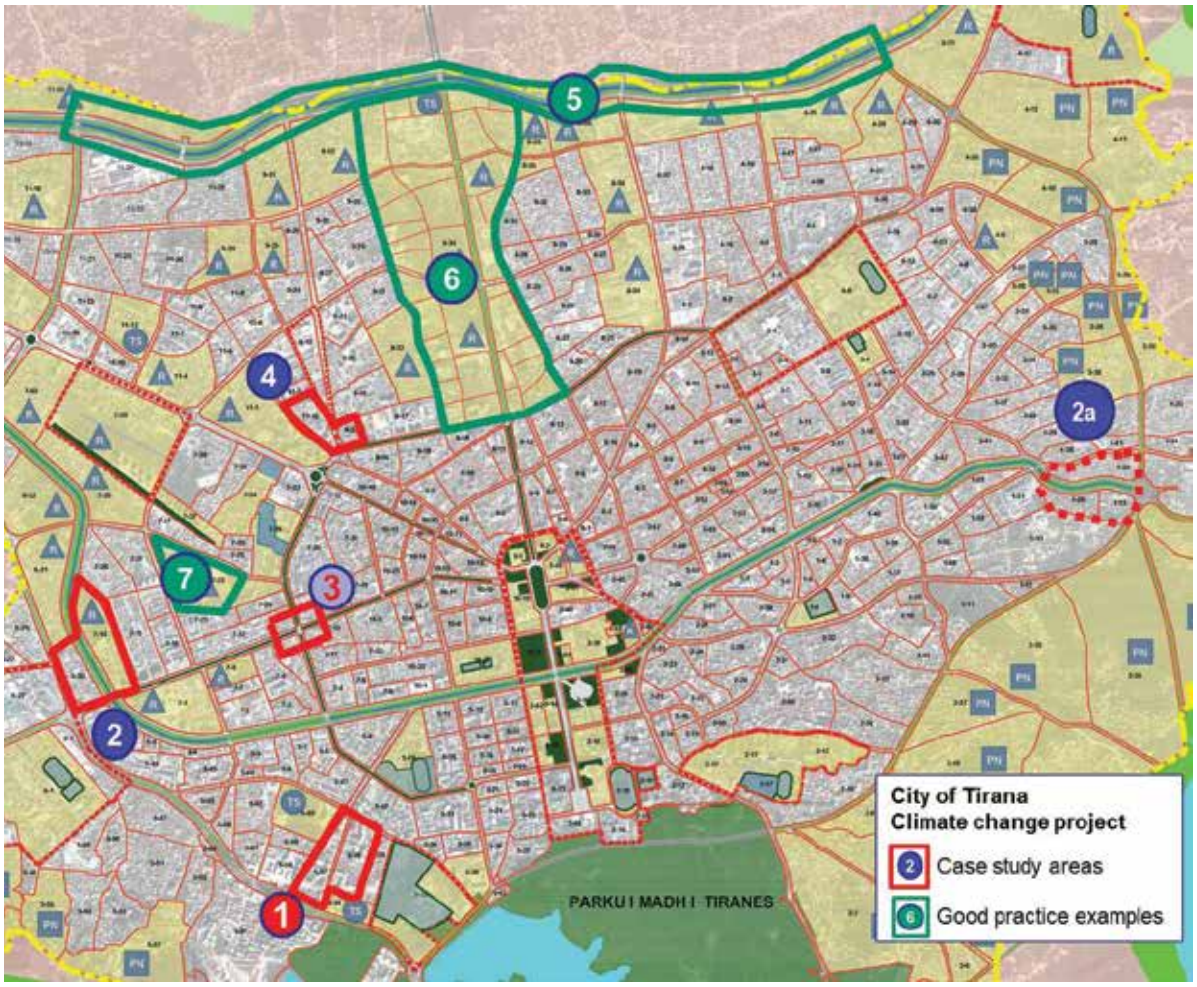


Figure 13: Case study areas

The next table gives an overview on the selection criteria and the characteristics of the areas.

Table 17: Selected case study areas

Area no	Area name	Characteristic / Criteria for selection
1	City Centre South-West (Komuna e Parisit / Medar Shtylla street)	Example for city center; highly intensified urban use; dense building structures and texture; few green; area with medium to high-rise buildings and heavy intensity development of 30-40 year old. Infrastructure is under stress from the heavy concentration of population and growth.
2	Lana River Neighbourhood	Area which is at the limits of the city center in the flood risk area of Lana River; partly uncontrolled (illegal) buildings; reconstruction area with the objective of increasing green space; connected to the future green areas along the Lana River. Partly high rise buildings, low building and greenhouses.
2a	East Lana River Neighbourhood	*For this area the situation and the options were not separately evaluated. This area is comparable regarding the Lana River situation with no. 2.* Flood Risk of Lana River, residential urban development area; less than 15% green space. Vulnerabilities concern the impacts of floods, high temperature and heat waves and low circulation of air. The window of opportunity is the ongoing Lana River restauration from the new Maternity hospital until Kombinat Quarter, which potentially creates options for CCA measures.
3	West-City-Center area (Ataturk Square)	Example for a densely used, traffic highly impacted and closely city-center-related area; influenced significantly by large roads and intensive traffic, almost no green space, poor air conditions and low ventilation (potential heat islands).
4	Urban Area Don Bosco street	Urban area with documented urban flooding problems; intensive urban uses.
Good practice examples		
5	Tirana River project	Ongoing project on restoration of the Tirana River regarding flood risk mitigation, improvement of the banks, new recreation and housing areas. Mainly informal settlements along Tirana River; flood risk; waste and river pollution problems; most important development project in Tirana with for restoration of the Tirana River and flood plains; high potential for upgrading the situation; ongoing redevelopment activities (River, Housing, land use).
6	Northern Boulevard Project	Ongoing project on improvement and development of the northern area of Tirana City Center to the Tirana River in the north. Connection of the City center and developing a new Boulevard, housing areas, business areas and a green corridor.
7	Magnet project area	Ongoing development of a new quarter in the west of Tirana City Center. The whole block is subject to new investments, housing, businesses, parking, green space. Focus on sustainable solutions, climate friendly and adapted design and constructions. Experiences in climate oriented urban development.

In the following sub-chapters the results of the case studies are summarised. The detailed fact sheets for the case study areas can be found in annex E.

5.2.2 Example 1: Densely used urban areas

(See also case study fact sheets in the annex E.)

Figure 14: Situation of case study area (google map, 2014)

The problem / challenge

The case study areas in the south-western city centre (Komuna e Parisit, Medar Shtylla street) is a typical densely populated quarter of the city with very compact urban texture and very low portion of green areas. The main vulnerabilities are people living and working in the area, especially older people being vulnerable regarding heat, low fresh air circulation and thus poor air quality. There is a high interdependence between heat in the streets or buildings and energy consumption for air conditioning, which generates even more heat outside of buildings. High vulnerabilities are also connected with schools in the area as well as water and sanitation systems regarding impacts of heat and droughts.

Regarding the projected impacts of climate change and future risks, the area will be more impacted by heat waves and higher mean temperatures, especially in summer. The “urban heat island effects”, that lead to warming up dramatically due to heat waves and very low air circulation as well as few or no urban structures that cool down the area will increase within the next decades.

Figure 15: Example for shadow in the street / small place

Municipal plans / urban planning for the area

Urban requalification projects are planned in this case study area, which give a good opportunity to reflect options to adapt to climate change and to integrate CCA standards. Plans foresee the construction of a new roundabout in the cross section between Medar Shtylla street and Skender Luarasi street. The urban planning unit (pdv unit) 5-32 is part of an urban requalification project: the building block created as part of Sulejman Delvina street, Medar Shtylla street, Skender Luarasi street will be restructured.

Options to adapt to climate change

Green structures / greening

Along the sidewalks should be created continues canopy shades. This can be achieved through the implementation of four technical conditions on designing of urban green areas:

- Selection of high tree species which can create wide and dense crown.
- Planting of the trees in a small distance from each other in such a way that their crowns can be as close and provide a continuous shade over a bigger area during sunny hours.
- Continues pruning of the highest tree branches and leaving the side branches, aiming so the tree growing into the horizontal direction, always without causing problems for the vehicles using the street.

Figure 16: Shadow spending trees (example from Tirana)

- Designing the tree limits in the same level as the sidewalk, so to maximise the walking surface and the number of pedestrians, and especially to give the conditions that the baby prams move freely in the shaded sidewalk.

Water in the city / public open space

- Create as much open water in the public space, covered by shadow spending features, to cool down the area. Develop green streets, green public spaces, water-penetrating concrete with light colours for sidewalks and public spaces / squares.

Figure 17: Water fountain in the middle of Boston (M. Thones 2014)

Construction / reconstruction of buildings

- Create green on the facades and roofs if possible from static point of view.
- Elements at facades and on roof tops (large overhang of the roofs) that create shadow support the ability to reduce heat in the streets and buildings.
- When obligatory greening is planned with new underground parking the design has to ensure "functional green structures" (cooling, spending shadow); just green (grass) is not responding to the CCA-requirements. Investors shall have the obligation to ensure the functions (sufficient depth of coverage to plant trees at least in some parts has to be required: > 80 cm[10]).

[10] Weigel and Wessolly (Stadt & Grün 2/96 S. 110-113)

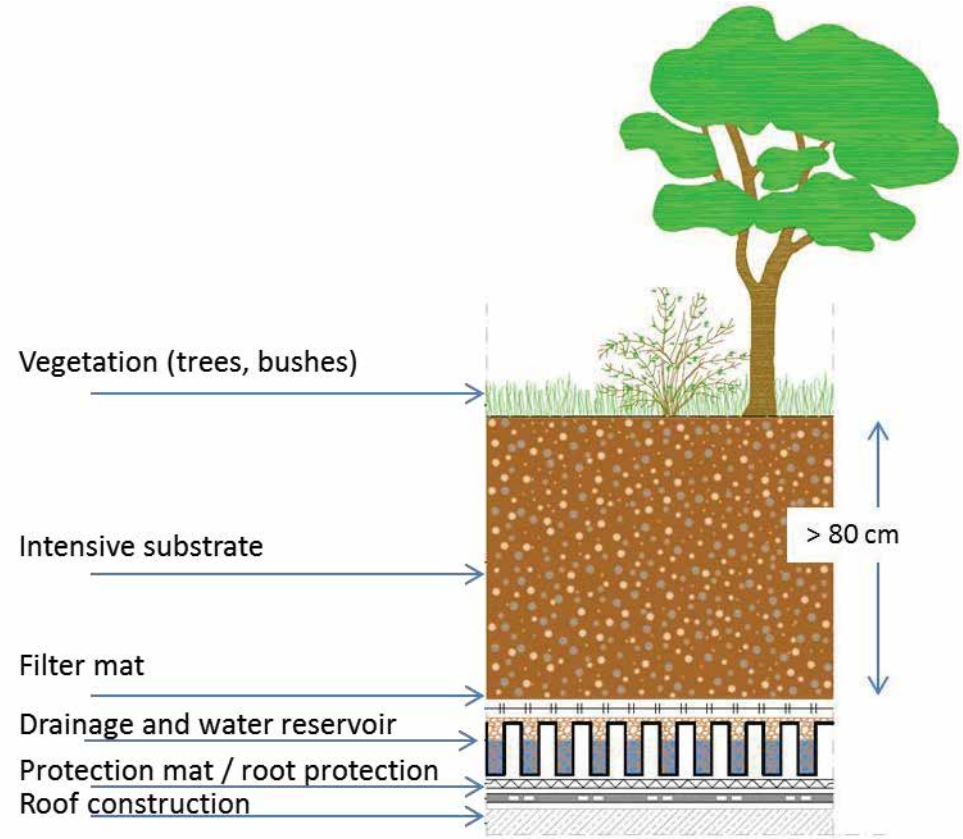


Figure 18: Schematic build-up of a green roof (above the roof construction); translated from climagruen.de

Urban development planning

- Identify and keep free ventilation corridors when developing new urban areas or redevelop existing urban areas.
- The green and blue features in the city should be fixed already in the urban development planning (minimum of green space per sqm building area, specific areas for green in roads and public places).
- It should be evaluated how much of the CCA oriented elements of buildings (shadow oriented, green, insulation) can be fixed in detailed urban development plans as preconditions for approvals for new constructions or reconstructions.
- For new urban development projects the standards for CCA orientation should be discussed in a very early stage with the investors. Often small and not costly designs can change a lot.

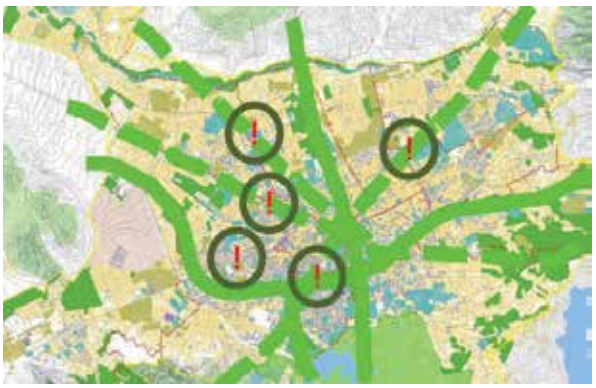


Figure 19: The idea of green corridors

5.2.3 Example 2: Water courses – flood risk in spatial planning

The problem / challenge

The Lana River floods regularly (sometimes once a year) the housing area along the river. The settlements here are informal. The urban development plan foresees mixed uses of the area. To prevent from being flooded some owners have taken individual measures: visible is a small wall (20-30 m long, 45 cm high). Others have renewed the banks to keep the water course further away of their own properties. Thus the course of the river has been narrowed by land owners; a former lower bank has been filled up with different materials.

Figure 20: The situation of Lana River in the case study area

This part of the Lana River is not maintained like in the upper part south of the bridge, where it was straightened and put into a trapezoid-profile.

Looking to the vulnerability assessment the following future risks should be considered:
- more floods from heavy rain fall events (higher intensity, more frequent);
- increasing temperatures, poorer water quality, demand for shadow to cool the water.

Municipal plans / urban planning for the area

The urban development plan foresees to organise this quarter with formal land use plans. The Lana River will be straightened on this stretch (see Figure 21). The plan shows a fixed profile and the reduction of natural curves. Thus the discharge might be increased but the water is not retained. The natural flow with steps in the river bed might be missed and self-cleaning effects by raising the oxygen in the water would have to be added.

Figure 21: Case study area 2 (left: satellite image from google earth; right: part of the urban development master plan)

Options to adapt to climate change

In general two principles could be the response to CC impacts - give room to the rivers and let them develop in limits. Therefore:

- the river course should get enough room to keep and retain water from flash floods;
- legal housing in the quarter shall be protected from floods;
- the river should meander and have steps in the river bed to slow down and to increase the oxygen-rate;
- vegetation along the river should give shadow to the river banks and the river to cool down the water temperature as much as possible (for water quality aspects).

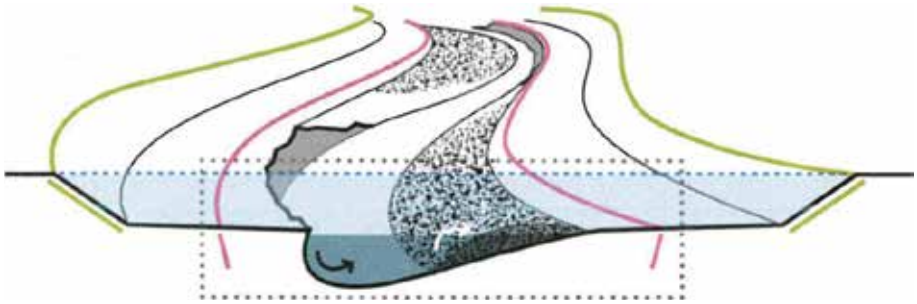


Figure 22: Guiding principle: give room to the rivers, let them develop in limits (from Prominski et al. 2012)

To reach these objectives / principals the following measures should be considered while developing the area further:

Urban development planning:

- Give enough room for the river in the urban master plan and urban development plan; protect river banks from buildings and constructions.
- Leave the river course meandering (like it is / it was); also: protect these areas along the river (must not be very big, but some spots every 200-500 m).
- Create new space for the river (like north of the existing bends, where former greenhouses are; here additional room for retention can be created).

River maintenance / river redevelopment planning / flood protection:

- Reconstruct the lowered banks of the river in the inner bend where the river turns west: formerly where the bank was low; dig all banks lower and not the opposite, as visible, where individuals have raised the banks.
- When creating new banks foresee a little “dam” (some 20-50 cm); the height should be similar throughout the river stretch. Even more important are small retention area in the meanders every 200-500 m.
- Create steps in the river bed. Some 10 cm are sufficient every 20-50 m.
- Clean regularly all bridges from wood, waste and other obstacles; these create more urban floods than “normal situations”.

Figure 23: Steps in the river bed to increase the oxygen in the water

Awareness raising:

- Invite people living in the area to discuss about the plans for the river (the project team met very interested people there; they called for better flood protection; however, they should understand from the beginning on why room for the river is an important protection).
- Make campaigns to inform why individual digging, walls or waste on the banks will not solve the problems (or even increases problems for the neighbours).
- Inform that the flood problems will increase due to CC; this water project is a very well visible demonstration site.

Figure 24: Economy and recreation along the river, Zürich (Prominsky et al., 2012)

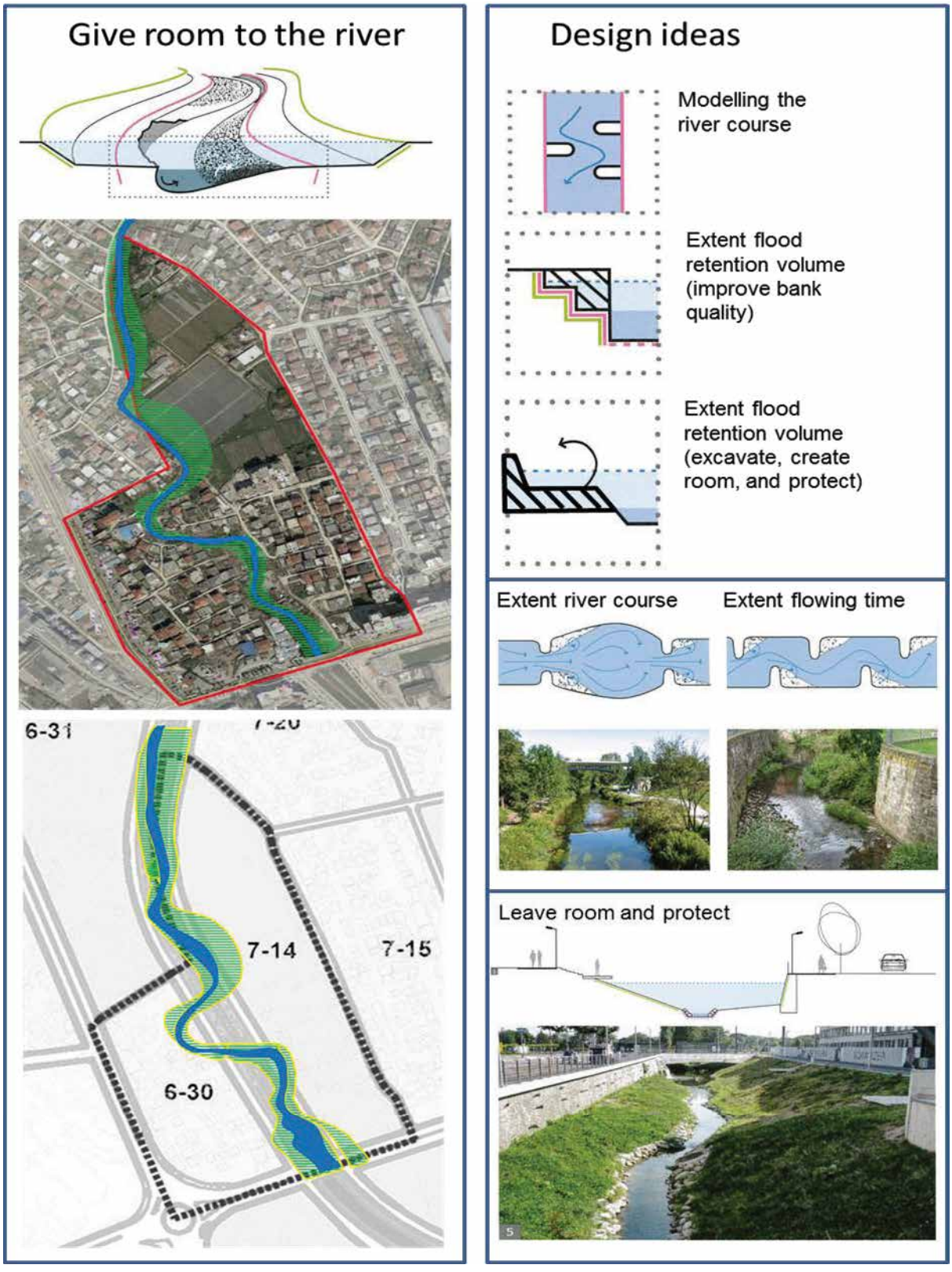


Figure 25: Development suggestions for the case study area (expl. from Prominsky et al. 2012)

5.2.4 Example 3: Measures at highly used urban cross roads (Ataturk Square)

The problem / challenge

The highly dense urban development in this area (West-City-Center; Ataturk Square), accompanied with a highly frequented cross road, creates a vulnerable situation for the population but also for all vegetation in the area. Here are different vulnerable infrastructures like the Polyclinic nr. 9, the Mehmet Akif school, the kindergartens nr. 24 and 43, the Sabaudin Gabrani school and others. The cross road situation leaves only small room for measures to improve the highly vulnerable situation.

Figure 26: Situation at the cross-road in case study area 3 (I)

Figure 27: Situation at the cross-road in case study area 3 (II)

Future risks will increase the impacts of heat waves, since there is no option for compensation or mitigation of the effects in the cross-section surrounding. Heat waves related effects, to elderly, sick people or children, might worsen during hot days and tropical nights (heat stress / no recovering). This will affect especially the highest vulnerabilities like Sabaudin Gabrani School and Turgut Ozal College but also housing areas around the hot spot. Cooling with air conditioning will increase the air temperatures.

Regarding the traffic situation, newly installed traffic lights with indicators for the waiting time are expected to speed up the traffic once green lights appear. The expected positive effects cannot be validated yet.

