INTEGRATED ACTION PLAN FOR URBAN RESILIENCE OF BURGAS MUNICIPALITY

I. INTRODUCTION

The city of Burgas is the fourth biggest city in Bulgaria and the second-largest city on the Bulgarian Black Sea Coast in terms of population. It is the most important economic, logistic and tourist municipality in south-eastern Bulgaria. The city has a favorable geostrategic location and natural biodiversity. It is located on a large bay on the Black sea. The Atanasovsko, Pomorie, Mandrensko and Vaya (Burgas) lakes are located close to the seashore within the city agglomeration. Together they form the largest complex of seaside lakes in Bulgaria - unique with its exceptional biodiversity. Here is Via Pontica - one of the main migratory paths of European migrant birds.

Burgas disposes of highly productive farmland, modern infrastructure and considerable human potential, which is a prerequisite for economic prosperity. The region around the city has preserved a variety of cultural and historical monuments and diverse cultural traditions. As a large commercial, industrial and tourist center, the city has a well-developed transport system and it is easily accessible by sea, air and land. The location of the municipality determines its role as a major logistics point in the country. The city is also part of the Orient/East-Med corridor of Trans-European transport network. Burgas International Airport is the second busiest airport with a capacity of two million passengers per year and it is a distribution hub for international and domestic tourism and provides excellent logistic connectivity. Burgas has the biggest port in the country and the only oil port in Bulgaria.

Burgas Municipality is the largest municipality located in southeastern Bulgaria and extends over an area of 514,362 acres, representing 0.43% of the country's territory. The Municipality includes 14 settlements, the city of Burgas, the small town Balgarovo, and 12 villages. The city of Burgas is the largest and most important industrial, commercial, transport and cultural center in southeastern Bulgaria. It is administrative center of the municipality and one of the largest districts of Bulgaria (the country is divided in 28 districts).

According to the data of the National Statistical Institute on December 31 st. 2016, the overall population of Burgas municipality is 209 331. A large majority of the population (more than 200 000) lives in the city of Burgas. In the last years, there is a clear tendency for progressive urbanization of the municipality, which is both economic and politically driven. For instance, the villages situated close to Burgas received the status of town districts with a decision of the municipal council in response to the appeal of the local inhabitants. This "promotion" provided them better access to public services, especially in terms of transport and infrastructure, and higher symbolic status, but in reality, many of the settlements remain villages. Like in the rest of the country, the population of Burgas municipality is aging – about 77 000, or approximately 37% of the total population, are over 50 years of age. The reason is both the decline in birth rates and the migration of the population to the capital and to other countries, mainly to EU members.

On the other hand, Burgas is one of the cities in Bulgaria, characterized by mechanical growth of the population because of internal and international migration, with immigrants mostly from Russia and Ukraine.

For decades, the economic landscape of Burgas was dominated by the chemical industry. Near the city, the largest chemical and oil refinery in southeastern Europe operates, which used to be the major employer of the local population. In the 70es and 80es of the last century, when the chemical industry was on the rise, it attracted workers from all over the country and contributed to the fast growth of the population. The manufacturing of various oil products, plastics and other chemical products is still vital for the local industry, along with shipbuilding, ventilation and climatic equipment, cargo carriages and fish processing.

In terms of governmental organization, a local government with a classical structure runs the Burgas Municipality: a municipal council and a mayor, elected at each four years, and an administration of about 400 public servants structured in several directorates. Under the Bulgarian legislation, the mayor is quite an empowered figure and has the discretion to launch a broad range of municipal policies and local initiatives. For instance, the municipal leadership of Burgas is considering an ambitious strategy for attracting investment by creating opportunities for youth entrepreneurship and innovation. Efforts are being made to enhance the quality of life by investing in healthcare and diversification of social services, as well as improving the urban infrastructure and sport facilities.

Burgas is considered to be one of the best developing cities in Bulgaria, especially in terms of public infrastructure. This view is broadly shared by most of the local citizens and guests visiting the city. According to the prevailing opinion, after a long period of stagnation, in the last years, Burgas has undergone considerable progress due to the active policy of the municipality and the charismatic mayor who was elected to run the city for third mandate. The secret of this revival is the ability of the municipal administration to utilize all available possibilities for funding projects and initiatives, provided by the national government and the European programs.