Municipal plans / urban planning for the area

The case study area is part of the development aiming at creation of improved street infrastructure, engineering net system and urban furnishing. This is part of the project "Urban Requalification of the block" defined from Kavaja street - Muhamet Gjollesha street - Myslym Shyri street and Municipality unit 10. Within this development adaptation options might be considered.

Options to adapt to climate change

- Regarding the vulnerabilities of the population improved urban design and planning to introduce new environmental elements should be considered.
- Introduction of shrubby vegetation that can serve as filters to divide the road from sidewalks.
- Another option is creating a continuous canopy shaded area for pedestrians through planting high tree species which can create wide and dense canopy.
- Introduce new measures including: green walls, green streets, green-blue public open spaces, green fences, water-penetrating concrete with light colours for sidewalks and public spaces / squares.

Figure 28: Example for greening of roof tops (Tirana City)

Figure 29: Ideas for greening cross-roads (Trees, bushes, water)

- Especially for the south and southwest sides of the buildings: creation of green walls in the windowless walls, or vegetation cover through continuous canopy in the areas that have windows and balconies.
- Green roofs and vegetation in terraces (e.g. placement of the trees in the vases on the roofs of the buildings) should be encouraged. The used plant species should be heat resistant and also the vases should be resistant to heat and strong winds.
- Improve building insulation, white / green roofs, green walls or white / self-cleaning facades.

5.2.5 Example 4: Rain water in streets and drainage

The problem / challenge

The urban area (Don Bosko street) is characterised from residential uses, businesses and markets. The main problem is regular flooding from drainage water after heavy rainfall. Heat effects, heat islands and low air circulation potential as well as other climate related impacts are also documented but not in the focus of this case study.

Figure 30: Example for multi usage streets (Tirana City)

During rainy days, the passage of the cars in Don Bosko street is often difficult due to the increased traffic (large number of individual cars) and also due to the water present in the streets (floods). The lines of the public transport are the ones of the "Unaza" and also "Lapraka". There is no record that the public transportation has stopped due to different weather events but there have happened some traffic jams and small delays in transportation especially during heavy rain.

Flooded streets might also affect houses and markets along the street if they reach highest water levels and if they further increase. Already now increasing damages and costs for protection and repair after heavy rain events are reported (but not documented).

How to handle uncertainties

The CC projections and future risk estimations for Tirana indicate decreasing mean precipitation (rainfall) over one year, especially decreasing rainfall for the summer months. But at the same time it is very reasonable that the frequency and intensity of heavy rain events will increase. For further planning with this impact factor it is important to validate the projections, since the signals for Tirana are not very confidential due to low significance.

However this is a very good example on how to handle uncertainties:
For the Don Bosko block, as example for urban flooding risk from heavy rain events, increasing risk should be considered when redesigning any infrastructure in the quarter on a low cost basis. When projecting new street design, new drainage or new housing along the streets it would be a

Figure 31: Don Bosko Street

“low-regret-measure” to take higher run-off from heavy rain into consideration without building new cost intensive protection works. Only if confidential figures for future heavy rainfall events are available further investment in risk reduction might – if applicable – reasonable.

Municipal plans / urban planning for the area

The municipal planning foresees the creation of street infrastructure, engineering net system and urban furnishing as part of the project "Urban Requalification of the block" (Laprake) defined from Don Bosko street - Turhan Pashë Përmeti street- Ibrahim Pashë Bushatlliu street - Lord Bajron street - Riza Cuka street- Learton Vathi street- Pandi Dardha street - Dritan Hoxha street. Detailed plans on the restructuring or improvement of the drainage system in the area are not known yet.

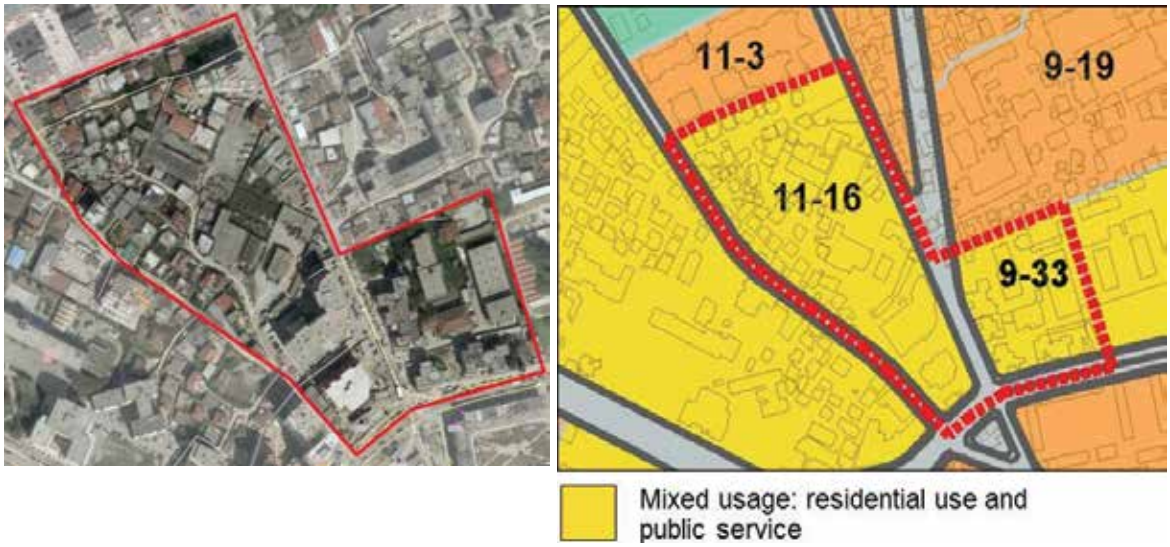


Figure 32: Case study area 4 (satellite image and urban development plan)

Options to adapt to climate change

To respond to the existing and potentially increasing risk of heavy rain caused urban flooding future projects on “Urban Requalification of the block” should consider more frequent and more intensive rain events. Measures that could be taken are:

Water Management

- Qualify the drainage system
- Disconnect sealed surfaces (streets, public areas, roof tops) from the waste water drainage system and collect the rain water in cisterns within the area
- Infiltrate rain water (actively by using adequate materials and simple collectors / small basins) and from the cisterns at the location where it is collected
- Infiltrate rain water from semipermeable surfaces (secondary streets, parking lots, private ground, public ground)
- Communicate the importance of these areas in the public and protect them from illegal constructions

Urban Planning

- Reserve and protect open space (urban planning) for decentralised rain water retention
- Develop multifunctional uses for retention space in case of low precipitation periods (green public space, water games etc.)
- Communicate the importance of these areas in the public and protect them from illegal constructions
- Support infiltration of rain water from semipermeable surfaces by setting standards and limits for sealed surfaces in detailed urban development plans; fix the standard of "minimisation" for sealed surfaces which allows minimisation on case-to-case basis
- Plan for additional reserve spaces to increase the water retention in the area on the long term, if the increasing intensity of heavy rain events will be validated in future climate change projections.

5.2.6 Example 5: Good practise on CCA within the Tirana River project

<u>The situation</u>

The Tirana River is currently in a critical environmental condition and therefore subject to a major regeneration project in combination with the new Outer Ring Road construction. At the same time the river is one of the few remaining potential recreational assets for the metropolitan area of Tirana - not to be lost but to be developed with the maximum care.

<u>Sustainable developments in Tirana</u>

The Tirana River Project is an important step for sustainable city development as it best integrates urban planning with cultural, environmental and ecological assets. Some of the main features include

- Creation of ecological corridors (North-South and East-West),
- Air ventilation corridors,
- Shaded areas / high canopy structures,
- Environmental friendly transportation system,
- Rehabilitation of riverbanks,
- Flood prevention and
- Restoration of ecological habitats providing richer biodiversity, etc.

Figure 33: Vision of Tirana River rehabilitation development

The environmental regeneration and emergency action of cleaning-up of the Tirana River shall be accompanied with the development of a new green and urban river front, well integrated with the natural context. By rehabilitating the Tirana River and structuring the urban development and recreational areas along the river the last natural and recreational assets will be revealed for Tirana.

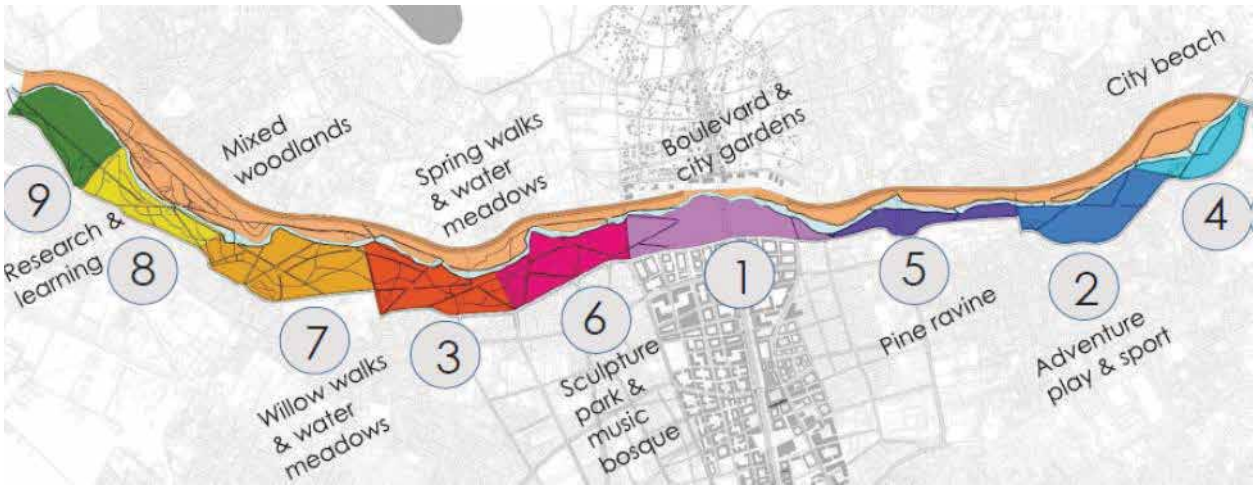


Figure 34: Ecological, environmental and cultural assets added by the River restoration

The river regeneration works have already started to (i) provide weirs for all-season water retaining pool structure and (ii) provide clean-up strategy for whole river bed. There are about 16 weirs constructed along the river in order to slow the speed of the river with its riverbank erosion consequences. Likewise, more than 100 tons of solid urban waste has been cleaned up from the riverbanks.

Figure 35: Construction of weirs for water retaining pool structure

The project has also mounted rocks for several miles along the riverbank as measures for flood protection and to preserve the riverbanks from erosion.

Figure 36: Flood protection measures (protection of riverbank from erosion)

The river rehabilitation part of the project would focus on:

- Defining the use of available water resources, providing measures for the river's regeneration and provision of concept of improving the water quality;
- Assessment on treating potential risk and flood areas and the infrastructural measures;
- Designing the river landscape, river shores and related infrastructure interventions, incorporating the placement of water features and areas for recreational purposes;
- Projection of a dense but attractive urban development along the Tirana River, definition of kind of development on each river bank, proposals of how these developments profit from the new urban qualities, definition of functional program and land use distribution;
- Smart integration of the layout of the Outer Ring Road;
- Definition of border conditions to adjacent zones;
- Design proposals of landscaping, recreational functions and urban development shall be in harmony with each other and well integrated with the natural and urban context.

Further foreseen activities

The project is foreseen to provide ecological corridors, valuable habitats and shaded areas providing a wide variety of environmental amenities much appreciated by the citizens. The project will serve as a best practice example of implementing innovative and sustainable urban development instruments and solutions of beautiful urban formations, ecological landscape ideas as well as well integrated infrastructure structures.

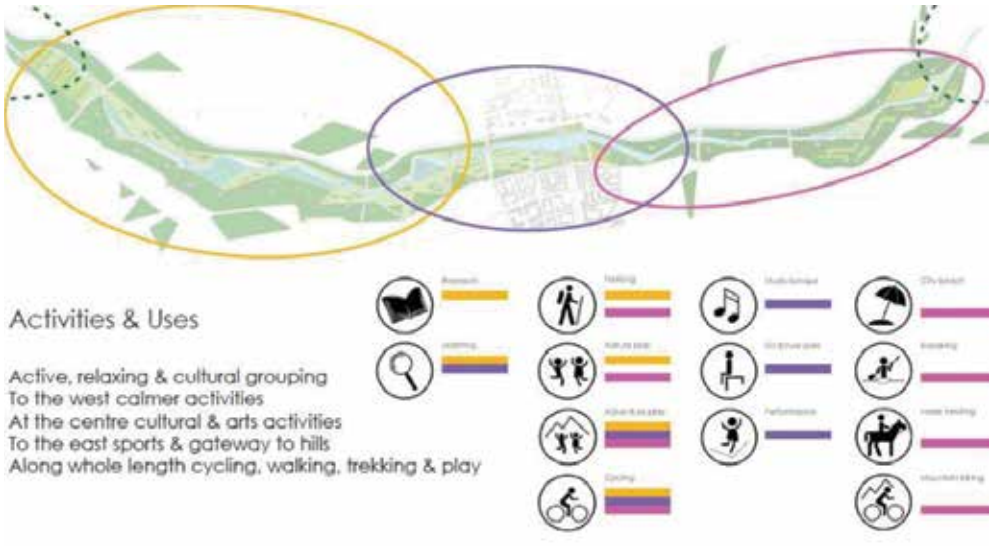


Figure 37: Recreational activities foreseen in different parts of the river

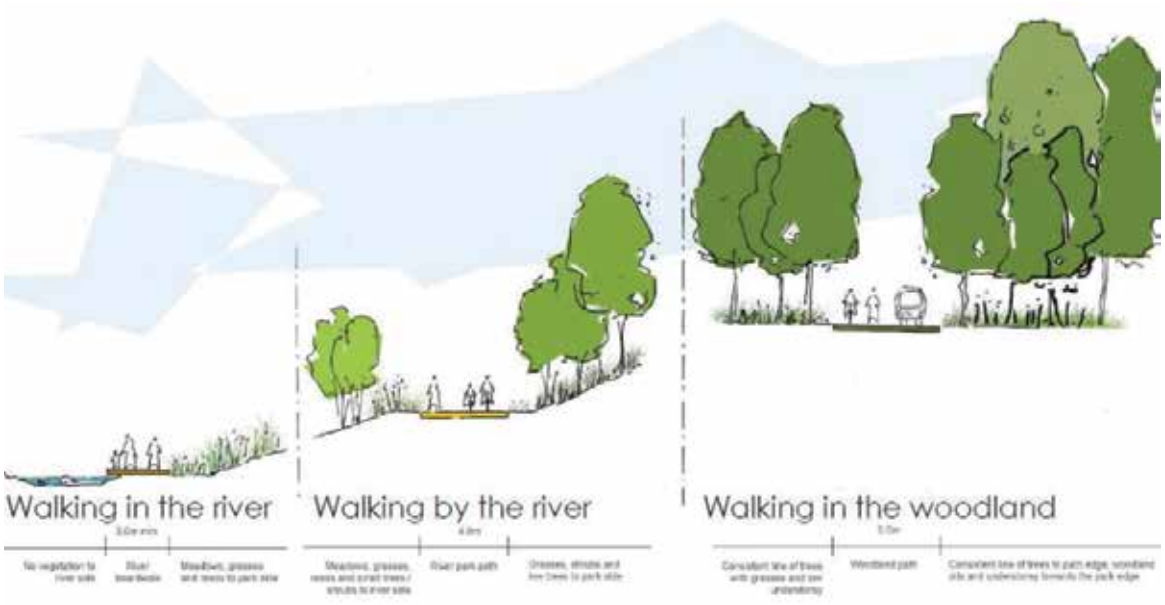


Figure 38: Walking options in the fine habitats that shall be created along the Tirana River

5.2.7 Example 6: Good practise on CCA within the Northern Boulevard project

The situation

The Tirana Northern Boulevard and River Project (TNBRP) is the Municipality's new vision for sustainable urban development aiming to show a model the future which would comply with the still expected population growth of another 100.000 inhabitants in the next 10 years, and provide sufficient space for main public facilities / institutions, recreational spaces and business functions. The urban development and general upgrading of nearly one quarter of the city's territory (ca. 14 km²) in the Northern part, an area currently mainly formed by vast informal residential settlements and redundant industrial zones, aims at regenerating the city's last natural and recreational assets such as the Tirana River and extending the public area urgently needed for the metropolitan area of Tirana.

Sustainable developments in Tirana

With the "New Northern Boulevard" a new lively downtown area will be developed along the Northern extension of the city's existing central boulevard.

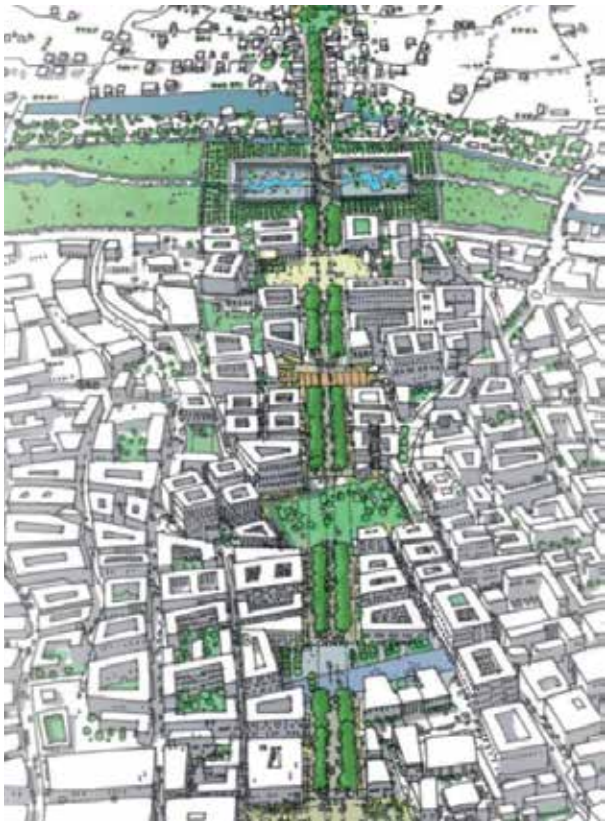


Figure 39: Conceptual design of the new urban development for TNBRP

It foresees to offer new possibilities for public and cultural centers for a series of main functions to be newly founded or in urgent need of modernization (e.g. National Library, Concert Hall, Modern Art Gallery, Convention Center, Palace of Justice, New City Hall and other supporting functions). The extension will result in a generous green boulevard running

through the city center between the two main parks, the existing “Parku i Liqenit” in the South and the new “Parku i Paskuqanit” to be developed in the North, thus serving as an important ecological corridor.

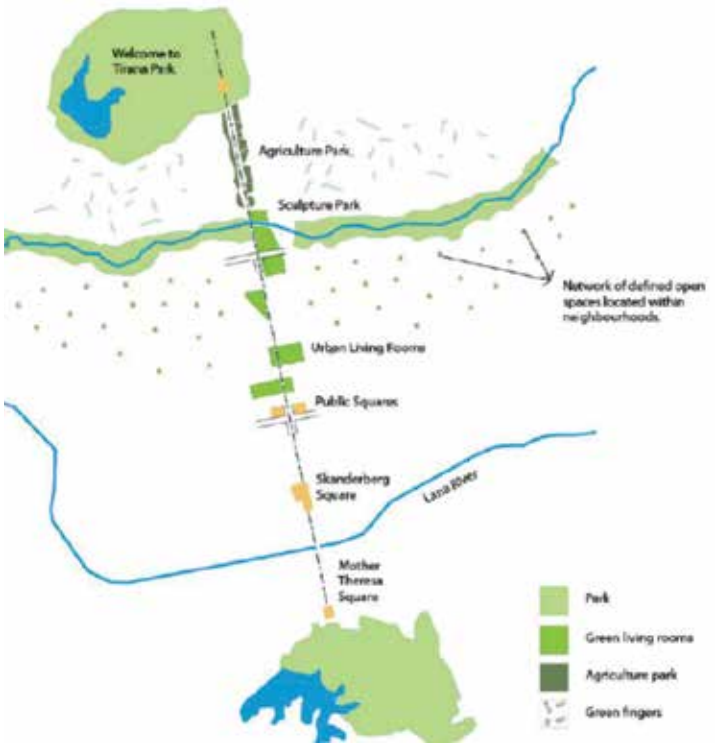


Figure 40: Conceptual design for the TNBRP (new ecological corridors and green areas)

The refined design and actual implementation of both intervention areas shall account for an immense potential of urban recreational space. The functional rezoning will compensate the inner city’s problems of congestion and pollution. At the same time it will initiate the social integration and urban upgrading of the adjacent underdeveloped areas.

The urban design provides ventilation corridors and is based on “courtyard” approach, thus providing patches of green spaces for local communities without the need to go all the way to the nearest park. The TNBRP alone will increase the green spaces in Tirana by 300,000 m^2, which accounts for about 90 % of the green spaces lost in Tirana in the past 25 years.

Figure 41: **Planned Northern Boulevard with tram, bike lanes, continuous canopy, green filters**

Figure 42: **Pedestrian sidewalks and public spaces under tree canopy and surrounded by vegetation filters**

Figure 43: **Water spaces for cooling as well as recreational purposes**

5.2.8 Example 7: Good practise on CCA within the Magnet project

The situation

"Magnet" is new urban development project currently under implementation in Tirana. It is a green site development in an area that was undeveloped. The original land owners belonging to some of the oldest families in Tirana wanted an environmental-friendly – yet economically sound project – that would provide more value to the community and hence gain more respect from the people of Tirana.

Recent developments in Tirana

The recent urban features in Tirana take more into consideration the environment and climate requirements. This might be in part thanks to new requirements from the Tirana Regulatory Plan (approved in 2013), but also due to other factors such as (i) better technologies available, (ii) public demand for better quality and more environmental-friendly solution, and (iii) better knowledge and environmental awareness.

The original urban concept and design of the Magnet project area was developed by a well-known architect Daniel Libeskind who also was the architect of the just completed "Eagle in Flight" building which is flagship project of the Magnet site.

Figure 44: "Eagle in Flight" building by architect Daniel Libeskind (two different angles)

The Magnet urban design was subsequently altered from the original design in order to adapt to the newly introduced Tirana Regulatory Plan that was approved in 2013. The approved urban plan maintains some of the most important and novel features, while the conceptual design, size, position and distances amongst individual buildings was changed in order to comply with urban regulatory requirements of the Tirana Regulatory Plan. The Magnet site includes several positive features, but perhaps the best one is that there shall be only a ring-road for traffic and underground parking spaces, while the whole ground level shall remain only for pedestrians and recreational activities such as green spaces, water fountain or water sprinkle areas, kids playgrounds, small basketball playing areas, etc.