While being an important economic center with unique characteristics, the city of Burgas faces a number of negative impacts. On one hand, the ups and downs of the economic development during the last decades resulted in considerable social inequalities and developmental imbalances. As usual at times of political and economic transition, the most vulnerable members of society found themselves at the losing end of the changing social hierarchy. In Burgas, there is a large Roma population, which is comparatively poor and underdeveloped, although the people from that ethnic minority enjoy equal access to municipal public services. Roma people inhabit several neighbourhoods in the city; one of them is “Dolno Ezerovo” district. All the areas where representatives of the ethnic group live in, distinguishes as less segregated and impoverished than the Roma neighborhoods in other Bulgarian cities. Still most of them have some of the characteristics of a ghetto – higher unemployment rates due to educational failure and

lack of proper qualification, lasting dependency on social welfare, early marriage and unstable families, as well as, higher school dropout, etc.
Another major challenge for local development with economic aspect are the structural disproportions of the regional economy, dominated by the tourist industry, which provides volatile seasonal employment and distorts the labor market. A great concern is the short-term strategy of the local business, which prefers to profit from the cheap labor force instead of investing in innovation. Apparently, at this point the driving force of the city development is the municipal government rather than the local economy.
On the other hand, the city does not remain unaffected by the negative influence of climate change. Disaster events in the past years, directly affected the physical environment, thus revealing the vulnerability of the population and the need of adaptation of people, institutions and business to the changing environment and communities. Flooding caused important physical deterioration and damages, threatened human lives and health and even took victims All these negative aspects faced in the process of city development required different approach of the local administration, citizens and businesses in order to preserve the balance, withstand the unprecedented circumstances and achieve sustainable and prosperous living and development. Here comes the importance of resilience. As Burgas Municipality continues its fast development, adopting a resilience approach will help the city to build capacity to deal with unexpected change threatening to erode or compromise its structure.

A vital step towards increasing city's resilience against shocks and stresses is the Burgas city involvement in the "Resilient Europe" project comprising a partnership of 11 cities. All the members in this partnership are united by the common vision that cities should enhance their resilience in a way that their capability to mitigate the foreseeable risks and withstand the unforeseeable events is improved. This will pave the way for their inhabitants towards wellbeing and thriving as smart, inclusive and sustainable European society.

A necessary tool for achieving the above-mentioned vision is the elaboration of adequate policy instruments. The Integrated action plan for urban resilience of Burgas Municipality is a strategic document that has been prepared as part of city's involvement in the "Resilient Europe" project. It has been developed by the Urbact Local Group (ULG) in "Dolno Ezerovo" district – chosen area for intervention within Resilient Europe project, characterized by high concentration of stresses and shocks. A major challenge for the area are the severe floodings due to high rainwater level leading to devastating consequences.

The current document is focused on "Dolno Ezerovo" district but actually, it is feasible for the Burgas city as a whole. It was made possible as a result of an extremely collaborative process involving a wide range of stakeholders. A valuable asset turned out to be the experience from the participation in the transnational exchange events within the URBACT network. The insights, and know-how of leading cities in city resilience participating in the network had a significant contribution in elaborating this document.

The current action plan analyses the city's problems in terms of stresses and shocks challenging urban eco system, infrastructure, institutions and people's resilience. The Integrated action plan for urban resilience of Burgas Municipality presents a thorough analysis of the area, identifying existing and potential vulnerable zones threatened by being flooded. The plan is a tool for outlining concrete measures based on expertise research for mitigating the risk of such devastating events. It covers several aspects:

- ✓ Climate characteristics in the area;
- ✓ Geological structure of soils;
- ✓ The capacity of the surface runoff within the urbanized territory;
- ✓ State of river beds in the area of the investigated territory;
- ✓ Stresses and shocks;
- ✓ Potential risks;
- ✓ Scope of potential threats and their impact;
- ✓ Intensity of negative impacts;
- ✓ Predictability of negative events;
- ✓ Vision for development of "Dolno Ezerovo" district;
- ✓ Priority objectives in terms of vision materialization;
- ✓ Pathways consisting of specific actions for priority objectives realization;
- ✓ Monitoring and assessing the progress towards urban resilience

The analysis contained in the risk assessment was essential for the development of the Integrated Action Plan in view of addressing the impacts of climate change, improving city resilience and flexibility in coping with climate change at local level. The information contained in the assessment will support the planning and management process of the municipal administration, by providing for adequate flood risk mitigation measures preserving the wellbeing and saving the life of citizens, keeping the integrity of infrastructure and ecosystems and enhancing the capacity of the institutions.