Figure 45: Magnet project site detailed planning (the new "Eagle in Flight" building is on the left side)

The project considers view corridors for air ventilation and sun light on public spaces for each season.

Figure 46: View corridors in the new Magnet project design

The plan foresees a combination of public spaces with functions for all ages starting from green public areas, to water surfaces, basketball courts, playground for kids, jogging and bike lanes, etc.

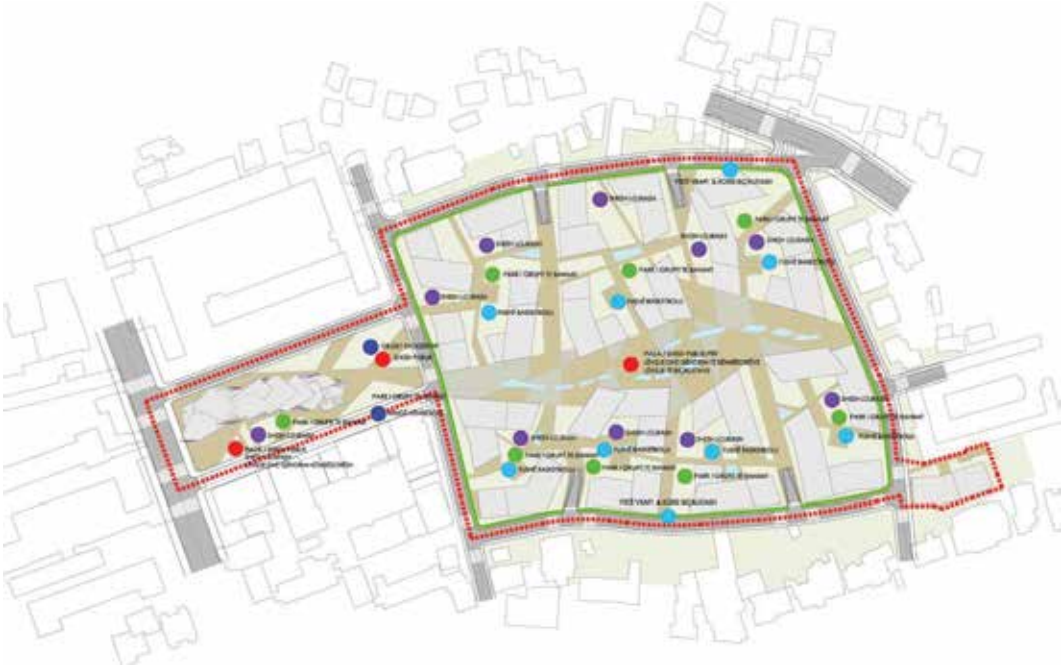


Figure 47: Public spaces and public infrastructure

The ground level foresees a combination of vegetation and recreational areas including basketball courts, playgrounds and water structures, while the terrace level is foreseen with vegetation and community gardens.

Figure 48: Ground vegetation and recreational areas (left); Planned vegetated terraces (right)

Examples how to adapt to climate change

The Magnet project development includes several adaptation measures which are novelties in Tirana and combined with best-available technologies and international standards, such as:

1. Green areas planted with olive trees, flowers or vegetables
2. Water surfaces in the ground level
3. Green terraces
4. White terraces for albedo effect
5. Solar panels used in some terraces
6. Groundwater used for irrigation of plants with a sprinkle system
7. Self-cleaning white facades
8. Water permeable concrete used in pavements to allow water penetration in the soil
9. Photovoltaic elements for public lights
10. LED technologies for public lights
11. Thermo insulated and fire-prevention facades in buildings (some ventilated facades)
12. Fire hydrant
13. Thermal insulated and fire-prevention windows

Most of the aforementioned measures have already been implemented while some are only in the project and yet to be introduced.

Figure 49: Green areas with vegetation (olive trees) and the planned promenade in Magnet project

Figure 50: Green public spaces and community gardens in the ground level

Figure 51: Vegetation in terraces (a cheap alternative to green terraces)

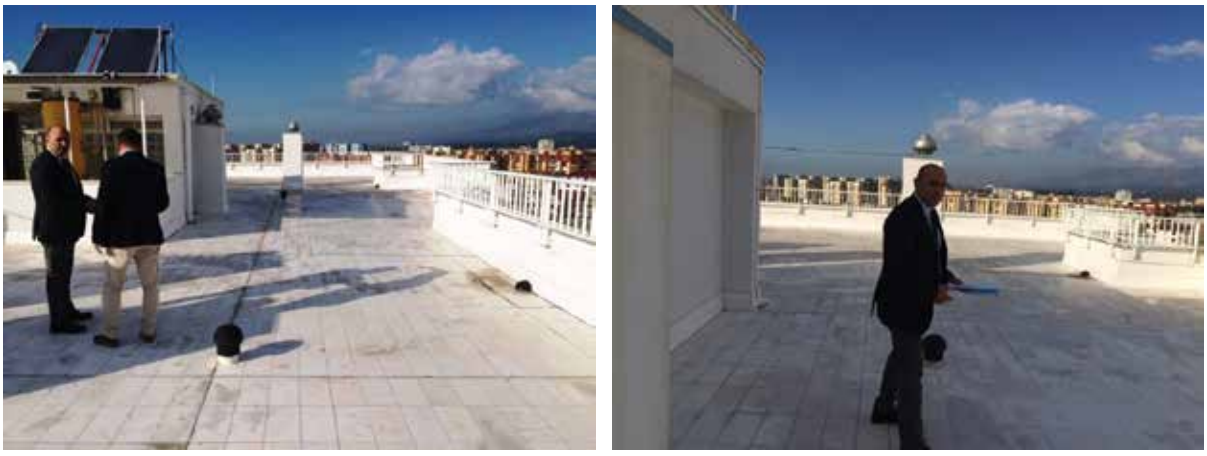


Figure 52: White terraces and solar panels

Figure 53: Water permeable concrete in sidewalks (testing permeability) and white self-cleaning facades

Figure 54: Public lights and fire hydrant in the site

5.3 Identified adaptation actions for very high risks in Tirana

This chapter contains both an extract of the identified adaptation actions for “very high” future risks in Tirana (which are considered as “the first to go” measures) as well as the detailed adaptation actions as defined by the working group.

Green structure measures extracted mainly focus on the receptors:

- Public health / vulnerable groups – regarding increasing heat stress;
- Green spaces - regarding increase of heat waves and drought impacts.

Water system measures extracted mainly focus on the receptors:

- Water supply and sanitation services – regarding increase of heat waves and drought impacts, but also regarding impacts of heavy precipitation events;
- Water resources and quality – regarding increase of heat waves and drought impacts.

Building design measures extracted mainly focus on the receptors:

- Building stock and materials - regarding increase of heat island effect;
- Social infrastructure – regarding increase of heat island effect / heat stress.

Most of these structural measures are linked to several non-structural measures (like awareness raising, information, management plans, mapping, etc.). Both cross-links between structural measures and cross-links between structural and non-structural measures are quoted in the whole list of adaptation option (annex F).

Moreover the whole list contains further columns with regard to general description of measures, responsible institution of the city administration, priority of action and comments (e.g. preconditions, bottlenecks, etc.).

Table 18: Adaptation measures with high priority (extract of list of adaptation options)

No.[11]	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study / example no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for starting
1a	Green roofs (roof tops)	Green roofs in the manner of vegetation planted in vases or especially designed roofs. A detailed manual should refer to technical and ecologic demands and in respect to solar energy potentials on roof tops. *Further explanation of the need for green roofs: see SEA Master Plan*	City wide, especially in high density areas and new developments	1, 2, 6,	New developments in the city foresee vegetated covered terraces and roofs, see ongoing Magnet project.	short term (<2017)
1b	Greenery on under-ground parking	The top of underground parking shall get multifunctional uses. Beside others urban green shall contribute to the reduction of heat islands in the city. Therefore climatic functions have to be ensured (trees, bushes); detailed guidelines on technical and ecologic specifications should be in place.	City wide, especially in high density areas and new developments	6, 7	New developments often have large underground parking. They often foresee green on top. But often only grass without climatic functions.	short term (<2017)
3	Green streets	Plant and maintain dense shrubby vegetation to divide roads from sidewalks. This could serve for both traffic safety and green filters. Along the sidewalks should be created continues canopy shades. All green corridors shall follow a city wide concept (green streets, rivers, tramways, open space etc.)	City wide, especially main streets with heavy traffic.	1, 2, 2a, 3, 5, 6	Main new roads foresee green streets. Existing standard: - Trees for every new street; - Depending on the size of the street	short term (<2017)
4a	Green open spaces	Introduce a combination of measures ranging from the creation of continuous canopy structure, green filters, green walls, to the introduction of fountain and other waterworks that would serve to provide shaded areas for pedestrians and recreational activities.	City wide	1, 2, 2a, 3, 5, 7	Several new developments foresee green open spaces (e.g. Tirana River rehabilitation project and Magnet project)	short term (<2017)
4b	Tree nursery	Tirana used to have a tree nursery, but is now decimated by illegal buildings. The municipality policies for increasing vegetation and community involvement projects would require a new tree nursery as a means for education, sustainable development and job creation.	Suburbs of the city. To be decided depending on soil quality, ownership rights and size.	2	No ongoing or planned measures to date	short term (<2017)
8	Water drainage	New water permeable concrete is introduced recently in a new development in Tirana. Such water permeable concrete should be widely introduced in all new developments	City wide, especially in flood-prone areas	1, 2, 2a, 3, 4, 6, 7	Already planned / realised at the Tirana Northern Boulevard and at Magnet new residential complex in Tirana	short term (<2017)

[11] No of actions selected of annex: actions with high priority

No. [11]	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study / example no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for starting
9	Flood protection	Improve retention and natural flows including steps on the river bed to retain water as much as possible. *Tirana River project has already introduced flood protection measures through weirs and flood protection walls (embankments)*	Especially along Tirana River and Lana River	1, 2, 2a, 4, 5, 6	Tirana River Rehabilitation Project, Lana downstream rehabilitation	short term (<2017)
11	Urban water spaces	Introduce fountain and other waterworks that would serve to provide cooling the area and serve for recreational activities, while at the same time improving air quality. Keep rain water in the areas, to reduce runoff and flood risk	Whole city; especially in densely build areas; main squares / crossroads with heat and poor air quality	1, 3, 5, 6	Foreseen in the Tirana Northern Boulevard and River Rehabilitation Project	short term (<2017)
15	Urban planning	Protection of buffer zones at rivers from buildings for risk reduction and for river quality; protect ventilation corridors and green corridors; improve policies for greenery in the city (ecological and technical standards for urban developments and investors)	city wide	2, 5, 6	-- (see examples 5 – 7)	short term (<2017)
16	Heat adapted design	Proper implementation of building insulation law 2004 to ensure heat resilient buildings (very limited implementation so far.)	city wide	1, 3, 6, 7	Already planned / realised at the Tirana Northern Boulevard and at Magnet new residential complex	short term (<2017)
17	Aware-ness raising	Regular public information on CCA activities and the individual tasks (via campaigns, internet, leaflets, TV, information events, etc.). Raise medium-term municipality budget to address such issues.	city wide		Information about air pollution via billboard, homepage of the municipality and leaflets	short term (<2017)
18	Informa-tion on adapting during extreme events	Regular public information on risks and behaviour in these periods; Raise medium-term municipality budget to address such issues. Billboards and other informative forms could be used	city wide		Emergency Department has the authority to call on the other departments and the public on these matters	short term (<2017)
21	Land use and spatial planning	Develop and include checklists with the CC criteria and potential mitigation measures for planners and decision-makers. Seminars with planners on adaptation options in their specific fields	city wide		No ongoing or planned measures to date	short term (<2017)
22	Mapping of risk areas	The vulnerability map should be regularly updated with additional data and know-how; heat maps (heat islands, heat risk areas) can improve the decision making; also flood risk maps have to be developed	city wide, especially of flood-prone areas and heat-risk areas		There is a basic mapping exercise on past extreme weather events	short term (<2017)

No. [11]	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study / example no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for starting
23	Manage-ment / manage-ment plans	Create a standing working group on CCA in Tirana (members of all relevant sectors). Regularly update and monitoring of the CCA actions plan. Implementation-reports for political and public information ("What have we done? What has improved?). This also serves for applying for additional funds	city wide		Proposed management and monitoring concept see chapter 6	medium term (<2020)
25	Upgraded services at Tirana Munici-pality	Some departments of the Municipality need to be upgraded to better address these challenges. For example, the Urban Planning Department should also hire landscape architects and landscape ecologists and have a unit within its department to better plan and adapt	Municipality Departments		No ongoing or planned measures to date	short term (<2017)

5.3.1 List of Adaptation Options

Table 19: Abbreviations of responsible institutions of the city administration of Tirana

DGoS	General Directory of Services;
DoEm	Department of Emergency
DoEnv	Department of Environment
DoTM	Department of Transport and Mobility
DoUP	Department of Urban Planning
IGEWE	Institute for Geoscience, Energy, Water and Environment
LD	Legal Department
MGE	Municipality Greenery Enterprises
PB	Planning Board
TCPW	Technical Council for Public Works;
TD	Tax Department
WUE	Water Utility Enterprise

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
Urban green structures (structural measures)									
1a	Green roofs	Green roofs in the manner of vegetation planted in vases. Further explanation of the need for green roofs can be found in Strategic Environmental Assessment of Tirana Territorial Plan (SEA, page 66)	City wide, especially in high density areas and new developments	1, 2, 6	New developments in the city foresee vegetated covered terraces and roofs, see ongoing Magnet project	short term (<2017)	PB; DoUP; DoEnv	**HIGH**	Opportunity to combine vegetation planted in vases with white roofs; see heat adapted building design measure below
		Green roofs in the manner of proper soil-covered roofs. The need for green roofs is explained in SEA (page 66)	City wide, starting with a pilot project on a public building to visualize positive effects		There are no ongoing or planned projects	long term (<2025)	PB; DoUP; DoEnv	LOW	The reason of a low priority is: - high cost (investment and also maintenance) - low acceptance of population (need for information, campaigns, etc.)
1b	Greenery on under-ground parking	The top of underground parking shall get multifunctional uses. Beside others urban green shall contribute to the reduction of heat islands in the city. Therefor climatic functions have to be ensured (trees, bushes); detailed guidelines on technical and ecologic specifications should be in place	City wide, especially in high density areas and new developments	6, 7	New developments often have large underground parking. They often foresee green on top. But often only grass without climatic functions	short term (<2017)		**HIGH**	Need for update of the regulation of the General Urban Plan of Tirana (+ approval by the Mayor)

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
1c	Com-munity gardens	Can be implemented as part of the green roofs where inhabitants of buildings share small plots to plant herbs or flowers on top of building, but the municipality can also offer its citizens some small plots of land in former warehouses where there are abandoned lands	City wide, especially in high density areas and at derelict former public institutions (e.g. former greenhouses in the suburbs, former military barracks or depots)	2, 6	No ongoing or planned measures to date	short term (<2017)	DGoS; DoUP; DoEnv; MGE	MEDIUM	Adjustment of urban regulations related to this measure (inclusion of this “land use category” among the “green areas” (combined central and local government competence)
2	Green walls	Municipality will identify south and southwest sides of the buildings and in the sides without windows and encourage creation of green walls	City wide, especially in South facing facades and new development areas	1, 2, 3, 5, 6	There are no ongoing or planned projects. Implementation has not started mainly due to the high costs	long term (<2025)	PB; DoUP; DoEnv	MEDIUM	New standards need to be drafted and approved. Training and know-how should be provided

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
3	Green streets	Introduce dense shrubby vegetation to divide roads from sidewalks. This could serve for both traffic safety and green filters. Along the sidewalks should be created continues canopy shades. This can be achieved through (i) selection of high tree species which can create wide and dense canopy, (ii) planting of the trees close to each other so that their canopy provide a continued shade over a bigger area during the sunny hours. Better planning for road standards. Revise and adjust transport system (e.g. single lane roads with wider sideways that would allow more vegetation)	City wide, especially main streets with heavy traffic	1, 2, 2a, 3, 5, 6	Main new roads foresee green streets.Existing standard: - Trees for every new street; - Depending on the size of the street	short term (<2017)	PB; DoUP; DoEnv	HIGH	Crosslink to non-structural measures: New standards need to be drafted and approved. - Lack of standards regarding soil composition - Lack of standards regarding species and height of vegetation- Lack of standards regarding design and size for the renewal of the old narrow streetsCorresponding training and know-how should be provided

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
4a	Green open spaces	Better planning for open public spaces. Introduce a combination of measures ranging from the creation of continuous canopy structure, green filters, green walls, to the introduction of fountain and other waterworks that would serve to provide shaded areas for pedestrians and recreational activities, while at the same time having a cooling effect and improving air quality	City wide	1, 2, 2a, 3, 5, 7	Several new developments foresee green open spaces (e.g. Tirana River rehabilitation project and Magnet project)	short term (<2017)	PB; DoUP; DoEnv	HIGH	Crosslink to non-structural measures:Improve planning regulations and standards - Proportion of green vs. covered space- Realise and set standards for landscape architecture and green urban planningInstruments for design and control are not existing (lack of planning experts/knowledge) Training and know-how should be provided regarding CCA, landscape architecture, maintenance and combination with water structures
4b	Tree nursery	Tirana used to have a tree nursery but is now decimated by illegal buildings. The municipality policies for increasing vegetation and community involvement projects would require a new tree nursery as a means for education, sustainable development and job creation	Suburbs of the city. To be decided depending on soil quality, ownership rights and size. Perhaps the former greenhouses can be cleaned up and turned into tree nursery	2	No ongoing or planned measures to date	short term (<2017)	DGoS; DoUP; DoEnv; MGE	HIGH	Problems on land property may be faced

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
5	Green new fences	Remove the existing walls around premises and replacing them with standard fences and tree planting within the backyards and along the streets	Suburban and informal areas of Tirana		Already realized (supported by municipality since 2012)	short term (<2017)	TCPW; DGoS; MGE	MEDIUM	Crosslink to non-structural measures:- Improve planning regulations and standards - suggest measures for green vegetation in fences to re-place existing walls in informal areas that shall experience urban requalification or other development projects- Realise and set standards for landscape architecture and green urban planningTraining and know-how should be provided regarding CCA, landscape architecture, etc.
Water system (structural measures)									
6	Rain water storage	New developments should foresee the implementation of rain water storage as a new standard	city wide, especially in new developments	2a, 3, 5, 6	Already planned for the new development of Tirana Northern Boulevard and Tirana River Rehabilitation	medium term (<2020)	PB; DoUP; DoEnv; WUE	MEDIUM	There is little if any knowledge on the importance of this issue. More efforts should be focused in explaining its importance (promotion). Costly operation - medium priority
7	Water retention	Measures in the urban water system which slow down rain water (storm water) drainage, including decentralised storage / retention. Depends on location, see beside. - retention basin - storage sewer, etc.	areas close to the Tirana River and Lana creek, especially close to study areas 2, 5, 6	2, 2a, 5, 6	Tirana Northern Boulevard and River Rehabilitation Project	medium term (<2020)	PB; DoUP; DoEnv; WUE	MEDIUM	Costly operation - medium priority Crosslink to non-structural measures: need for training and know-how

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
8	Water drainage	New water permeable concrete is introduced recently in a new development in Tirana. Such water permeable concrete should be widely introduced in all new developments and pavements, see also measure no. 14	City wide, especially in flood-prone areas	1, 2, 2a, 3, 4, 6, 7	It is already planned-realised at the Tirana Northern Boulevard and at Magnet new residential complex being developed in Tirana. Water permeable cement is widely used for sidewalks at Magnet site	short term (<2017)	PB; DoUP; DoEnv; WUE	HIGH	New developments should foresee the introduction of such measures as a new standard.
9	Flood protection	Tirana River project has already introduced flood protection measures through weirs and flood protection walls (embankments)	Especially along Tirana River and Lana.	1, 2, 2a, 4, 5, 6	Tirana River Rehabilitation Project, Lana downstream rehabilitation	short term (<2017)	PB; DoUP; DoEnv; WUE	HIGH	Follow-up Tirana River Rehabilitation Project Crosslink with other non-structural measures such as know how
10	Urban water spaces flowing	Increase natural water elements in the city such as wider riverbeds, creation of meanders to slow the speed of Tirana river, introduction of weirs, introduction of recreational ponds	Tirana river	2, 2a, 5, 6	Foreseen in the Tirana Northern Boulevard and River Rehabilitation Project. Weirs already introduced	medium term (<2020)	PB; DoUP; DoEnv; WUE	MEDIUM	Follow-up Tirana River Rehabilitation Project Crosslink with other non-structural measures such as knowhow and planning design. Training needs and knowhow for landscape architecture
11	Urban water spaces standing	Introduce fountain and other waterworks that would serve to provide shaded areas for recreational activities, while at the same time having a cooling effect and improving air quality	Public and private spaces, especially at main squares and cross-roads with poor air quality	1, 3, 5, 6	foreseen in the Tirana Northern Boulevard and River Rehabilitation Project	short term (<2017)	PB; DoUP; DoEnv; WUE	HIGH	Crosslink with other non-structural measures such as knowhow and planning design. Training needs and knowhow for landscape architecture

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
12	Water saving and re-use	Installation of rainwater saving device for the irrigation of the trees in the Northern Boulevard	Boulevard area North of Tirana	5, 6	Foreseen in the Tirana Northern Boulevard and River Rehabilitation Project	medium term (<2020)	PB; DoUP; DoEnv; WUE	MEDIUM	Crosslink with other non-structural measures such as knowhow and training
Urban structure (structural measures)									
13	Urban setting	According to existing regulations, the long side of buildings should not be oriented to the north (considering energy efficiency aspects for residential buildings)	City wide	5, 6	Tirana Northern Boulevard and River Rehabilitation Project	short term (<2017)	PB; DoUP; DoEnv	MEDIUM	Lack in regulations to ensure implementation
		Ventilation of urban space by intelligent urban design: Connection of northern areas with southern lake park	North extension of Boulevard	6, 7	It is already planned-realised at the Tirana Northern Boulevard and at Magnet new residential complex being developed in Tirana	short term (<2017)	PB; DoUP; DoEnv	MEDIUM	
14	Urban texture	New water permeable concrete is introduced recently in a new development in Tirana. Such water permeable concrete should be widely introduced in all new developments and pavements, see also measure no. 8	city wide	1, 2, 3, 4, 6, 7	It is already planned-realised at the Tirana Northern Boulevard and at Magnet new residential complex being developed in Tirana. Water permeable cement is widely used for sidewalks at Magnet site	short term (<2017)	PB; DoUP; DoEnv	MEDIUM	New developments should foresee the introduction of such measures as a new standard

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
15	Urban planning	No developments are allowed in certain areas which may pose them to risks, such as slopes or riverbeds and their buffer areas. Such measures are also foreseen at page 89 of the SEA report	city wide	2, 5, 6		short term (<2017)	PB; DoUP; DoEnv	HIGH	Need to review flood protection measures at case study no. 2. Need for a revised flood risk assessment
Building design (structural measures)									
16	Heat adapted design	Proper implementation of building insulation law 2004 to ensure heat resilient buildings (very limited implementation so far.)	city wide	1, 3, 6, 7	It is already planned-realised at the Tirana Northern Boulevard and at Magnet new residential complex being developed in Tirana	short term (<2017)	PB; DoUP; DoEnv	HIGH	The new urban plan and SEA requires the use of insulation for new developments although there is no specific reporting or monitoring system in place. Crosslink to non-structural measures: provide training and know how
		White facades of buildings (reflect sun exposure/heat)	New developments city wide	7	Already being implemented in some parts of the city, e.g. Magnet project	short term (<2017)	PB; DoUP; DoEnv	MEDIUM	Crosslink to the green walls
		Introduction of standards and regulations for usage of blinds to provide shade in new and reconstructed public and private buildings	City wide		Most new developments include blinds	medium term (<2020)	PB; DoUP; DoEnv	MEDIUM	New law or regulation might be needed to oblige use of blinds
		White roofs - white tiles on roofs to reflect sun exposure/heat	New developments city wide	7	Already being implemented in some parts of the city, e.g. Magnet project	short term (<2017)	PB; DoUP; DoEnv	MEDIUM	Crosslink to the green roofs

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
Non-structural measures									
17	Awareness raising	Need for better planning on municipality medium-term budget to address such issues. Public information via internet, leaflets, TV, information events, etc. could be used for this purpose			Information about air pollution via billboard, homepage of the municipality and leaflets	short term (<2017)	DoEm; DoUP; DoEnv	HIGH	Cross-link to structural measure no.:1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 16, 29 and 30
18	Informa-tion on adapting during extreme events	Need for better planning on municipality medium-term budget to address such issues. Billboards and other informative forms could be used			Emergency Department has the authority to call on the other departments and the public on these matters	short term (<2017)	DoEm; DoUP; DoEnv	HIGH	Cross-link to structural measure no.: 6, 7, 8, 9 and 12
19	Behaviour change	Monitoring of climate change and measures to minimize extreme weather events	risked areas		No ongoing or planned measures to date	medium term (<2020)	DoEm; DoUP; DoEnv	MEDIUM	Need to draft a guide on behaviour during extreme weather events
20	Institutional / organisational measures	Need to set up a working group amongst relevant departments to ensure implementation of adaptation measures			No ongoing or planned measures to date	medium term (<2020)	DoEm; DoUP; DoEnv	MEDIUM	The General Department of Civil Emergencies is in charge to provide timely information and guidance. Periodic meetings amongst a permanent working group to ensure implementation of measures
21	Land use and spatial planning	Include checklists with the CC criteria and potential mitigation measures to decision-makers.	city wide		No ongoing or planned measures to date	short term (<2017)	PB; DoUP; DoEnv	HIGH	CC mitigation measures should be provided and considered in land-use planning

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
22	Mapping	Limited know-how and expertise	city wide, especially of flood-prone areas and heat-risk areas		There is a basic mapping exercise on past extreme weather events	short term (<2017)	PB; DoUP; DoEnv	HIGH	Consider CC scenarios into the mapping exercise
23	Management / management plans	Limited know-how and expertise at the local administration	city wide		Foreseen in the Tirana Northern Boulevard and River Rehabilitation Project	medium term (<2020)	DoUP; DoEnv; IGEWE	HIGH	Highly important but needs cross-sectoral cooperation and expertise
24	Warning systems	There is a warning system in place at country level with specific information for Tirana. There is a need to update the list of extreme weather events related to CC, as well as to upgrade the system to provide data in real time	city wide		There is an Early Warning system in place at the Municipality level. There are efforts to upgrade the Early Warning into a so-called "Integrated Rescue System 112"	medium term (<2020)	DoUP; DoEnv; DoEm; IGEWE	MEDIUM	Both warning system development, as well as public outreach should be developed asap
25	Upgraded services related to CCA at Tirana Municipality	Some departments of the Municipality need to be upgraded to better address these challenges. For example, the Urban Planning Department should also hire landscape architects and landscape ecologists and have a unit within its department to better plan and adapt	Municipality Departments		The working group for this action plan is considered as a starting point for this.	short term (<2017)	DGoS; DoUP; DoEnv; MGE	HIGH	

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
26	Preparedness	Social centers should have an operational manual on how to handle the impacts of extreme weather events. Urban Green Enterprise is already looking at removing old trees as a precaution measure	city wide		No ongoing or planned measures to date	short term (<2017)	DoUP; DoEnv; DoEm	MEDIUM	
27	Emergency response	The Emergency Dept. need to update and publish an Emergency Response Plan including an Evacuation Plan if needed for flood-prone areas. Similarly, Water Utility Enterprise should have its own Emergency Response Plan	city wide		There are efforts to upgrade the warning system into a so-called "Integrated Rescue System 112"	short term (<2017)	DoUP; DoEnv; DoEm	MEDIUM	There is a need for better coordination amongst different local and national departments
28	Financial instruments	Provision of financial incentives for implementing private CC adaptation measures. Houses close to flood prone areas is recommended to be covered by insurance		2, 6	No ongoing or planned measures to date	short term (<2017)	DoUP; DoEnv; LD; TD	MEDIUM	Tax reductions might provide important incentives: e.g. reduction of infrastructure tax in case of implementation of CC mitigation/adaptation measures
Mitigation measures									
29	Emission	SEAP (Sustainable energy action plan): refers on CO2 reduction; Measures might contribute also to measures regarding adaptation; Links on public awareness			Urban transportation vehicles have a limit of age	short term (<2017)	DoTM; DoEnv; ID	MEDIUM	There is a need for better coordination amongst different local and national departments to ensure successful implementation

No.	Type of measure	Comment / explanation for implementation in Tirana	Relevant Locations	See case study no.	Relevant ongoing or planned projects to realise this kind of measures	Time horizon for start / realisation	Responsible institution of city administration	Priority of action	Comments e.g. preconditions / bottlenecks / cross-sectoral synergies or dependencies
30	Renewable energy	Regulation for mandatory solar collectors in new residential buildings (SEAP page 85). Subsidies for the use of renewable energy sources in the existing commercial and service sector in the City of Tirana (SEAP page 90)	city wide		Shifting from fuel to pellets for heat of public institutions. UNDP is supporting with drafting a new regulation for use of solar energy for heating water in the city	short term (<2017)	DGoS	MEDIUM	There is a need to provide some financial incentives and know how
32	Increase energy efficiency	Measures foreseen in SEAP (Sustainable energy action plan) as well as SEA	city wide		Nearly all public institutions are being upgraded with energy efficient solutions, such as thermal insulation	short term (<2017)	DGoS; DoUP; DoEnv	MEDIUM	The implementation of SEAP requires cooperation and good will from both local and national levels of governance. The new urban plan and SEA requires the use of insulation for new developments although there is no specific reporting or monitoring system in place. Crosslink to non-structural measures: provide training and know how

6 Implementation and monitoring of CCA actions

The purpose of monitoring the implementation of the CCA action plan is to understand whether the project or activity delivers the planned benefits and to be able to adjust the measures and activities to potentially changing conditions and new knowledge. Furthermore, the findings from the monitoring process should be reflected in a long term adaptation strategy and in new adaption measures as well as future planning.

In the following this document gives practical advice to understand which monitoring questions should be asked regularly and how to organise the process of monitoring. In many sectors, e.g. environmental protection, monitoring programmes are well defined and established, like for air or water quality monitoring. Once a comprehensive monitoring programme for Tirana exists, the monitoring regarding adaptation should be integrated.

Here the cross-cutting approach is substantial to reach the goals and to use the capacities efficiently.

Monitoring Step 1: Set-up of a monitoring working group

To be able to run a monitoring process the personal preconditions have to be agreed:

- First a monitoring board or working group should be delegated: This should be the CCA-City-Tirana working group (created for the CCA project) consisting of representatives of all relevant departments of the city administration.

Monitoring Step 2: Set-up of a monitoring process

The agreement on the process should include at least following criteria:

- Frequency of monitoring: A recommendation is to have yearly meetings of the CCA working group. The meetings are prepared by the CCA coordinator. This group reflects jointly new data, new projects, implemented projects and activities, critical developments in the light of CCA etc.; one topic is the joint yearly monitoring session.
- Method of monitoring: The CCA working group reflects in a joint approach, based on a checklist that refers to the actions plan, the achievements of the action plan, demands for corrections and updated actions. In a first approach this reflection should be done in verbal form. If indicators will be created in follow up steps, the indicators shall function as assessment scale.

- Documentation of monitoring results: The results should be documented in written form to allow communication of the results. The documentation should include comments on implemented measures, projects that have reflected adaptation options, projects and developments that are critical in the light of CCA demands and give comments on how the developments might be improved. Special focus should be laid on cross-sector projects, developments and observations.
- Communication of monitoring results: The monitoring results should be communicated in the CCA working group internally and with the superiors of the sections and the heads of the municipality. The monitoring documentation is firstly an internal document to self-assess and communicate the quality of climate change adaptation and preparedness. It shall help to improve internal processes with focus on cross-sector communication and cross-sector planning.

Monitoring Step 3: Assessment criteria and checks, if the set objectives are reached

When having implemented an adaptation measure a wide range of objectives have been identified. These are specific for different situations, dependent not only on the local natural and technical background but also on the experts and decision makers in charge. To assess the grade of reaching these objectives the working group might use structured goals in the following categories.

Greater goals for Tirana City Development:

Are the measures contributing to the overall goals of adaptation for Tirana, like

- the moderation of negative climate change impacts or / and
- the exploitation of positive aspects of climate change?

Functionality goals for the adaptation measure:

Functionality aspects regarding issues such as the amount of water retention in rivers and on surfaces, the quantity of green areas, green roofs etc. and also the success of the measures should be assessed, always: Concerning the reduction of heat islands, heat wave effects etc. or reduction of flood water in the streets or along the rivers (see vulnerability hot spots).

Economic goals for the adaptation measure:

Economic aspects concern the cost-benefit for the measures if they are predefined. Sometimes unexpectedly, new costs arise for building or maintenance of the measure that have initially not been thought of. Or a measure might cause higher maintenance costs in other infrastructure parts or with other stakeholders. On the other hand, costs might have been estimated too high in the beginning, to be on the safe side, but are less after implementation.

Acceptance / communication goals for the adaptation measure:

In the process of adaptation several target groups need to be involved and informed about the necessity of adaptation in general and / or the adaptation measure itself.

- Have all relevant target groups been informed / reached?
- Do they understand and access the information?
- Did a participatory approach take place and did it work as planned?
- Is continuous participation reached?
- Did the attitude of the targeted groups change?

Time aspects of the adaptation measure:

A further aspect is time: In the planning and implementation phase, time always plays a central role for decision-making. The CCA working group should also integrate some thoughts in the monitoring:

- Was the time for decision making, for implementation as expected?
- Time frame of the measure's impacts (long term, short term): is it as planned?

What were major restrictions regarding the necessary time frame (budgets, elections, other unforeseen restrictions)?

7 Glossary

The methodological approach of the Climate Change Adaptation project in Tirana builds up on the Adaption Compass of the EU project Future Cities (FC, 2013). The following definitions are extracted from the Future Cities Adaptation Compass and adjusted to this report.

Adaptation	Adjustment in natural or human systems in response to observed or expected climatic changes or their impacts. Adaptation moderates harm (*risks*) or exploits benefits (*opportunities*). Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation (IPCC, 2007a; Ribeiro et al. 2009). In this report, planned adaptation (i.e. adaptation that is the result of a deliberate policy decision) is meant.
Adaptation measure	Measure to adapt to *climate change and weather impacts* can be technical, participatory, communicative, planning, etc. The goal of implementing an adaptation measure is - to reduce the *vulnerability* of a *receptor*, - to enforce the *capacity to adapt* and / or - to strengthen the positive impacts (*opportunities*) of climate change. In this report the measures are categorised according to their function: measures in *green structures*, measures in the *water system*, measures for *energy efficiency* and *mitigation*, measures regarding *city structures* and *awareness raising measures*.
Addressed problem	Addressed problem relates to the *climate change impact* and the hence arising *risks*, which are addressed and reduced by the selected *adaptation measure*.
Awareness raising measure	An awareness measure is a category for *adaptation measures* aiming to raise awareness and integrate the public or other *target groups* in the *adaptation* process.
Balancing effect	Climate change impacts the *parameters* in a balancing way: *weather extremes* are moderated and therefore, identified problems will ease. In this report this term is used to connect the projected *climate change impacts* with the impacts of weather extremes already identified in the module “Check Vulnerability”.

Good-practice	Good-practice means methods, approaches and actions, which already proved successful and reliable for a certain situation / problem.
Biodiversity / ecosystems	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Capacity to adapt	Ability to adjust to *climate change*, to take advantage of the opportunities or moderate potential harm (IPCC, 2007; Ribeiro et al. 2009). In this report, the capacity to adapt is used in relation to the *receptors*, i.e. the following questions should be answered for all sectors individually (e.g. vulnerable groups, water and sanitary service, tourism, etc.): → Is the receptor ***able*** (financially, technologically, socially), ***willing*** and ***ready*** to cope with the expected changes? For non-human receptors, e.g. building environment or green spaces, the question has to be posed towards the respective decision makers (planning or administrative strength).
City structure	See *urban structure.*
Climate	Climate is described by long-term statistic values, like means, variances, probabilities etc. of meteorological parameters (e.g. temperature). Long-term in the context of climate typically means a time span of at least 30 years.
Climate change	Any change in *climate* over time, whether induced by natural variability or as result of human activity (IPCC, 2001).
Climate change impact	Impacts or consequences of *climate change* on natural or human systems (IPCC, 2007a).
Climate change trend	A trend is defined as the direction of change of a variable for a specific time span. In this report the term *climate change* trend refers to the direction of changes which are projected by *climate models* for the indicated time span. The trend gives no information about the amount and probability of change.
Climate model	A quantitative (mostly dynamic) model, which tries to simulate the global *climate* and affecting, processes on earth.
Climate parameter	Climate parameters are all parameters, which are essential to the climate system (e.g. humidity, temperature, radiation).

Climate projection	A simulation of future *climate* with a *climate model* is called climate projection. All models have to make assumptions, which cause a range of uncertainties about the calculations. For climate projections the time frame is rather big (usually until 2050 or 2100) and therefore lots of assumptions are made and the level of uncertainty is relatively high. The models project different *climate parameters*, e.g. air temperature, rainfall.
Demographic change	The term describes changes in the population. In general it is a change in the structure of the population. One main consequence of declining birth rate and increased life expectancy in most European countries is an aging population.
Emission scenario	Assumptions on future development of emissions are the bases for all *climate models*. These assumptions are described in *scenarios*. The major scenarios A1, A2, B1, B2, A1B were defined by the IPCC Special Report on Emission Scenarios and are the so called SRES *scenarios*.
Energy efficiency	Energy efficiency describes the capacity of a machine, method or approach to transform energy from an energy carrier. Often also efforts to power-saving (e.g. energy-saving lamps, insulation of buildings) are included under the term energy efficiency. The increase of energy efficiency is a claim in order to reduce energy consumption and eliminate energy wastage. The aim behind this strategy is to *mitigate* greenhouse gas emissions.
Exposure	The nature and degree to which a system is exposed to significant climatic variations (IPCC 2001). In this report the term is used in the context of the assessment of *vulnerability*, it comprises the local abundance of a *receptor* and its *sensitivity* against the respective *weather* phenomenon.
Global Climate Model	A General Circulation Model (GCM), more commonly called a global climate model, is a mathematical model of the general circulation of the planet's atmosphere or oceans. GCMs are widely applied for *weather* forecasting, understanding the *climate*, and projecting climate change.
Green structure	Green structure is a category for *adaptation measures* dealing with the installation of green features (flora) in the city, e.g. building green roofs, redesigning park areas.
Heat island effect	The Heat Island or Urban Heat Island (UHI) effect describes the possible temperature difference between rural and build-up urban areas. The effect can be explained by the absorption of solar radiation by materials in cities (e.g. dark surfaces: tar etc.). Furthermore, in cities buildings block the air exchange with the outer and cooler surroundings of the city.
Heat stress	Heat stress describes all strain for the human body/human health resulting from heat.

Indicators	Indicators are parameters to monitor and classify the environment, - in our case the *receptors* of a city with regard to the impacts of climate or weather. The indicators help to make definite statements and to systemize observations and information. To describe the spatial appearance *(spatial relevance)* of the receptors, practical indicators are used.
Indifferent effect	The climate change trends are not significantly changing the current situation; therefore, identified problems stay the same. Here this term is used to connect the projected *climate change impacts* with the impacts of *weather extremes* already identified in the module “Check *Vulnerability*”.
Infrastructure	Infrastructure determines the physical and organisational structures in a city. It is differentiated between hard infrastructure, i.e. physical structures like transport facilities, water, sanitation, energy plants and soft infrastructure, i.e. organisational features, like institutions, community networks.
Mitigation	Mitigation is used for actions which reduce the potential impacts of global warming (see *climate change*) by decreasing or avoiding greenhouse gas emissions.
Monitor	Monitoring adaptation is described as checking the implemented *adaptation measures* for the goals predefined during the planning phase of the measure.
Natural resources	Natural resources are assets occurring in nature that are used, consumed or exploited by human activities.
No-regret measures	The term no-regret measure is widely discussed and often substituted by low-regret measure. In this report, “no-regret measure” is used in the following sense: No-regret measures are measures that are not only beneficial for *climate change adaptation* but also for other sectors, e.g. economic growth. If the actual reason for implementing the measure - an expected *climate change impact* - doesn’t occur as expected, the *adaptation measure* is though beneficial. No-regret measures serve several objectives, especially in the framework of sustainable development. No-regret measures have a long-term impact, create a robust and flexible system and can be adjusted / rebuilt to future needs at reasonable costs.
Opportunities	In combination with *climate change* the term opportunities is used to describe the positive aspects of climatic changes for certain regions (see *climate change impacts*), e.g. hotter summer can influence the tourism sector positively.

Public health

Public health refers to all organized measures (whether public or private) to prevent disease, promote health, and prolong life among the population as a whole. Its activities aim to provide conditions in which people can be healthy and focus on entire populations, not on individual patients or diseases. Thus, public health is concerned with the total system and not only the eradication of a particular disease.

Receptor

Receptors describe local physical features and socio-economic conditions of cities and regions that are affected by *weather* impacts. They include the major functions and features of a city like population, *infrastructure*, built environment, economy and *natural resources*.

CC relevant receptors (physical features and socio-economic conditions) in cities - categories and examples, see table below:

Population	Infrastructure	Built environment	Local Economy	Natural resources
				
• Public health/ vulnerable groups	• Transport • Electricity and heating services • Water supply and sanitation services • Social infrastructure	• Building stock and materials	• Industry • Retail • Tourism	• Green spaces • Water resources and quality • Air quality • Agriculture • Forestry • Biodiversity / ecosystems

Regional Climate Model

A Regional Climate Model is a mathematical model of the general circulation of the atmosphere on a regional scale. These regional models use a statistical or dynamic downscaling of the *global model data* and reach horizontal resolutions of 10 x 10 km.

Resilience

The ability of a system to recover from the effect of an extreme load that may have caused harm (Willows and Connell 2003).

Review

A review or reviewing process describes the check and examination of background conditions, initial reasons for adaptation and relevant input data.

Risk	Risk is the combination of the current *vulnerability* (high, medium, low) and the *climate change impact* (balancing, indifferent, reinforcing) and is categorised in the classes very high, high, medium, low. In classical risk approaches the term risk is defined as the combination of the probability of occurrence and the magnitude of the consequence or hazard (Metcalf et al. 2009). Here the probability of occurrence is not evaluated, because no climate change data is used; only tendencies and qualitative descriptions are given. Additionally, the *uncertainties* of climate change projections are, at least for some *climate parameters* very high. A reasonable rating of probabilities seems therefore impossible.
Scale of measure	The scale or spatial scale of an *adaptation measure* describes where (area size) the measure is showing its impacts.
Sensitivity	The degree to which a system is affected by *climate* or weather stimuli. The impacts may be direct or indirect and can be beneficial or adverse (IPCC, 2001; Ribeiro et al. 2009).
Social infrastructure	The *receptor* social infrastructure includes all public service facilities, like community and recreational facilities (e.g. schools, libraries, public sports grounds, swimming pools), hospitals as well as volunteer networks and community based agencies.
Spatial relevance	The term spatial relevance is used in the report to describe the local abundance of the previously identified *sensitivities* with the help of *indicators.* The determination of the *spatial relevance* of the *receptors* helps to avoid implementing an *adaptation measure* at a location where no vulnerability exists.
Structural adaptation measure	Structural *adaptation measures* change the structure of a house, street, quarter or whole city. Building, reconstruction or modification of the e.g. *infrastructure* is necessary.
Synergy	Here the term is used with regard to the *adaptation measures*. The combination of several measures may produce a better result than implementing only one single measure. This context is called synergy.
Target group	Each message that is disseminated should be fitted to a group of people to reach the optimum effect. This group of people is called target group. Messages specified for a target group are more likely to be understood and implemented.
Uncertainty	An uncertainty is the degree to which a variable (e.g. the climate condition) is unknown. Uncertainties can result from lack of information or from disagreement about what is known or even knowable. Uncertainty can therefore be represented by quantitative measures, e.g. by modelling and taking assumptions or by a qualitative statement, e.g. reflecting the judgment of a team of experts.

Urban structure	Urban structure is a category for *adaptation measures* addressing the whole city and its morphology, i.e. the city build-up as well as its elements and materials are regarded (volume, density of buildings related to open spaces).
Vulnerability	The degree to which a system is susceptible to and unable to cope with adverse *climate* or *weather* induced impacts. Vulnerability is a function of *sensitivity* and *exposure* of a *receptor* to the climate / weather impacts and the *capacity to adapt* towards those conditions (Smit & Wandel, 2006). This definition differs from the definition of the IPCC which refers to climate change impacts instead of integrating actual and observed climatic or weather related impacts (compare IPCC, 2007a). The reason is that it is more practicable to start with the already known vulnerabilities which give the user also better arguments for implementing *measures* to adapt to already existing problems.
Vulnerable Group	The term refers to population groups or parts of society, which are easily susceptible to or have difficulties to cope with *climate* or *weather* impacts. These are mainly groups with limited mobility, e.g. elderly, disabled or children and people with chronic illnesses.
Weather	Describes the day-to-day changes in atmospheric conditions in a specific place at a specific time.
Weather extremes / extreme weather event	An event connected with extreme weather conditions like heat, storm or heavy precipitation that occurs rarely at a certain place and time (Birkmann et al. 2011).
Water system	Water system is a category for *adaptation measures* dealing with water in the city, e.g. the integration of water bodies in cities or the improvement of water management.
Weather sensitivity	*see sensitivity*
Win-win options	An arrangement in which all parties benefit. “Win-win-option” example could be the reduction of the greenhouse gas emissions while promoting, not limiting the economic growth at the same time. The term is often used in the context of *adaption measures* that could present an improvement or positive solution for several parties.

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Annex A:

List of Former Events in Tirana

Specific event	Weather extreme	Consequences (indirect impacts of events)	Responses taken	Receptors affected	Location	Comment
Heat wave						
Summer 1998 (26/6/1998)	High Temperatures	Several Injured persons and one Fatality (old person)	• Maximum alert and care from the white uniforms • Interventions and services from relevant structures • Intervention to facilitate traffic flow • Intervention from municipality structures • Intervention from Tirana Water Company (UKT)	• Vulnerable groups like Infants, the elderly people, people with high sensitivity to heat, people with social problems public health • Transport • Social infrastructures • Trade Green Spaces • Water Resources • Water Quality • Apartments • Mobility of people	Tirane	Municipality of Tirana and its structures in collaboration with relevant bodies have intervened for resolving problems and returning the situation to normal living conditions.
		• Health problems (epidemies and infections) • Air quality problems (highest concentration of air pollution) • Increasing Stress from the heat associated with the growth of social problems • High Costs for maintanance of social spaces and cooling of the buildings • Problems with drinking water during draught periods • High maintenance costs for water supply • Problems in the development of the vegetation and fire hazards				
Summer 1998 (8/7/1998)	High Temperatures	• Health problems (epidemies and infections)			The center, main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str.	
		• Air quality problems (highest concentration of air pollution)				
		• Increasing Stress from the heat associated with the growth of social problems				
		• High Costs for maintanance of social spaces and cooling of the buildings				
		• Problems with drinking water during draught periods				
		• High maintenance costs for water supply				
Summer 1999 (8/8/1999)	High Temperatures	Several injuries and 27 fatalities (mainly elderly people)			The problematic part for drinking water supply in recent years is the south-western part of Tirana and 'Komuna e Parisit' street	
		• Health problems (epidemies and infections) • Air quality problems (highest concentration of air pollution) • Increasing Stress from the heat associated with the growth of social problems • High Costs for maintanance of social spaces and cooling of the buildings • Problems with drinking water during draught periods • High maintenance costs for water supply • Problems in the development of the vegetation and fire hazards				
Summer 2006 (01/06/2006; 02/11/2006)					One apartment was set on fire at Rruga Dibres; One building basement was set on fire	
Summer 2007 (25/06/2007)	High Temperatures until 43 degree celcius				Fire in Plant former Dinamo market	
Summer 2008 (25/06/2008)					Fire in Sharra Landfill	

Specific event	Weather extreme	Consequences (indirect impacts of events)	Responses taken	Receptors affected	Location	Comment
Heavy precipitation / Floods						
May 2001 (7/5/2001)	• Heavy precipitation (the largest in the last 10 years) • High humidity levels • Low temperatures • Torrential rains	Floods, there were houses affected, 160 persons evacuated	• Engagement of the Army • Intervention from the civil emergencies service • Intervention from the municipality • Maximum alert and Care from the white uniforms • Intervention from the civil emergency service and UKT • Intervention from the municipality structures for the public features • Help on recovering from floods	• Vulnerable people (infants, old people) • Agriculture, sanitation • Transportation • People mobility • Infrastructure • Buildings • Electricity • Water supply • Sanitation services • Social infrastructures • Tourism • Industry • Commerce • Green spaces	Tirane e Re, Laknas, Alias, Berxull, Bathore, Shkoze, Sauk	
April, September, October, December 2002 (12/04;19/10;27/09;18/12)	Heavy Precipitation; flash floods, floods high humidity levels and low temperatures, torrential rains	• There are flooded the ground floors of the buildings; • Its created a pond nearby Archeological museum; • Due to high water level are damaged 20 ecectricity cabins,150 affected houses, there were and also evacuated people. The damage of bussinesses is 160 million ALL & 20 million ALL is the damage of the houses; • Lana river floods Shallvare buildings basements& groundfloor, infrastructure affected			Lagjia nr.1, neighbourhood near archeological museum Shallvare	Flooding in the north of Tirana and around Tirana river due to increased levels and river flows.
October 1946 (23/10/1946)	Floods	9 bridges collapsed, 23 houses destroyed			Tirana	During the years there have been sporadic flooding from rainfall. We can mention here floods caused by swelling of Lana level, blocking of sewearage network area near ETC, flooding of the 21 Dhjetori Cross road and some other cross roads due to blocking of wastewater network. In the same time we can mention the flooding of the 'Komuna e Parisit' to 'Vasil Shanto' neighbourhud by the increased level Artificial Lake dam.
November 1962 (16/11/1962)	Floods				Tirana, Kombinat	
June 1976 (6/6/1976)	Floods	Paper Factory got flooded			Tirana	
November 1979 (16/11/1979)	Floods	4 houses damaged			Tirana	
November 1985 (19/11/1985)	Floods	200 houses damaged			Tirana	
October1998 (1/10/1998)	Floods	There were houses damaged mainly the buildings number 143 and 165, and also damaged infrastructure			Tirana	

Specific event	Weather extreme	Consequences (indirect impacts of events)	Responses taken	Receptors affected	Location	Comment
Heavy precipitation / Floods						
September 2002 (30/09/2002)	Floods	There were affected many streets, the underground warehouses, and basements of the whole neighbourhood of Tirana e Re, and also around 150 economic entities	• Engagement of the Army • Intervention from the civil • emergencies service • Intervention from the • municipality • Maximum alert and Care • from the white uniforms • Intervention from the civil • emergency service and • UKT • Intervention from the • municipality structures for • the public features • Help on recovering from • floods	• Vulnerable people • (infants, old people) • Agriculture, sanitation • Transportation • People mobility • Infrastructure • Buildings • Electricity • Water supply • Sanitation services • Social infrastructures • Tourism • Industry • Commerce • Green spaces	Tirana, Tirana e Re	66.8 mm rain during the night
January 2005 (24-25/01/2005)	Heavy precipitation	Flooded roads and sidewalks due to blocked sewage system and smaller capacity of manholes or etc			Municipality units 1 (near Shkoza bridge, 2 Elbasani street, 4 (the hospital areas, 5 (komuna e parisit), 6 (the entrance of Tirana, end of Lana River)	41 mm rain for a short period; 84 mm in 24 hours
October, December 2008 (3/12)	Floods	• There was only one house flooded in june, • Flooding problems is the roads in october			Tirana, Vasil Shanto neighbourhood	34 mm rain in 4 hours; 62 mm rain over the night
April, May 2012 (15/04; 27/05)	Floods	• Houses damaged; • Infrastructure damages			Tirana; Ura e Shkozes, Siri Kodra	
December 2005 (17/12/2005)	Flash Floods	There were some flooded houses			Tirana	
August 2008 (24/08/2008)	Flash Floods	Flooding problems in the street			Tirana	
September, October 2010 (4/09; 13/10)	Flash Floods	Heavy traffic jam during the raining period (90 min)			Tirana, Near paskuqani, (municipality unit 11)	40.4 mm rain for 24 hours
October, December 2012 (26/10;26/12)	Flash Floods	Heavy traffic jam during the rainy period			Tirana, Don Bosko street, Siri Kodra street, Shkoze,Gramoz Pashko street, Shaban Bardhoshi street.	58 mm rain for 3 hours, 84 mm rain for 24 hour
September, October 2013 (17/09;16/10)	Flash Floods	Heavy traffic jam during the rainy period			Don Bosko street, Tirana, Don Bosko street, Siri Kodra street, Shkoze	22 mm for 1 hour 34 mm for 4 hours
June 2014 (16-17/06/2014)	Flash Floods	Heavy traffic jam during the rainy period			Tirana, Don Bosko street, siri kodmisto mame street.	

Specific event	Weather extreme	Consequences (indirect impacts of events)	Responses taken	Receptors affected	Location	Comment
Heavy precipitation / Floods						
November 2014 (8/11/2014)	Flash Floods	Heavy traffic jam during the rainy period, street closure			Shkoze bridge, Elbasani Street, The street near the Foreign Ministry, ex Restaurant Durresi etc	56.44 mm for 3 hours 38.4 mm for 1 hour
Extreme cold						
No former events documentation regarding extreme cold						
Storm						
July 2009 (2.07.2009)		There was heavy rainfall and trees that fell down			Komuna e Parisit, Don Bosko, Elbasani street (ETC) etc	
Erosion						
June 2006 (03/06/2006)	landslide as result of a heavy rainfall				Sharra neighbourhood	
Receptors describe local physical features and socio-economic conditions of cities and regions that are affected by weather or climate impacts. They include the major sectors but also e.g. features like population (e.g. public health, vulnerable groups), built environment (e.g. existing building stock, construction material, urban (green) spaces) or infrastructure (e.g. transport, water and sanitation services, electricity and heating services, communication services, waste water management).						

Annex B:

List of Current Vulnerability of Tirana

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Population	Public health / vulnerable groups	Heat wave	- Deaths, mainly due to cardiovascular diseases - Spread of vector-born and infectious diseases (epidemics and infections) - Altered allergic pattern - Heat stress	Elderly people, babies, children, sensitive people; especially in densely built areas (e.g. Komuna e Parisit, Don Bosko, ish Shkolla Teknologjike)	High	Medium	High
		Extreme cold	- Injured and deaths - Spread of respiratory and infectious diseases	Sensitive people, babies, elderly and immobile people, homeless	Medium	Low	Medium
		Drought	- Effects on the air-hygienic situation - Leads to an accumulation of trace elements - Diseases caused by consuming water and food of poor quality - Anxiety or depression of economic losses	All people living or working in affected areas, especially in south-western part of Tirana and 'Komuna e Parisit'	Medium	Medium	Medium
		Heavy precipitation / Floods	- Injured and deaths - Spread of diseases due to contaminated water, mainly infections - Health problems due to interruptions / difficulties providing services - Psychological effects - Political implication (loss of trust)	All people living or working in affected areas (e.g. ish Shkolla teknologjikie,ura e Shkozes, Don Bosko)	Low	Low	low
		Storm	- Casualties and deaths	All people living or working in affected areas	Medium	Medium	Medium

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Infrastructure	Transport	Heat wave	- Damages - Changes in behaviour pattern / demand - Air quality problems - Higher maintenance costs - Damages on the automobile cooling systems	- Roads, rail roads, etc., public transport, mobility of people, side walks - Air quality problems, highest concentration of pollutants, especially in the center, main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str., 21 Dhjetori Crossroad, and Zogu i Zi crossroad.	Medium	Medium	Medium
		Extreme cold	- Damages - Changes in behaviour pattern / demand - Higher maintenance costs - Street Closure - Traffic Jam - Diesel engines get stressed	Transport operators	Medium	Medium	Medium
		Drought	- Difficult transport of bulk material - Air quality problems	- Water management - Roads, rail roads, etc., public transport, mobility of people, side walks - Air quality problems, highest concentration of pollutants, especially in the center, main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, Don Bosko street, 21 Dhjetori crossroad.	Medium	Medium	Medium
		Heavy precipitation / Floods	- Damage - Interruption of traffic flow and services	All means of transport, public transport, mobility of people, infrastructure in the affected areas	High	Medium	High
		Storm	- Damages / failures		Medium	Medium	Medium

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Infrastructure	Electricity services	Heat wave	- Damages - Altered load peaks / demand - Efficiency changes - Cooling problems - Higher maintenance costs, mainly own consumption	All electricity providers OSHEE, power substation (e.g. Pallati I Kongreseve, Rr.Siri Kodra, Selita neighbourhood, Don Bosko), consumers	High	High	Medium
		Extreme cold	- Damages - Altered load peaks / demand - Cracking of heating system - Interruption of power supply	All electricity generation and distribution, providers in the affected areas, consumers	Medium	Medium	Medium
		Drought	- Cooling problems - Higher maintenance costs, e.g. environmental requirements - Lower electricity production	Mainly hydro-power which are located outside of Tirana, but have a big importance for the city)	Medium	Medium	Medium
		Heavy precipitation / Floods	- Damages / failures - Interruption of work of the power supply system	All electricity generation like ex-powerplant not working since three years ago, also some power sub-stations in: e.g. Pallati I Kongreseve, Rr.Siri Kodra, Selita neighbourhood,. Hand distribution in affected areas and all other activities that use electricity.	High	Low	High
		Storm	- Damages / failures	All electricity generation and distribution, also some other power lines and wind power plants	High	Low	High
	Water supply and sanitation services	Heat wave	- Higher water demand - Water quality problems - Higher maintenance costs - Higher risk of fire and landfill	Health of people, technical infrastructure, public budget through higher maintenance costs, Tirana Water Company (UKT), especially in south-western part of Tirana and 'Komuna e Parisit'	High	Medium	High
		Extreme cold	- Damages e.g. on infrastructure - Water quality problems - Higher maintenance costs - Ground freezing problems	Parts of the City that have the old pipe system (iron pipes instead of plastic ones) so mainly the buildings who are constructed after 1998 all over the city	Medium	Medium	Medium

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Infrastructure		Drought	- Water scarcity - Water quality problems - Higher maintenance costs - Higher risk of fire and landfill	Technical infrastructure, public budget through higher maintenance costs, Tirana Water Company (UKT), especially in south-western part of Tirana and 'Komuna e Parisit'	High	Low	High
		Heavy precipitation / Floods	- Damages - Higher maintenance costs - Water quality problems - Pollution of soil and water from leakage of sewage	Blockage of the sewage system from Lana river overflow; North area of Tirana and settlements along Tirana river, Don Bosko street.	High	Medium	High
		Storm	- Damages - Water quality problems	Technical infrastructure, public budget through higher maintenance costs, water boards	Medium	Medium	Medium
	Social infrastructure	Heat wave	- Changes in behaviour pattern, e.g. living outdoors - Altered demands, e.g. for cooling - Higher crime rate (conflicts, accidents…) - More patients in hospitals - Higher maintenance costs for public spaces (waste disposal, watering of parks etc.) and cooling of buildings	Hospitals, homes for the elderly, nurseries, schools, public spaces, sport complexes; city council	High	Medium	High
		Extreme cold	- More patients in hospitals - Higher maintenance costs, e.g. for heating		Medium	Medium	Medium
		Drought	- Altered demands, e.g. for water supply		High	Medium	High
		Heavy precipitation / Floods	- Damages - Emergency management needed - More patients in hospitals - Higher maintenance costs		Medium	High	Low
		Storm	- Damages - Emergency management needed - More patients in hospitals - Higher maintenance costs		Low	High	Low

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Built environment	Building stock and materials	Heat wave	- Damages e.g. on asphalt - Higher cooling demand - Higher maintenance costs - Heat island effect - Possibility of fires	Buildings, technical & urban infrastructure, especially in densely built areas (Komuna e Parisit) and Big Squares (21 Dhjetori) with dark surfaces, asphalt, concrete, etc.	High	Medium	High
		Extreme cold	- Damages, e.g. on asphalt - Higher heating demand - Higher maintenance costs	Buildings, technical & urban infrastructure especially in dense built areas (e.g. Don Bosko, Komuna e Parisit) and big squares like (21 dhjetori)	Medium	Medium	Medium
		Drought	- Higher water demand - Dikes may collapse - Possibility of fires		Medium	Medium	Medium
		Heavy precipitation / Floods	- Damages - Surface runoff, increase of flooding - Torrential streams	Buildings, technical & urban infrastructure, roads, rail roads, all buildings in the affected areas, sealed surfaces; e.g. winter precipitation floods at Bregu i Lumit, Kamëz, Kashar, Komuna e Parisit, Don-Bosko	Medium	Medium	Medium
		Storm	- Damages, demolition and failures	Buildings, technical & urban infrastructure, roads, all buildings in the affected areas	Medium	Medium	Medium
Economy	Tourism	Heat wave	- Altered high / low seasons - Image changes - Increasing costs, e.g. for cooling	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy	Low	High	Low
		Extreme cold	- Altered high / low seasons - Image changes - Increasing costs, e.g. for heating		Medium	Medium	Medium
		Drought	- Altered high / low seasons - Image changes - Increasing costs, e.g. for water supply - Higher water demand		Medium	Medium	Medium
		Heavy precipitation / Floods	- Damages on touristic infrastructure - Higher costs for maintenance and repair		Medium	High	Medium
		Storm	- Damages on touristic infrastructure - Higher costs for maintenance and repair		Medium	High	Low

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Economy	Small Scale Industry	Heat wave	- Lower efficiency - Cooling problems and higher costs - Shortfall of workers	Consumer, and all small scale industry mainly connected to construction industry and all industries with need for cooling or high water use, transport of bulk commodities, workers, companies, distribution networks (e.g. Porcelani, gjeologjikja, Josif Pashko, Ish Nesheraku, Kombinati (beer brewery), Ish Frigoriferi)	High	High	Medium
		Extreme cold	- Damages - Increasing costs, e.g. for heating - Efficiency changes		Medium	Medium	Medium
		Drought	- Water scarcity / cooling problems - Supply problems due to limited bulk transport	Consumer, all industries with need for cooling or high water use, transport of bulk commodities, workers, companies, distribution networks	High	High	Medium
		Heavy precipitation / Floods	- Damages / failures	Josif Pashko and Don Bosko industry	High	Medium	High
		Storm	- Damages / failures	Industries, workers, companies, distribution networks in affected areas	Medium	High	Low
	Retail	Heat wave	- Changes in buying behaviour - Sales boost / shortfall	Consumer (access & price level), shop owners, shops in the affected areas city wide	Medium	Medium	Medium
		Extreme cold	- Changes in buying behavior - Sales boost / shortfall		Low	Medium	Low
		Drought	- Changes in buying behaviour - Sales boost / shortfall		Medium	Medium	Medium
		Heavy precipitation / Floods	- Damages / failures - Sales shortfall	Consumer (access & price level), shop owners, shops in the affected areas and more problematic Don Bosko, ish shkolla Teknologjike	Medium	Medium	Medium
		Storm	- Damages / failures	Consumer (access & price level), shop owners, shops in the affected areas	Low	Medium	Low

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	Potential effects				
Natural resources	Green spaces	Heat wave	- Dying of plants - Altered behaviour pattern / demands - Higher maintenance costs due to extensive use / water use etc.	Tirana lake park, parks nearby city center, future development area in the northern part of Tirana (Tirana river banks)	High	Medium	High
		Extreme cold	- Damages, dying of plants		Medium	Medium	Medium
		Drought	- Dying of plants - Higher maintenance costs, mainly watering - Risk of fires		High	Low	High
		Heavy precipitation / Floods	- Damages on infrastructure and plants		Medium	Medium	Medium
		Storm	- Damages on infrastructure and plants		Medium	Medium	Medium
	Water resources and quality	Heat wave	- Higher evaporation / higher water uptake by ecosystem / lower water flows - Spread of algae, bacteria - Altered fauna - Lower groundwater recharge	Tirana wide, groundwater resources and surface water (river, lake)	High	Low	High
		Extreme cold	n/a	n/a			
		Drought	- Lower water flows / lower groundwater recharge - Salinization	Tirana wide, groundwater resources and surface water (river, lake)	High	Medium	High
		Heavy precipitation / Floods	- Water quality problems/sewage overflow		High	High	Medium
		Storm	- Water quality problems	Ecosystem in affected areas	Medium	Medium	Medium
Natural resources	Air quality	Heat wave	- Spread of diseases - Smog / higher concentration of air pollutants and allergens	Tirana wide, especially in the densely populated areas like main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, 21 Dhjetori Crossroad, Zogu I Zi crossroad.	High	Medium	High

Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
	Extreme event	Potential effects				
	Extreme cold	n/a	n/a			
	Drought	- Smog / higher concentration of air pollutants and allergens	Tirana wide, especially in the densely populated areas like main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, 21 Dhjetori Crossroad, Zogu I Zi crossroad.	High	Medium	High
	Heavy precipitation / Floods	n/a	Tirana wide, especially in the densely populated areas like main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, 21 Dhjetori Crossroad, Zogu I Zi crossroad, Don Bosko			
	Storm	n/a	n/a			
Agriculture	Heat wave	n/a	n/a			
	Extreme cold	n/a	n/a			
	Drought	n/a	n/a			
	Heavy precipitation / Floods	n/a	n/a			
	Storm	n/a	n/a			
Forestry	Heat wave	- Changes in growth cycle (decrease in growth or drying of wood) - Possibility of a fire	Tirana lake park	Medium	Medium	Medium
	Extreme cold	- Mortality of trees		Medium	Medium	Medium
	Drought	- Damages / dying of trees		High	Medium	High
	Heavy precipitation / Floods	- Damages / dying of trees - Spoiling of water bodies and soil quality - Damage to the root system - Erosion of forest land		Medium	Medium	Medium
	Storm	- Damages / dying of trees		Medium	Low	Medium

	Receptors	General weather sensitivity of receptor		Who / What is affected	Sensitivity/ Exposure	Capacity to adapt	Vulner-ability
		Extreme event	**Potential effects**				
Natural resources	Bio-diversity / eco-systems	Heat wave	- Altered flora and fauna, new & invasive species - Loss of species - Mortality of flora and fauna	All flora and fauna with low adaptive capacity, ecosystem in Tirana lake park, Tirana river, botanical garden and Zoological garden	Medium	Low	Medium
		Extreme cold	- Reduced food source for animals		Medium	Medium	Medium
		Drought	- Altered flora and fauna, new & invasive species - Loss of species - Mortality of flora and fauna		Medium	Low	Medium
		Heavy precipitation / Floods	- Altered flora and fauna, new & invasive species - Loss of species - Torrential streams		Low	Low	Low
		Storm	- Loss of natural resources		Low	Low	Low

Annex C:

List of Future Risk and Opportunities of Tirana

Assessed future risk and opportunities:

Population - Public health / vulnerable groups:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Deaths, mainly due to cardiovascular diseases - Spread of vector-born and infectious diseases (epidemies and infections) - Altered allergic pattern - Heat stress	Elderly people, babies, children, sensitive people; especially in densly built areas (e.g Komuna e Parisit, Don Bosko, ish Shkolla Teknologjike)	**High**	Heat waves - reinforcing in summer	n/a	- Reinforcement of heat stress - Increasing spread of new vector-born and infectious diseases - Altered allergic patterns	**very high**	**-**	n/a
Extreme cold	- Injured and deaths - Spread of respiratory and infectous diseases	Sensitive people, babies, elderly and immobile people, homeless	**Medium**	n/a	Extreme cold - balancing in winter	n/a	**-**	**low**	- Decrease of typical winter illnesses because of the warmer temperatures - Less spread of respiratory and infectious diseases
Drought	- Effects on the air-hygienic situation - Leads to an accumulation of trace elements - Diseases caused by consuming water and food of poor quality - Anxiety or depression of economic losses	All people living or working in affected areas, especially in south-western part of Tirana and 'Komuna e Parisit'	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increased allergic reactions through pollen flight and others - Decreased air quality - More respiratory troubles	**high**	**medium**	- Dicrease of Rheumatism disease
Heavy precipitation / Floods	- Injured and deaths - Spread of diseases due to contaminated water, mainly infections - Health problems due to interuptions / difficulties providing services - Psychologichal effects - Political implication (loss of trust)	All people living or working in affected areas (e.g. ish shkolla teknologjikie,ura e Shkozes, Don Bosko)	**low**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Growing spread of diseases due to contaminated water - Increasing utillisation of health care - Increase of damages and injured through flooding	**medium**	**medium**	n/a
Storm	- Casualties and deaths	All people living or working in affected areas	**Medium**	n/a	n/a	n/a	**-**	**-**	n/a

Infrastructure - Transport:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Damages - Changes in behaviour pattern / demand - Air quality problems - Higher maintenance costs - Damages on the automobile cooling systems	- Roads, rail roads, etc., public transport, mobility of people, side walks - Air quality problems, highest concentration of pollutants, especially in the center, main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str., 21 Dhjetori Crossroad, and Zogu i Zi crossroad.	**Medium**	Heat waves - reinforcing in summer	n/a	- Increase of damages - Increasing costs for maintenance - Increase of air quality problems	**high**	**-**	- Changes in behaviour pattern, e.g. more people using bikes
Extreme cold	- Damages - Changes in behaviour pattern / demand - Higher maintenance costs - Street Closure - Traffic Jam - Diesiel enginees get stressed	Tranport operators	**Medium**	n/a	Extreme cold - balancing in winter	- Increase of damages due to increasing freeze-thaw cycle	**-**	**low**	n/a
Drought	- Difficult transport of bulk material - Air quality problems	- Water management - Roads, rail roads, etc., public transport, mobility of people, side walks - Air quality problems, highest concentration of pollutants, especially in the center, main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, Don Bosko Street, 21 Dhjetori crossroad.	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	n/a	**high**	**medium**	n/a
Heavy precipitation / Floods	- Damages - Interruption of traffic flow and services	All means of transport, public transport, mobility of people, infrastructure in the affected areas	**High**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increase of damages - Higher costs for protection, rebuilding - Less mobility	**very high**	**very high**	n/a
Storm	- Damages / failures	All means of transport, public transport, mobility of people, infrastructure in the affected areas	**Medium**	n/a	n/a	n/a	**-**	**-**	n/a

Infrastructure - Electricity services:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Damages - Altered load peaks / demand - Efficiency changes - Cooling problems - Higher maintenance costs, mainly own consumption	All electricity providers OSHEE, power substation (e.g. Pallati I Kongreseve, Rr.Siri Kodra, Selita neighbourhood, Don Bosko), consumers	**Medium**	Heat waves - reinforcing in summer	n/a	- Increasing maintenance costs - Possible supply problems due to higher energy demands and less efficiency - Increase of cooling problems	**high**	**-**	- Altered load peaks / demand - Eco-friendly energy business thrive
Extreme cold	- Damages - Altered load peaks / demand - Chracking of heating system - Interruption of power supply	All electricity generation and distribution, providers in the affected areas, consumers	**Medium**	n/a	Extreme cold - balancing in winter	- Increasing number of damages due to increasing freeze-throw cycle - Possibly supply problems	**-**	**low**	- Decreasing energy demand for heating
Drought	- Cooling problems - Higher maintenance costs, e.g. environmental requirements - Lower electricity production	Mainly hydro-power which are located outside of Tirana, but have a big importance for the city)	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increase of cooling problems - Less hydropower potential - Increasing maintenance costs (e.g. environmental requirements)	**high**	**medium**	n/a
Heavy precipitation / Floods	- Damages / failures - Interruption of work of the power supply system	All electricity generation like ex-powerplant not working since three years ago, also some power sub-stations in: e.g. Pallati I Kongreseve, Rr.Siri Kodra, Selita neighbourhood,. Hand distribution in affected areas and all other activities that use electricity.	**High**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages/ failures on production & distribution facilities	**very high**	**very high**	n/a
Storm	- Damages / failures	All electricity generation and distribution, allso some other power lines and wind power plants	**High**	n/a	n/a	n/a	**-**	**-**	n/a

Infrastructure - Water supply and sanitation services:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Higher water demand - Water quality problems - Higher maintenance costs - Higher risk of fire and landfill	Health of people, technical infrastructure, public budget through higher maintenance costs, Tirana Water Company (UKT), especially in south-western part of Tirana and 'Komuna e Parisit'	**High**	Heat waves - reinforcing in summer	n/a	- Increasing water demand - Increasing maintenance costs - Increasing spread of diseases - Decreasing availability of water - Increasing water quality problems due to lower water levels and heavy concentration of components	**very high**	**-**	n/a
Extreme cold	- Damages e.g. on infrastructure - Water quality problems - Higher maintenance costs - Ground freezing problems	Parts of the City that have the old pipe system (iron pipes instead of plastic ones) so mainly the buildings who are constructed after 1998 all over the city	**Medium**	n/a	Extreme cold - balancing in winter	- Vermin and bacteria survive mild winters	**-**	**low**	- Decreasing number of damages on infrastructure (Sanitation)
Drought	- Water scarcity - Water quality problems - Higher maintenance costs - Higher risk of fire and landfill	technical infrastructure, public budget through higher maintenance costs, Tirana Water Company (UKT), especially in south-western part of Tirana and 'Komuna e Parisit'	**High**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Decreasing availability of water	**very high**	**high**	n/a
Heavy precipitation / Floods	- Damages - Higher maintenance costs - Water quality problems - Pollution of soil and water from leakage of sewage	Blockage of the sewage system from Lana river overflow; North area of Tirana and settlements along Tirana river, Don Bosko street.	**High**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages - Increasing maintenance costs (increasing filter replacement costs) - Reinforcement of water quality / problems - Increasing number of flooding of sewerage systems	**very high**	**very high**	n/a
Storm	- Damages - Water quality problems	Technical infrastructure, public budget through higher maintenance costs, water boards	**Medium**	n/a	n/a	n/a	**-**	**-**	n/a

Infrastructure - Social infrastructure:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Changes in behaviour pattern, e.g. living outdoors - Altered demands, e.g. for cooling - Higher crime rate (conflicts, accidents...) - More patients in hospitals - Higher maintenance costs for public spaces (waste disposal, watering of parks etc.) and cooling of buildings	Hospitals, homes for the elderly, nurseries, schools, public spaces, sport complexes; city council	**High**	Heat waves - reinforcing in summer	n/a	- Higher stress at the hospitals - Increasing necessity for cooling social infrastructures like hospitals, schools	**very high**	**-**	n/a
Extreme cold	- More patients in hospitals - Higher maintenance costs, e.g. for heating	Hospitals, homes for the elderly, nurseries, schools, public spaces, sport complexes; city council	**Medium**	n/a	Extreme cold - balancing in winter	n/a	**-**	**low**	- Fewer patients in hospitals - decreasing maintenance costs
Drought	- Altered demands, e.g. for water supply	Hospitals, homes for the eldelry, nurseries, schools, public spaces, sport complexes; city council	**High**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Less availability of water (economisation of resources) - More people with respiratory problems in hospitals	**very high**	**high**	n/a
Heavy precipitation / Floods	- Damages - Emergency management needed - More patients in hospitals - Higher maintenance costs	Hospitals, homes for the elderly, nurseries, schools, public spaces, sport complexes; city council	**Low**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages - Increasing attrition of buildings - Increasing maintenance costs	**medium**	**medium**	n/a
Storm	- Damages - Emergency management needed - More patients in hospitals - Higher maintenance costs	Hospitals, homes for the eldery, nurseries, schools, public spaces, sport complexes; city council	**Low**	n/a	n/a	n/a	**-**	**-**	n/a

Built environment - Building stock and materials:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Damages e.g. on asphalt - Higher cooling demand - Higher maintenance costs - Heat island effect - Possibility of fires	Buildings, technical & urban infrastructure, especially in densly built areas (Komuna e Parisit) and Big Squares (e.g. 21 Dhjetori) with dark surfaces, asphalt, concrete, etc.	**High**	Heat waves - reinforcing in summer	n/a	- Increasing number of damages, e.g. on asphalt - Increasing need for standard of protection - Reinforcement of heat island effect - Risk of overheating - Increasing maintenance costs - Increasing need for cooling	**very high**	**-**	n/a
Extreme cold	- Damages, e.g. on asphalt - Higher heating demand - Higher maintenance costs	Buildings, technical & urban infrastructure especially in dense built areas (e.g. Don Bosko, Komuna e Parisit) and big squares like (21 dhjetori)	**Medium**	n/a	Extreme cold - balancing in winter	n/a	**-**	**low**	- Decreasing number of damages - Decreasing maintenance costs
Drought	- Higher water demand - Dikes may collapse - Possibility of fires	Buildings, technical & urban infrastructure especially in dense built areas (e.g. Don Bosko, Komuna e Parisit) and big squares like (21 dhjetori)	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increasing damages, e.g. of the foundation because of soil drying	**high**	**medium**	- Less humility problems in building stock (moss, fungi)
Heavy precipitation / Floods	- Damages - Surface runoff, increase of flooding - Torrential streams	Buildings, technical & urban infrastructure, roads, rail roads, all buildings in the affected areas, sealed surfaces; e.g. winter precipitation floods at Bregu i Lumit, Kamëz, Kashar, Komuna e Parisit, Don-Bosko	**Medium**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages - Increasing number of maintenance costs - Increasing need for standard of protection - Increasing of surface runoff, increase of flood risk	**high**	**high**	n/a
Storm	- Damages, demolition and failures	Buildings, technical & urban infrastructure, roads,all buildings in the affected areas	**Medium**	n/a	n/a	n/a	**-**	**-**	n/a

Economy - Tourism:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Altered high / low seasons - Image changes - Increasing costs, e.g. for cooling	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy	**Low**	Heat waves - reinforcing in summer	n/a	- Altered seasons - Increasing damages of cultural monuments and institutions - Negative image changes	**medium**	**-**	n/a
Extreme cold	- Altered high / low seasons - Image changes - Increasing costs, e.g. for heating	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy	**Medium**	n/a	Extreme cold - balancing in winter		**-**	**low**	- Decreasing damages on touristic infrastructure
Drought	- Altered high / low seasons - Image changes - Increasing costs, e.g. for water supply - Higher water demand	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increasing costs for water supply - Decreasing bathing water quality (esp. Lakes, rivers)	**high**	**medium**	n/a
Heavy precipitation / Floods	- Damages on touristic infrastructure - Higher costs for maintenance and repair	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy	**Medium**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing damages - Increasing costs for protection and repairs -slight decrease of nature and heritage tourism	**high**	**high**	n/a
Storm	- Damages on touristic infrastructure - Higher costs for maintenance and repair	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy	**Low**	n/a	n/a	n/a	**-**	**-**	n/a

Economy - Small Scale Industry:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Lower efficiency - Cooling problems and higher costs - Shortfall of workers	Consumer, and all small scale industry mainly connected to construction industry and all industries with need for cooling or high water use, transport of bulk commodities, workers, companies, distribution networks (e.g. Porcelani, gjeologjikja, Josif Pashko, Ish Nesheraku, Kombinati (beer brewery), Ish Frigoriferi)	**Medium**	Heat waves - reinforcing in summer	n/a	- Increasing cooling problems (e.g. beer brewery) and energy costs - Increasing number of damages of stocks or equipment or loss of business continuity	**high**	**-**	n/a
Extreme cold	- Damages - Increasing costs, e.g. for heating - Efficiency changes	Consumer, and all small scale industry mainly connected to construction industry and all industries with need for cooling or high water use, transport of bulk commodities, workers, companies, distribution networks (e.g. Porcelani, gjeologjikja, Josif Pashko, Ish Nesheraku, Kombinati (beer brewery), Ish Frigoriferi)	**Medium**	n/a	Extreme cold - balancing in winter	n/a	**-**	**low**	- Decreasing heating costs
Drought	- Water scarcity / cooling problems - Supply problems due to limited bulk transport	Consumer, all industries with need for cooling or high water use, transport of bulk commodities, workers, companies, distribution networks	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Growing water supply problems - Increasing water scarcity / cooling problems	**high**	**medium**	n/a
Heavy precipitation / Floods	- Damages / failures	Josif Pashko and Don Bosko industry	**High**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages of stocks or equipment or loss of business continuity	**very high**	**very high**	n/a
Storm	- Damages / failures	Industries, workers, companies, distribution networks in affected areas	**Low**	n/a	n/a	n/a	**-**	**-**	n/a

Economy - Retail:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Changes in buying behaviour - Sales boost / shortfall	Consumer (access & price level), shop owners, shops in the affected areas city wide	**Medium**	Heat waves - reinforcing in summer	n/a	- Increasing problems with transporation of goods - Increasing costs of cooling (increasing demand for energy) - Changes in buying behaviour -less income for small retail shops	**high**	**-**	- Change in buying behaviour - Sale of different assortment of goods - New market opportunities
Extreme cold	- Changes in buying behaviour - Sales boost / shortfall	Consumer (access & price level), shop owners, shops in the affected areas city wide	**Low**	n/a	Extreme cold - balancing in winter		**-**	**low**	n/a
Drought	- Changes in buying behaviour - Sales boost / shortfall	Consumer (access & price level), shop owners, shops in the affected areas city wide	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Changes in buying behaviour - Less income for small retail shops	**high**	**medium**	n/a
Heavy precipitation / Floods	- Damages / failures - Sales shortfall	Consumer (access & price level), shop owners, shops in the affected areas and more problematic Don Bosko, ish shkolla Teknologjike	**Medium**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing damages and costs for protection and repair - Increasing problems with transport of goods	**high**	**high**	n/a
Storm	- Damages / failures	Consumer (access & price level), shop owners, shops in the affected areas	**Low**	n/a	n/a	n/a	**-**	**-**	n/a

Natural resources - Green spaces:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Dying of plants - Altered behaviour pattern / demands - Higher maintenance costs due to extensive use / water use etc.	Tirana lake park, parks nearby city center, future development area in the northern part of Tirana (tirana river banks)	**High**	Heat waves - reinforcing in summer	n/a	- Increasing number of dying plants - Increasing maintenance costs (mainly watering) - Introduction to forest fire risk	**very high**	**-**	n/a
Extreme cold	- Damages, dying of plants	Tirana lake park, parks nearby city center, future development area in the northern part of Tirana (tirana river banks)	**Medium**	n/a	Extreme cold - balancing in winter	- Increasing damages by vermin as they survive mild winters	**-**	**low**	n/a
Drought	- Dying of plants - Higher maintenance costs, mainly watering - Risk of fires	Tirana lake park, parks nearby city center, future development area in the northern part of Tirana (tirana river banks)	**High**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increasing maintenance costs (mainly watering) - Increasing risk of fire - Increasing number of dying plants - Introduction to forest fire risk	**very high**	**high**	n/a
Heavy precipitation / Floods	- Damages on infrastructure and plants	tirana lake park, parks nearby city center, future development area in the northern part of Tirana (tirana river banks)	**Medium**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages on infrastructure and plants - Increasing maintanance costs	**high**	**high**	n/a
Storm	- Damages on infrastructure and plants	n/a	**Medium**	n/a	n/a	n/a	**-**	**-**	n/a

Natural resources - Water resources and quality:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Higher evaporation / higher water uptake by ecosystem / lower water flows - Spread of algae, bacteria - Altered fauna - Lower groundwater recharge	Tirana wide, groundwater resources and surface water (river, lake)	**High**	Heat waves - reinforcing in summer	n/a	-Growing spread of algae, bacteria -Reduction of water quality (e.g. algae bloom) -General low groundwater recharge -Increasing evaporation / high water uptake by ecosystem / low water flow	**very high**	**-**	n/a
Extreme cold	n/a	n/a	0	n/a	Extreme cold - balancing in winter	- More vermin survive in mild winters	**-**	**-**	n/a
Drought	- Lower water flows / lower groundwater recharge - Salinisation	Tirana wide, groundwater resources and surface water (river, lake)	**High**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Growing spread of algae, bacteria -Reduction of water quality (e.g. algae bloom) -General low groundwater recharge -Increasing evaporation / high water uptake by ecosystem / low water flow - Water shortage - Decreasing water flows / low groundwater recharge	**very high**	**high**	n/a
Heavy precipitation / Floods	- Water quality problems/sewage overflow	Tirana wide, groundwater resources and surface water (river, lake)	**Medium**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	-Increasing water problems: Quality of surface water and ground water -Pollution of water due to flood sediments	**high**	**high**	n/a
Storm	- Water quality problems	Ecosystem in affected areas	**Medium**	n/a	n/a	n/a	**-**	**-**	n/a

Natural resources - Air quality:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Spread of diseases - Smog / higher concentration of air pollutants and allergens	Tirana wide, especially in the densily populated areas like main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, 21 Dhjetori Crossroad, Zogu I Zi crossroad.	**High**	Heat waves - reinforcing in summer	n/a	- Increasing spread of diseases - Reinforcement of smog - Increasing concentration of air pollutants and allergens - Increasing costs for mitigation measures (e.g. street washing by water tank vehicles)	**very high**	**-**	n/a
Extreme cold	n/a	n/a		n/a	Extreme cold - balancing in winter	n/a	**-**	**-**	n/a
Drought	- Smog / higher concentration of air pollutants and allergens	Tirana wide, especially in the densily populated areas like main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, 21 Dhjetori Crossroad, Zogu I Zi crossroad.	**High**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increasing spread of diseases - Reinforcement of smog - Increasing concentration of air pollutants and allergens	**very high**	**high**	n/a
Heavy precipitation / Floods	n/a	Tirana wide, especially in the densily populated areas like main entry nodes in Tirana as well as main arteries like Durrësit str, Kavaja str, Elbasan str, 21 Dhjetori Crossroad, Zogu I Zi crossroad, Don Bosko		Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	n/a	**-**	**-**	- Decrease costs of street cleaning
Storm	n/a	n/a		n/a	n/a	n/a	**-**	**-**	n/a

Natural resources - Agriculture:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	n/a	n/a	0	Heat waves - reinforcing in summer	n/a	n/a	-	-	n/a
Extreme cold	n/a	n/a	0	n/a	Extreme cold - balancing in winter	n/a	-	-	n/a
Drought	n/a	n/a	0	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	n/a	-	-	n/a
Heavy precipitation / Floods	n/a	n/a	0	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	n/a	-	-	n/a
Storm	n/a	n/a	0	n/a	n/a	n/a	-	-	n/a

Natural resources - Forestry:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Changes in growth cycle (decrease in growth or drying of wood) - Possibility of a fire	Tirana lake park	Medium	Heat waves - reinforcing in summer	n/a	- Decreasing number of species - Increasing risk of fire - Changes in growth cycle - Increasing number of infestation of pests - Increasing damages / dying of plants - Growing need of irrigation - Increasing number of loss of harvest	high	-	- Growing of new species - Better conditions for specific species - Formation of ground for trees who need aridity
Extreme cold	- Mortality of trees	Tirana lake park	Medium	n/a	Extreme cold - balancing in winter	- Vermin survive mild winters and cause damages	-	low	- Better conditions for specific species
Drought	- Damages / dying of trees	Tirana lake park	High	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increasing damages / dying of trees - Loss of drought sensitive species	very high	high	- Thrive of drought resistant species - Settlement of new species
Heavy precipitation / Floods	- Damages / dying of trees - Spoiling of water bodies and soil quality - Damage to the root system - Erosion of forest land	Tirana lake park	Medium	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Increasing number of damages - Increasing number of altered flora and fauna, new invasive species	high	high	n/a
Storm	- Damages / dying of trees	n/a	Medium	n/a	n/a	n/a	-	-	n/a

Natural resources - Bio-diversity / eco-systems:

Weather sensitivity	Potential effects	Who is affected / What is affected	Current vulnerability	CC impact - spring and summer	CC impact - autumn and winter	Future risk	Future risk - summer	Future risk - winter	Future opportunity
Heat wave	- Altered flora and fauna, new & invasive species - Loss of species - Mortality of flora and founa	All flora and fauna with low adaptive capacity, ecosystem in Tirana lake park, Tirana river, botanical garden and Zoological garden	**Medium**	Heat waves - reinforcing in summer	n/a	- Increasing loss of some species - Increasing reduction of diversity of species - Increasing number of altered flora and fauna, new (invasive) species	**high**	**-**	- Growing of new species - Better conditions for specific heat resistant species
Extreme cold	- Reduced food source for animals	All flora and fauna with low adaptive capacity, ecosystem in Tirana lake park, Tirana river, botanical garden and Zoological garden	**Medium**	n/a	Extreme cold - balancing in winter	n/a	**-**	**low**	- Better conditions for specific species
Drought	- Altered flora and fauna, new & invasive species - Loss of species - Mortality of flora and founa	All flora and fauna with low adaptive capacity, ecosystem in Tirana lake park, Tirana river, botanical garden and Zoological garden	**Medium**	Drought - reinforcing in summer	Drought - indifferent in autumn and winter	- Increasing loss of some species - Increasing reduction of diversity of species - Increasing number of altered flora and fauna, new (invasive) species	**high**	**medium**	- Growing of new species - Better conditions for specific species
Heavy precipitation / Floods	- Altered flora and fauna, new & invasive species - Loss of species - Torrential streams	All flora and fauna with low adaptive capacity, ecosystem in Tirana lake park, Tirana river, botanical garden and Zoological garden	**Low**	Heavy precipitation / Floods - reinforcing in summer	Heavy precipitation / Floods - reinforcing in winter	- Damages to existing habitat and ecosystem - Increasing loss of some species (locally) - Increasing reduction of diversity of species	**medium**	**medium**	- Establishment of new habitat (e.g. in flood plains) like temporary ponds
Storm	- Loss of natural resources	All flora and fauna with low adaptive capacity, ecosystem in Tirana lake park, Tirana river, botanical garden and Zoological garden	**Low**	n/a	n/a	n/a	**-**	**-**	n/a

Annex D:

List of SG and WG / SHG meetings

Date / mission	Kind of meeting
29./30. Jan 2014	1st RWG meeting in Brussels
24.-26. Feb. 2014 Fact Finding Mission	- SG-meetings - Single (bilateral) meetings with representatives of municipality and stakeholders
14.-16. Jul 2014 Mission 2	- 1st WG-meeting - SG-meetings - Single (bilateral) meetings with representatives of municipality and stakeholders
12.-23. Oct. 2014 Mission 3	- 2nd WG-meeting - SG-meetings - Single (bilateral) meetings with representatives of municipality and stakeholders
10.-13. Feb. 2015 Mission 4	- 3rd WG-meeting - SG-meetings - Single (bilateral) meetings with representatives of municipality and stakeholders
25./26. Feb. 2015	2nd RWG meeting in Belgrade
17.-19. Mar. 2015 Mission 5	- SG-meetings - Single (bilateral) meetings with representatives of municipality and stakeholders
13.-15. Apr. 2015 Mission 6	- 4th WG-meeting - SG-meetings - Single (bilateral) meetings with representatives of municipality and stakeholders
21.-23. Apr. 2015	- Final event (presentation of project results) - SG-meetings

Annex E:

Fact sheet of Case Studies

1	
Name	**City center South West (Komuna e Parisit / Medar Shtylla street)**
Statistical Data	
Size of area (ha)	12.54
Land uses / urban characterisation	Residential area
Main building period (age)	7-14 years
Green spaces (% of area)	Less then 10 %, fragmentized green spaces
Open water / streams	-----
Air quality	Medium
Inhabitants (ca.)	8612
Density (persons/ha)	687
Persons > 65 years (%)	~ 11.05 (calculation based on city average)
Persons < 10 years (%)	~ 12.2 (calculation based on city average)
Social level	Upper / medium / lower / no significance

Characterisation (description) of the climate relevant situation: Urban Structure / Texture / Buildings		Potential Relevance
Urban texture (elevations)	It is a residential area with different elevations for buildings as given below: 1-3 fl = 32 %, 4-6 fl = 12.5 %, 7-9 fl = 21.5 %, 10-13 fl = 34 %	++
Building density (compactness)	1,76 m² living area/m²	++
Main material of surfaces (or: %)	Buildings: plaster, glass, bricks, concrete Roofs: dark black made of tar Steets / sidewalks / squares: asphalt	++
Technical standards of buidlings	There is insufficient information about the insulation or the quality of insulation in the new buildings (68 % of total number of buildings) , while the old buildings have no insulation.	++
Main Color of surfaces	Buildings: almost beige, brown, gray, the buildings are mainly new Roofs: dark black made of tar Steets / sidewalks / squares: asphalt	+
Amount of air conditioning [%]	Air conditioning is used in about 95 % of buildings / apartments	O
Green areas; green structures	Green structures are not developed. Green areas not within the studied area	+
Water in the city (areas, risks)	-----	O
Urban squares; paved / unpaved	Most squares are paved with concrete tiles	+
Ventilation corridors	Ventilation only along the roads. No surveys has been carried out for the other parts in the area and the buildings do not follow a certain pattern	O

Infrastructure		Potential Rlevance
Sensitive punctual infrastruct. (e.g. hospitals, child care, elderly homes, etc.)	In the area are 2 private kindergartens, "Maria Mazzarello" Social Center, "Kristaq Rama" School, International Montessori School of Albania and New York University	++
Offices (public, private)	There are no public or private offices	-
Water supply system (important installations, observation, works)	The area has a good coverage of the water supply coming from the Partitari Tank and the water pipe diameter is 426 mm. The materials used for the water pipes are mixed starting from steel, cast-iron, and polyethilene. In this area some interventions are done for reconstructions of water pipes.	-
Water drainage system (important installations, observation, works)	The water drainage system is existing in the area and there are no special installations.	-
Energy infrastructure	No major problem during summer time. Some problems appear in winter due to increasing engery demand (e.g. occasional breakdowns).	O
Public Transport	The main traffic line that pass by this area is Qendra Kristal to Qender. This line is licenced from Farka Commune. There is no documenation about pubic transportation affected by weather events.	-
Individual Transport	The main axes of this road face high fluxes of traffic jam mainly in the peak hours (morning and afternoon). In case of heavy rainfall, the amount of the cars used gets increased creating so a traffic jam. The area that gets affected the most is the axe of Medar Shtylla and its connection with the big Ring of the City.	-
Sport areas, recreation	There are sportive or recreational areas	-
Touristic Infrastructure	There is no touristic infrastructure within the case study area.	-

* Relevance for VA-scoping (potential heat sensitivity): ++ High OO → Medium - - Low

Summary of highest vulnerabilities (objects, areas, situations) - marked map if possible

Object / Area / Situation (Receptor)	Vulnerab.*	Potential impact of CC (today / in future)	Risk	Comment
Population (public health / vulnerable groups): Sidewalks and public places / squares (there is direct sunlight, no green / shade and no air circulation)	+	Heat wave related effects to elderly, sick people or children might worsen during the day (heat stress).	+	
Population (public health / vulnerable groups): Dense building structure (heat islands and no air circulation). Special focus on social infrastucture (schools, kindergardens, etc.)	+	Heat wave related effects to elderly, sick people or children might worsen during hot days and tropical nights (heat stress/no recovering). Speicial public builidngs: Montesori School, New York University.	+	
Infrastructure (water supply and sanitation services): area wide	+	Heat wave/ drought related effects might stress even more water resources (potential deficit on water supply). Water discharge could also be affected (sediments / blocking due to lack of constant water flow).	+	
Infrastructure (social infrastructure): Hospitals, homes for the elderly, nurseries, schools, public spaces, sport complexes city council, Montesori School, New York University.	+	Heat wave related effects, like: - Changes in behaviour pattern, e.g. living outdoors - Altered demands / higher costs, e.g. for cooling - Higher crime rate (conflicts, accidents…) - More patients in hospitals - Higher maintenance costs for public spaces (waste disposal, watering of parks etc.)	+	
Infrastructure (electricity services): Energy supply for the whole area	O	Heat wave related effects: - Increasing demand for energy expected during summer (air conditioning) - Expected decrease in energy demand in winter (due to balancing effect of temperture trend).	O	
Natural resources (air quality): Main streets and crossroads in the area	+	Heat wave related effects in combination with heavy traffic and narrow roads might worsen air quality.	+	

* Estimated current vulnerability / ** estimated future risk: ++ High OO → Medium - - Low

Measures / Actions to reduce the risk

Object / Area (Receptor) at risk	Possible measure / action	Chance / Impact *	Comment (link to other / cross-cutting)
Population (public health / vulnerable groups): Sidewalks and public places / squares (there is direct sunlight, no green / shade and no air circulation)	Along the sidewalks should be created continues canopy shades. This can be achieved through the implementation of 4 technical conditions on designing of urban green areas: 1. Selection of high tree species which can create wide and dense crown. 2. Planting of trees in a small distance from each other in such a way that their crowns can be as close and provide a continues shade over a bigger area during the sunny hours. 3. Continues pruning of the highest tree branches and leaving the side branches, aiming so the tree growing into the horizontal direction, always without causing problems for the vehicles using the street. 4. Designing tree limits in the same level as the sidewalk to maximise the walking surface and the number of pedestrians, and especially to give the conditions that the baby prams move freely in the shaded sidewalk. Introduce green streets, green public spaces, water-penetrating concrete with light colors for sidewalks and public spaces/squares.	+	Crosslink with "Build environment" (building stock and materials). Other measures needed as well, such as public awareness, training and know how on CC adaptations including landscape ecology and landscape architecture, better planning of roads, public spaces, etc.

Population (public health / vulnerable groups): Dense building structure (heat islands and no air circulation). Special focus on social infrastucture (schools, kindergardens, etc.) Special focus on social infrastucture (schools, kindergardens, etc.)	Introducing building insulation, white / green roofs, green walls or white/self-cleaning facades: - Identifying of the south and southwest sides of the buildings. In this cases there are only two options: 1. If these sides are windowless walls, then it should be encouraged to create green walls. 2. If these sides have windows, then it shoud be encouraged the installation of brise soleil to create more shades for the windows and balkonies. For the latter one, can be designed a project in order that they are unified for the whole area, using it also as the same decorative element for the area. - There should be encouraged through local government projects, the placement of the trees in the vases on the roofs of the buildings, in order to decrease a bit the heat. The used plant species should be heat resistant and also the vases shoyld be resistant to the strong wind during the winter season. - For the new areas which are still undeveloped, should be ensured since in the design phase and urban development in order to guarantee the circulation of the airflow.	+	New requirements and regulations on building insulation are needed. Non-structural measures are also needed such as public awareness, training and know how on CC adaptations including landscape ecology and landscape architecture, better planning of roads, public spaces, etc.
Infrastructure (water supply and sanitation services): area wide	- Renewing the sanitation systems. - Providing more funds for maintenance of sewer, manholes and pumping stations.	+	Crosslink with "Population". Other measures needed as well: Updating the know-how of technical staff in the Municipality on the technical requorements for rainwater collection systems vis-a-vis wastewater systems. Upgrading the preparedeness systems
Infrastructure (social infrastructure): Hospitals, homes for the elderly, nurseries, schools, public spaces, sport complexes city council, Montesori School, New York University.	- Improving the landscape architeture of the area by planing high trees with continuous canopy structure and other green-blue measures (e.g. fountain) in the courtyard of the schools and public places. - Introduction of building insulation, white/green roofs, green walls	+	Crosslink with "Population". Other measures needed as well: Improve know-how on Landscape Ecology and Landscape Architecture. Public awarenness and education at schools. New requirements and regulations on building insulation should be introduced.
Infrastructure (electricity services): Energy supply for the whole area	The use of alternative renewable energies should be supported, such as the use of solar panels. Ensure thermal insulation of building to lower the energy demand. Introduce alternative heating for families.	+	Public awarenness and education at schools. Usage of alternative energies should be encouraged.
Natural resources (air quality): Main streets and crossroads in the area	- Better planning for road standards. Revise and adjust transport system (e.g. Better traffic control. - Introducing green streets, green roofs / walls and green-blue public spaces. - Avoiding creation of dust during street cleaning especially in summer. Improving street cleaning technology. Watering the streets daily to remove pollutants and dust. Introcuding waterworks (e.g. fountain) in the urban public space.	+	Setting up a monitorying station for air quality and basic meterological data that can be managed jointly with the schoolkids.

* Level impact / chance to reduce the risk: ++ High OO → Medium - - Low

Ongoing projects in the area with potential synergies with adaptation measures

Category / kind of project	Description	Synergies / recommendation to use synergies
Requalification project	Building up a node (roundabout) in the crossection between Medar Shtylla street and Skender luarasi street.	
Urban Requalification	The pdv unit 5-32 is part of an urban Recualification project, the building block created as part of Sulejman Delvina Street, Medar Shtylla Street, Skender Luarasi street.	

Additional / summarising recommendations for the area

Maps of the area

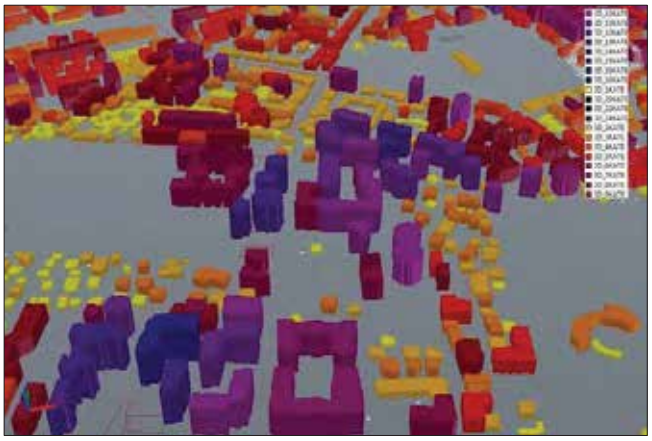
Satelite Image: urban situation

Master Plan: Land use / buildings / green areas / etc.

Mixed usage: residential

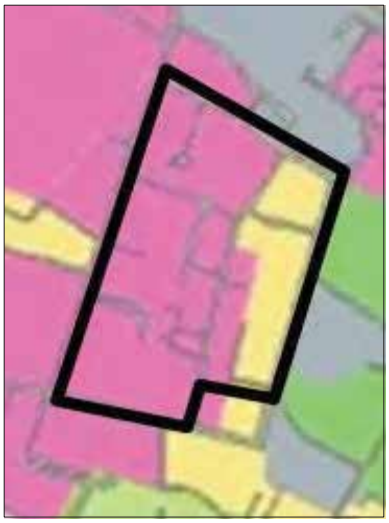
Single usage: Residential usage

Urban texture / hight (or density) of buildings



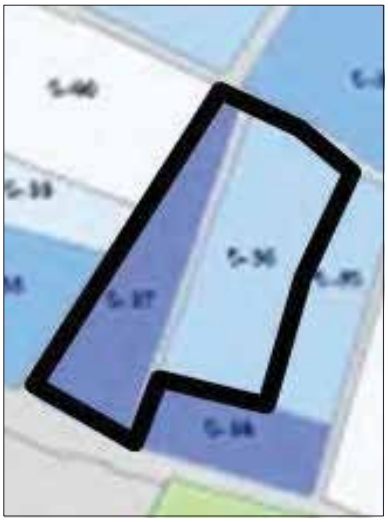
Map of existing green territories and local general plan

Existing settlement typologies



- Compact area with low buildings
- Developing Area with high buildings
- Area with mixed type of buildings
- Developed area with high buildings
- Non residential area

Population - Density



- 201 - 400 in/ha
- 401 - 600 in/ha
- 601 - 800 in/ha
- 801 - 1200 in/ha

2	
Name	**Lana River Neighbourhood**
Statistical Data	
Size of area (ha)	14.13
Land uses / urban characterisation	Residential area and Public Services
Main building period (age)	< 25 years
Green spaces (% of area)	~ 30 % of the total area; potential from Lana River
Open water / streams	Lana River: open narrow channel
Air quality	no significance
Inhabitants (ca.)	3673
Density (persons/ha)	260
Persons > 65 years (%)	11.5
Persons < 10 years (%)	12.2
Social level	Upper / medium / lower / no significance

Characterisation (description) of the climate relevant situation: Urban Structure / Texture / Buildings		Potential Relevance
Urban texture (elevations)	Mixed use area with different types of buildings (main parts of the buildings are informal developments): 1-3 fl = 61.7 % , 4-6 fl = 17.15 %, 7-9 fl = 18.15 %, 10-12 fl = 3 %	-
Building density (compactness)	0,64 m² living area/m²	-
Main material of surfaces	Buildings: plaster, glass, bricks, concrete Roofs: dark black made of tar Steets / sidewalks / squares: asphalt	+
Technical standards of buildings	There is insufficient information about the insulation or the quality of insulation in the higher buildings (38.3 % of total number of buildings), while in the old buildings the insulation does not exist at all.	-
Main Color of surfaces	The main colors of the surfaces: almost beige, brown, gray Roofs: dark black made of tar Steets / sidewalks / squares: asphalt	-
Amount of air conditioning (%)	Air conditioning is used in about 65 % of buildings / apartments	-
Green areas; green structures	Green areas with untreated low vegetation	+
Water in the city (areas, risks)	Lana River flows in a narrow channel (trapezium-shaped cross-sections). The stream floods regualrily the banks, gardens and houses along the channel (1-2 times every 5 years; sometimes yearly); individual protection measures were taken (small wall along the channel, banks reinforced with concrete, channel was narrowed partly to lift the bank level).	++
Urban squares (paved / unpaved)	------	-
Ventilation corridors	Lana River functions as corridor (South-North); relatively narrow	-
Social level (indicative / tendency)	Lower than medium; partly (there are mainly poor settlements, but also some new buildings)	O

Infrastructure		Potential Rlevance
Sensitive punctual infrastruct. (e.g. hospitals, child care, elderly homes, etc.)	In the area there is "Eurovision" Private school	-
Offices (public, private)	There are no public or private offices within the case study area.	-
Water supply system (important installations, observation, works)	The area has a good coverage of the water supply coming from Bovilla drinking water plant and the new Tank of Tirana. The materials used for the water pipes are mixed (steel, cast-iron, and polyethilene).	-
Water drainage system (important installations, observation, works)	The water drainage system is existing in the area but there are also some parts with illegal settlements (on the left bank of the river) and some of the buildings are using septic tanks.	+
Energy infrastructure	-----	-
Public Transport	The main traffic lines that pass by this area are the ones that pass in the main streets like the line " Kombinat - Kinostudi" , the line "Qendër - Sharrë " and some suburban lines. In teodor Keko street it passes the "tirana e Re" line. There is no documenation about pubic transportation affected by weather events.	O
Individual Transport	The most affected area is the one of the "Bread Industry " node (very long traffic lines, even though the transport is directly controled via traffic light by the traffic center control). In this node the predicted solution is to create a node with different levels as part of the "Outer Ring of Tirana" project.	O
Sport areas, recreation	No sportive or recreation areas	-
Touristic Infrastructure	No touristic infrastructure	-

* Relevance for VA-scoping (potential flood sensitivity): ++ High OO → Medium - - Low

Summary of highest vulnerabilities (objects, areas, situations) - marked map if possible

Object / Area / Situation (Receptor)	Vulneralb.*	Potential impact of CC (today / in future)	Risk	Comment
Infrastructure (transport): Bridge Rruga e Kavajës (Lana River)	O	Heavy precipitation / floods related effects: - Damages, blockings, sediments - Increasing mainanace cost	O	Take into account increasing flood impacts due to CC while planning of underpass between the Big Ring and Kavaja Street.
Infrastructure (water supply and sanitation services): Lana River (northern part of Rruga e Kavajës)	+	Heavy precipitation / floods related effects: - Drainage and sewage system: blocking, overflow, backwater in sewage system - Increasing mainanace cost	+	
Build environment (building stock and materials): settlements along Lana river bank (northern part of Rruga e Kavajës)	+	Heavy precipitation / floods related effects: - Damage of buildings, sheds, gardens, etc. - Informal settlements (uncontrolled construction)	+	
Natural ressources (water resources and quality): Lana River (northern part of Rruga e Kavajës)	+	Heavy precipitation / floods related effects: - Flooding of river banks, due to insufficient depth of riverbed, not enough space / width of the river meander, potential high groundwater level Heat wave related effects: - The increasing temperatures cause lower water quality (oxygen-rate)	+	Consideration of flood impacts in development / intervention plans.

* Estimated current vulnerability / ** estimated future risk: ++ High OO → Medium - - Low

Measures / Actions to reduce the risk

Object / Area (Receptor) at risk	Possible measure / action	Chance / Impact *	Comment (link to other / cross-cutting)
Infrastructure (transport): Bridge Rruga e Kavajës (Lana River)	Clean regularly the bridge from wood, waste and other obstacles; these create more urban floods than “normal situations".	+	Consdideration of CCA aspects within urban development plans.
Infrastructure (transport): Cross Road: Rruga Teodor Keko and Rruga e Kavajës (planned redign with new underpass or fly-over)	The planned redesigning of the crossroad foresees two alternatives: a fly-over or an underpass. When further designing the measure flood risk of Lana River should be considered. By creating sufficient retention areas for the Lana River downstream of the bridge the flood risk (overflow, infiltration) for both alternatives can be eliminated.	+	Adjustment of street planning to the adaptations needs; adjustment of Lana river training in combination with the redesign of the crossroad Rruga Teodor Keko / Rruga e Kavajës
Infrastructure (water supply and sanitation services): Lana River (northern part of Rruga e Kavajës)	Prevent backwaters from river that cause blocking of the sewage system, see flood protection measures below.	+	Crosslink to natural ressources (water resources and quality).
Build environment (building stock and materials): settlements along Lana river bank (northern part of Rruga e Kavajës)	- Renew the river banks to keep the water course away of building stock. - Protection of settlements from floods via technical protection measures (e.g. deepen / extend the riverbed)	+	Prevention of illegal constructions via appropriate regulations
Natural ressources (water resources and quality): Lana River (north of bridge of Rruga e Kavajës)	- Reconstruct the lowered banks of the river, foresee a little “dam” (some 20-50 cm); the height should be similar throughout the river stretch. Even more important are small retention area in the meanders. - The river should meander and have steps in the river bed to slow down (give room to the river / let develop in limits) - Avoid straightening of the river and putting into trapezoid-profile - Protect river banks from buildings and constructions via official regulations - Regular maintenance to avoid blocking / sediments - Vegetation along the river should give shadow to the river banks and the river to cool down the water temperature (for water quality aspects) - Natural flow to enable self-cleaning effects by rasing the oxygen-rate	+	Consdideration of CCA aspects within urban development plans. Adjustment of regulations regarding river protection measures, maintanance and monitoring. Awareness raising via campaigns, meetings, etc.

* Level impact / chance to reduce the risk: ++ High OO → Medium - - Low

Ongoing projects in the area with potential synergies with adaptation measures

Category / kind of project	Description	Synergies / recommendation to use synergies
Urban Requalification	Creation of the street infrastructure and engineering net system in the unit 7-14 as part of the project of Urban Recualification (defined from Nga Kavaja street, Babë Rexha street, Ferdinand Deda street and Lana river.	

Additional / summarising recommendations for the area

The area, the assessment results regarding CC-impacts and the potential measures can be transferred to different other parts of Lana River. Especially the general approach not to straighten the river but to improve retention, meandering and protective measures can be realisaed accordingly.

Maps of the area

Satelite Image: urban situation

Master Plan: Land use / buildings / green areas / etc.

Mixed usage: residential use and public service

Single usage: Residential usage

Urban texture / height (or density) of buildings

Map of existing green territories and local general plan

Existing settlement typologies

Developing area with high buildings

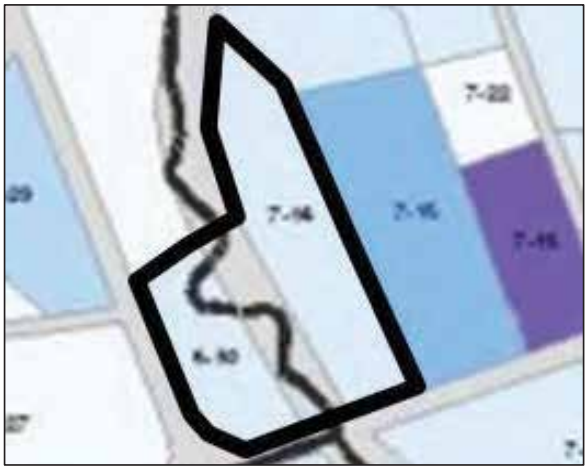
Area with natural usage

Compact area with low buildings

Medium compact area with medium height buildings

Area with low

Population - Density



201 - 400 in/ha

0 - 200 in/ha

3	
Name	**West-City-Center area**
Statistical Data	
Size of area (ha)	6
Land uses / urban characterisation	Residential area and Public Services
Main building period (age)	> 50 years
Green spaces (% of area)	Circa 2%
Open water / streams	---
Air quality	Poor
Inhabitants (ca.)	3293
Density (persons/ha)	549
Persons > 65 years (%)	11.5
Persons < 10 years (%)	12.2
Social level	Upper / medium / lower / no significance

Characterisation (description) of the climate relevant situation: Urban Structure / Texture / Buildings		Potential Relevance
Urban texture (elevations)	Mixed use area with different types of buildings: 1-3 fl = 55.17 %, 4-6 fl = 39.66 %, 7-9 fl = 0 %, 10-11 fl = 5.17 %	+
Building density (compactness)	1.65	+
Main material of surfaces (or: %)	Buildings: plaster, glass, bricks, concrete Roofs: dark black made of tar Steets / sidewalks / squares: asphalt	+
Technical standards of buidlings	There is insufficient information about the insulation or the quality of insulation in the new buildings (5.17 % of total number of buildings), while the old buildings have no insulation.	+
Main Color of surfaces	Main colors of surfaces: almost beige, red, yellow, white, brown, gray, mainly old renovated buildings Roofs:dark black made of tar Steets / sidewalks / squares: asphalt	+
Amount of air conditioning [%]	Possibly 95 % of buildings/apartments	O
Green areas; green structures	no green areas	+
Water in the city (areas, risks)	-----	-
Urban squares; paved / unpaved	Urban squares are mostly paved with concrete tiles	+
Ventilation corridors	-----	O
Social level (indicative / tendency)	upper than medium / lower than medium / average / low / high / not significant	-

Infrastructure		Potential Rlevance
Sensitive punctual infrastruct. (e.g. hospitals, child care, elderly homes, etc.)	Polyclinic no. 9, "Mehmet Akif" school, kindergarten no. 24, kindergarten no. 43 and "Sabaudin Gabrani" school.	+
Offices (public, private)	Police station no. 2, Tirana District council, Tirana district prefecture, Municipality unit no.7, National Agency for privatization, Indipendent trade unions, the post office, Tirana Bank, Credins Bank and Raiffeisen Bank	+
Water supply system (important installations, observation, works)	The water supply system in this areas is an open network. The materials used for the water pipes are mixed starting from steel, cast -iron and polyethilene. In this area are done some interventions for reconstructions of water pipes. The area has a good coverage of the water supply coming from Bovilla drinking water plant and the line Tirana-center.	-
Water drainage system (important installations, observation, works)	The water drainage system is existing in the area and there are no special installations.	-
Energy infrastructure	-----	-
Public Transport	The lines of the public transport are: "Kombinat - Kinostudio", "Main Ring", "Qendër - Sharrë" and some other suburban lines. In Teodor Keko street it passes the "Tirana e Re" line. There is no documenation about pubic transportation affected by weather events, but there have been some traffic and small delays in transportation especially when it rained a lot and the traffic was busier due to also the individual transport.	O
Individual Transport	During rainy days the transport system gets busier due to the fact that there is an intersection of the two main arteries (the ring with the Kavaja street). The increased number of individual cars as a result of an increased transportation need has created traffic lines and traffic paralysis.	+
Sport areas, recreation	There are no sportive areas or recreational areas.	-
Touristic Infrastructure	There is no touristic infrastructure.	-

* Relevance for VA-scoping (potential heat sensitivity): ++ High OO → Medium - - Low

Summary of highest vulnerabilities (objects, areas, situations) - marked map if possible

Object / Area / Situation (Receptor)	Vulnerab.*	Potential impact of CC (today / in future)	Risk	Comment
Population (public health / vulnerable groups): Sidewalks and urban public places / squares (there is direct sunlight, no continuous green / shaded areas for pedestrians).	+	Heat wave related effects to elderly, sick people or children might worsen during the day (heat stress).	+	
Population (public health / vulnerable groups): Dense building structure (heat islands). Special focus on social infrastucture (schools, kindergardens, etc.)	+	Heat wave related effects to elderly, sick people or children might worsen during hot days and tropical nights (heat stress/no recovering). Special public builidngs: Sabaudin Gabrani School, Turgut Ozal college.	+	
Infrastructure (transport): Main streets and crossroad in the area	+	Increased traffic expected combinded with increased heat waves impacst. - Negative effects on air quality, smog / dust exposure - Traffic behaviour might change and alternative means of transport.	+	
Infrastructure (electricity services): Energy supply of the whole area	O	Heat wave related effects: - Increasing energy demand expected during summer (air conditioning) - Expected decrease in energy demand in winter (due to balancing effect of temperture trend)	O	
Infrastructure (social infrastructure): Schools, public spaces, city buildings (e.g. Prefecture building and police station)	+	Heat wave related effects, like: - Changes in behaviour pattern, e.g. living outdoors - Altered demands / higher costs for cooling - Higher maintenance costs for public spaces (waste disposal, watering of parks etc.)	+	
Build environment (building stock and materials): Area wide	+	Heat wave related effects, like: - Increasing number of damages, e.g. on asphalt - Increasing need for standard of protection - Reinforcement of heat island effect, risk of overheating - Increasing maintenance costs and need for cooling	+	
Natural resources (air quality): Main streets and crossroads in the area	+	Heat wave related effects in combination with heavy traffic and narrow roads might worsen air quality.	+	

* Estimated current vulnerability / ** estimated future risk: ++ High OO → Medium - - Low

Measures / Actions to reduce the risk

Object / Area (Receptor) at risk	Possible measure / action	Chance / Impact *	Comment (link to other / cross-cutting)
Population (public health / vulnerable groups): Sidewalks and urban public places / squares (there is direct sunlight, no continuous green / shaded areas for pedestrians).	- Improve urban design and planning to introduce new environmental elements. - Introduction of shrubby vegetation that can serve as filters to devide road from sidewalks, creating a continuous canopy shaded area for pedestrians through planting high tree species which can create wide and dense canopy. - Introduce new measures including green streets, green-blue public open spaces, water-penetrating concrete with light colors for sidewalks and public spaces / squares. - When obligatory greening is planned with new underground parking the design has to ensure "functional green structures" (cooling, spending shaddow); just green (gras) is not supportive. Investors shall have the obligation to ensure the functions (sufficient depth of coverage to plant trees at least is some parts has to be required).	+	Crosslink with "Build environment - building stock and materials". Other measures needed as well, such as public awareness, training and know how on CCA including landscape ecology and architecture, better planning of roads, public spaces, etc.
Population (public health / vulnerable groups): Dense building structure (heat islands). Special focus on social infrastucture (schools, kindergardens, etc.)	- Introducing building insulation, white / green roofs, green walls or white / self-cleaning facades and waterworks (e.g. fountain) in the urban public space. - Identifying the south and southwest sides of the buildings: creation of green walls in the windowless walls, or vegetation cover through continuous canopy in the areas that have windows and balkonies. - Green roofs and vegetationi in terraces (e.g. placement of the trees in the vases on the roofs of the buildings) should be encouraged. The used plant species should be heat resistant and also the vases shoyld be resistant to heat and strong winds.	+	New requirements and regulations on building insulation are needed. Non-structural measures also needed, such as public awareness, training and know how on CCA including landscape ecology and architecture, better planning of roads, public spaces, etc.

Infrastructure (transport): Main streets and crossroad in the area	- Better planning for road standards. Revise and adjust transport system (e.g. better traffic control). - Introducing green street design including green vegetation filters. - Watering the streets daily to remove pollutants and dust.	+	Public awarenness and education at schools. Providing training and know how on CCA including landscape ecology and architecture, better planning of roads, public spaces, etc.
Infrastructure (electricity services): Energy supply of the whole area	- The use of alternative renewable energies should be supported, such as the use of solar panels. Introduce alternative heating for families. - Ensure thermal insulation of building to lower the energy demand.	+	Public awarenness and education at schools. Usage of alternative energies should be encouraged.
Infrastructure (social infrastructure): Schools, public spaces, city buildings (e.g. Prefecture building and police station)	Introduction of building insulation, white / green roofs, green walls or white / self-cleaning facades and planting vegetation in courtyards if possible.	+	Improved know-how on Landscape Ecology and Architecture. Public awarenness and education at schools. Introduce new requirements and regulations on building insulation.
Build environment (building stock and materials): Area wide	Introduce new measures including: green walls, green roofs and vegetation in terraces, green fences, water-penetrating concrete with light colors for sidewalks and public spaces/squares.	+	Improved urban design and planning standards. New requirements and regulations on building insulation are needed. Providing training and know how on CCA including landscape ecology and architecture.
Natural resources (air quality): Main streets and crossroads in the area	- Better planning for road standards. Revise and adjust transport system (e.g. better traffic control). - Introducing green streets and green-blue public spaces. - Avoiding creation of dust during street cleaning especially in summer. Improving street cleaning technology. Watering the streets daily to remove pollutants and dust.	+	Setting up a monitorying station for air quality and basic meterological data that can be managed jointly with the schoolkids.

* Level impact / chance to reduce the risk: ++ High OO → Medium - - Low

Ongoing projects in the area with potential synergies with adaptation measures

Category / kind of project	Description	Synergies / recommendation to use synergies
Urban Requalification	Creation of street infrastructure, engineering net system and urban furnishing as part of the project " Urban Requalification of the block" defined from Kavaja Street - Muhamet Gjollesha Street - Myslym Shyri Street and Municipality unit 10.	

Additional / summarising recommendations for the area

Maps of the area

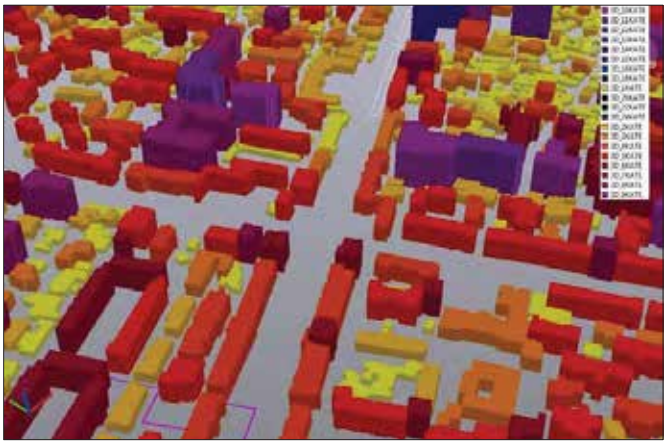
Satelite Image: urban situation

Master Plan: Land use / buildings / green areas / etc.

Mixed usage: residential

Single usage: Residential usage

Urban texture / height (or density) of buildings



Map of existing green territories and local general plan

Existing settlement typologies

Compact area with low buildings

Developing Area with high buildings

Area with mixed type of buildings

Developed area with high buildings

Non residential area

Population - Density

201 - 400 in/ha

401 - 600 in/ha

601 - 800 in/ha

801 - 1200 in/ha

add othe maps if nescessary

4	
Name	**Urban Area (Don Bosko Street)**
Statistical Data	
Size of area (ha)	6.45
Land uses / urban characterisation	Residential area and Public Services
Main building period (age)	> 25 years
Green spaces (% of area)	Less then 5 %
Open water / streams	---
Air quality	---
Inhabitants (ca.)	3353
Density (persons/ha)	520
Persons > 65 years (%)	11.5
Persons < 10 years (%)	12.5
Social level	Upper / medium / lower / no significance

Characterisation (description) of the climate relevant situation: Urban Structure / Texture / Buildings		Potential Relevance
Urban texture (elevations)	Mixed use area with different types of buildings: 1-3 fl = 41.4 %, 4-6 fl = 19.7 %, 7-9 fl = 38.9 %, 10-13 fl = 0 %	-
Building density (compactness)	1.34	-
Main material of surfaces (or: %)	Plaster, glass, bricks, concrete, there are mainly new buildings.	O
Technical standards of buidlings	There is insufficient information about the insulation or the quality of insulation in the new buildings (58.6 % of total number of buildings), while the old buildings have no insulation.	-
Main Color of surfaces	Main colors of surfaces: almost beige, white, brown, gray, and the buildings are new buildings Roofs: dark black made of Tar Steets / sidewalks / squares: asphalt	+
Amount of air conditioning [%]	Air conditioning is used in about 75 % of buildings/apartments	-
Green areas; green structures	No green structures	+
Water in the city (areas, risks)	No surface water (river, open channels)	-
Urban squares; paved / unpaved	Squares are paved with concrete tiles	+
Ventilation corridors	---	-
Social level (indicative / tendency)	upper than medium / lower than medium / average / low / high / not significant	-

Infrastructure		Potential Rlevance
Sensitive punctual infrastruct (e.g. hospitals, child care, elderly homes, etc.)	----	-
Offices (public, private)	Institute of Geosciences, Caritas Albania Offices, National Commercial Bank (BKT)	O
Water supply system (important installations, observation, works)	The water supply system in this area is an open network, the materials used for the water pipes are mixed starting from steel, cast-iron and polyethilene. The area has a good coverage of the water supply coming from Bovilla drinking water plant and the diameter of the pipe is 1200 mm.	+
Water drainage system (important installations, observation, works)	The water drainage system is existing in the area, but the capacity of rainwater drainage and sewage system is not sufficient.	+
Energy infrastructure	Electrical Substation ("Don Bosko" street)	+
Public Transport	The lines of the public transport are "The Ring" and also "Lapraka line". There is no documenation about pubic transportation affected by weather events, but there have been some traffic and small delays in transportation especially when it rained a lot and the traffic is busier due to also the individual transport.	O
Individual Transport	During the rainy days, the passage of the cars in don Bosko street is gets more difficult due to the increased traffic (there are more individual cars) and also due to the water present in the streets (floods).	O
Sport areas, recreation	There are no sportive areas or recreational areas.	-
Touristic Infrastructure	There is no touristic infrastructure.	-

* Relevance for VA-scoping (potential flood sensitivity): ++ High OO → Medium - - Low

Summary of highest vulnerabilities (objects, areas, situations) - marked map if possible

Object / Area / Situation (Receptor)	Vulneralb.*	Potential impact of CC (today / in future)	Risk	Comment
Population (public health / vulnerable groups): Sidewalks and urban public places / squares (there is direct sunlight, no continuous green / shaded areas for pedestrians). Dense building structure (heat islands).	O	Heat wave related effects to elderly, sick people or children might worsen during hot days and tropical nights (heat stress / no recovering). Special public builidngs: Don Bosco church and vocational school. Dence building texture expected to worsen the effects of heat wave.	O	
Population (public health / vulnerable groups): Water contamination, damages / injuries area wide	+	Heavy precipitation / flood related effects: Growing spread of diseases due to contaminated water, increasing utillisation of health care, increase of damages and injured through flooding.	+	
Infrastructure (transport): Main streets and crossroad in the area	+	Increased traffic expected combinded with increased heat waves impacst. Negative effects on air quality, smog / dust exposure. Traffic behaviour might change and alternative means of transport.	+	
Infrastructure (electricity services): Energy supply of the whole area (electrical substation Don Bosko)	+	Heavy precipitation / flood related effects: - Damages / breakdown of electrical substation Heat wave related effects: - Increasing demand for energy expected during summer (air conditioning) - Expected decrease in energy demand in winter (due to balancing effect of temperture trend).	+	
Infrastructure (water supply and sanitation services): Rainwater discharge and sewage system in the whole area	+	Heavy precipitation / flood related effects: - Increasing no. of days with flooded roads / crossroad - Increased number of damages - Increasing maintenance costs (e.g. filter replacement) - Reinforcement of water quality / problems - Increasing number of flooding of sewerage systems	+	
Infrastructure (social infrastructure): Schools, public spaces, city buildings (e.g. Don Bosco church and vocational school)	O	Heat wave related effects: - Changes in behaviour pattern, e.g. living outdoors - Altered demands / higher costs for cooling - Higher maintenance costs for public spaces	O	
Build environment (building stock and materials): Area wide	+	Heavy precipitation / flood related effects: Increasing number of damages and maintenance costs. Increasing of surface runoff, increase of flood risk.	+	
Economy (retail): Area wide	O	Heavy precipitation / flood related effects: Increasing damages and costs for protection and repair. Increasing problems with transport of goods.	O	
Natural resources (air quality): Main streets and crossroads	O	Heat wave related effects in combination with heavy traffic and narrow roads might worsen air quality.	O	

* Estimated current vulnerability / ** estimated future risk: ++ High OO → Medium - - Low

Measures / Actions to reduce the risk

Object / Area (Receptor) at risk	Possible measure / action	Chance / Impact *	Comment (link to other / cross-cutting)
Population (public health / vulnerable groups): Sidewalks and urban public places / squares (there is direct sunlight, no continuous green / shaded areas for pedestrians). Dense building structure (heat islands).	- Introducing building insulation, white / green roofs, green walls, white / self-cleaning facades and waterworks (e.g. fountain) in the urban public space. - Identifying the south and southwest sides of the buildings: creation of green walls in the windowless walls, or vegetation cover through continuous canopy in the areas that have windows and balkonies. - Green roofs and vegetationi in terraces (e.g. placement of the trees in the vases on the roofs of the buildings) should be encouraged. The used plant species should be heat resistant and also the vases shoyld be resistant to heat and strong winds.	+	New requirements and regulations on building insulation are needed. Non-structural measures also needed, such as public awareness, training and know how on CCA including landscape ecology and architecture, better planning of roads, public spaces, etc.

Population (public health / vulnerable groups): Water contamination, damages / injuries area wide	- Upgrading the sewage and drainage systems - Building a new reliable systems for rainwater collection independent from the wastewater pipes.	+	Updating the know-how of technical staff in the municipality on the technical requirements for rainwater collection and wastewater systems. Upgrading the preparedeness systems.
Infrastructure (transport): Main streets and crossroad in the area	- Better planning for road standards. - Revise and adjust transport system (e.g. better traffic control). - Introducing green street design including green vegetation filters. - Watering the streets daily to remove pollutants and dust.	+	Public awarenness and education at schools. Providing training and know how on CCA including landscape ecology and architecture, better planning of roads, public spaces, etc.
Infrastructure (electricity services): Energy supply of the whole area (electrical substation Don Bosko)	- Technical protection measures against flooding - Support of alternative renewable energies, such as the use of solar panels. - Ensure thermal insulation of building to lower the energy demand.	+	Public awarenness and education at schools. Usage of alternative energies should be encouraged.
Infrastructure (water supply and sanitation services): Rainwater discharge and sewage system in the whole area	- Upgrading the sewage and drainage systems - Building a new reliable systems for rainwater collection independent from the wastewater pipes.	+	Crosslink with "Population" Other measures needed as well, such as updating the know-how of technical staff in the municipality on the technical requorements for rainwater collection and wastewater systems. Upgrading the preparedeness systems.
Infrastructure (social infrastructure): Schools, public spaces, city buildings (e.g. Don Bosco church and vocational school)	Improving the landscape architeture of the area by planing high trees with continuous canopy structure and other green-blue measures (e.g. fountain) in the courtyard of the Don Bosco Church and Vocational School. Introduction of building insulation, white/green roofs, green walls	+	Crosslink with "Population" Improved know-how on landscape ecology and architecture. Public awarenness and education at schools. New requirements and regulations on building insulation should be introduced.
Build environment (building stock and materials): Area wide	- Introducing water-penetrating concrete for sidewalks and urban public spaces '- Upgrading the sewage and drainage systems - Building a new reliable systems for rainwater collection independent from the wastewater pipes.	+	Setting up an early warning and preparedness system. Improved urban design and planning standards. Providing training on CCA including landscape ecology and architecture.
Economy (retail): Area wide	- Introducing water-penetrating concrete for sidewalks and urban public spaces '- Upgrading the sewage and drainage systems - Building a new reliable systems for rainwater collection independent from the wastewater pipes.	+	Crosslink with "Build Environment" Other measures needed as well, such as setting up an early warning and preparedness system. Improved urban design and planning standards. Providing training on CCA including landscape ecology and architecture.
Natural resources (air quality): Main streets and crossroads	- Better planning for road standards. Revise and adjust transport system (e.g. better traffic control). - Introducing green streets and green-blue public spaces. - Avoiding creation of dust during street cleaning especially in summer. Improving street cleaning technology. Watering the streets daily to remove pollutants and dust.	+	Setting up a monitorying station for air quality and basic meterological data that can be managed jointly with the schoolkids.

* Level impact / chance to reduce the risk: ++ High OO → Medium - - Low

Ongoing projects in the area with potential synergies with adaptation measures

Category / kind of project	Description	Synergies / recommendation to use synergies
Urban Requalification	Creation of street infrastructure, engineering net system and urban furnishing as part of the project " Urban Requalification of the block" (laprake) defined from Don Bosko street - Turhan Pashë Përmeti street - Ibrahim Pashë Bushatlliu street - Lord Bajron street - Riza Cuka street - Learton Vathi street - Pandi Dardha street - Dritan Hoxha street.	

Additional / summarising recommendations for the area

Maps of the area

Satelite Image: urban situation

Master Plan: Land use / buildings / green areas / etc.

Mixed usage: residential use and

Urban texture / height (or density) of buildings

Map of existing green territories and local general plan

Existing settlement typologies

Compact area with low buildings

Developing Area with high buildings

Area with mixed type of buildings

Developed area with high buildings

Non residential area

Population - Density

201 - 400 in/ha

401 - 600 in/ha

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