II. CHARACTERISTICS OF THE TERRITORY AND CURRENT SITUATION ANALYSIS

1. Location and geographic data.

The identified territory of "Dolno Ezerovo" district is located in the eastern part of Burgas region, in the city of Burgas, right nearby its administrative center. The region is situated in the southeastern part of Bulgaria on a territory of 7,748 km^2 (6.9% of the country's area) and it is the second largest one after Sofia region. On the east, the area has a broad Black Sea oulet of 224 km. On the south, it borders on the Republic of Turkey, on the west on the regions of Yambol and Sliven, and on the north on Varna and Shumen regions. Here is the largest bay on the Black Sea coast - Burgas Bay with a total length of 12 km.

Burgas region comprises the territory of 13 municipalities including the following towns: Aytos, Burgas, Kameno, Karnobat, Malko Tarnovo, Nessebar, Pomorie, Rouen, Sozopol, Sredets, Soungurlare, Primorsko and Tsarevo.

Burgas Municipality is located in the eastern part of Bulgaria on an area of 51 436 ha, which represents 0.43% of the country's territory. On the east, the Municipality borders on Black Sea, on the north it is bounded by the Municipality of Pomorie, on the west by the Municipality of Kameno, on the northwest by the Municipality of Aytos. On the south, Burgas Municipality borders on the Municipality of Sozopol, and on the southwest, it is bounded by the Municipality of Sredets.

Burgas Municipality consists of 14 settlements, including the municipal center of Burgas, with the neighborhoods of "Sarafovo", "Lozovo", "Kraimorie", "Gorno Ezerovo", "Dolno Ezerovo", “Bulgarovo” and 12 villages. Burgas is the largest city in Southeastern Bulgaria.

The present study is concentrated on the territory of Burgas city agglomeration and the area of “Dolno Ezerovo” district in particular. “Dolno Ezerovo” district is located to the west of the city in the central part of the Burgas plain. The protected area of "Vaya" lake is located in close proximity. Currently the number of the residents living in the district is a little more than 5,600 people, inhabiting mainly their own separated housing estates, with adjacent large courtyard spaces. Despite the good property conditions, the social standard of the population is low and the unemployment rate is high.

2. Socio-economic characteristics of the area.

The region’s sea outlet enhances its transport and geographic importance. The eastern border is a prerequisite for the development of port activities, fishing, tourism, exportation, and for the concentration of production capacities and industries relying on imported raw materials. Due to the favorable natural and economic conditions, a significant part of the population and business potential are concentrated in the region.

On the territory of "Dolno Ezerovo“district, there are small enterprises of the light industry, several workshops for production of joinery, several logistic and warehouse bases, including a medicine warehouse. Next to the district, the warehouses of “Despred” are located along with some of the largest nursery-gardens on the territory of the

municipality. The development of transport and logistics industries in the area is mainly driven by the proximity of the port infrastructure, good transport connections, including rail infrastructure, as well as the close situation of the largest oil refinery in Bulgaria - Lukoil Neftochim LTD.

3. Topography

Burgas region has a diverse topography. It is a mixture of the flat terrain of the Thracian Valley and the highly wavy foothills of the Balkan Mountains. Predominant topographic forms are lowlands with an altitude of up to 200 m. and hilly lands.
The territory of Burgas Municipality occupies part of the Burgas lowland. It is located in the heart of the valley formed by the fore lake area to the Black Sea. The city of Burgas is situated on a terrace between "Atanasovsko" lake, "Vaya" (Burgas) lake and "Mandrensko" lake. The area locked within the boundaries of Burgas Municipality is characterized by shrouded coastline and location of 10 to 100 meters above sea level.
The Aytoska and Chakarliyska rivers flow through its territory. Here are also the Burgas Mineral Baths, which in combination with the therapeutic mud of „Atanasovsko" lake have a great potential for medicinal bath treatment.
According to the seismic map, the area falls into a seventh-degree zone, with 0.10 seismicity.
The flat nature of the relief is a prerequisite for intensive agriculture, construction of a quality communication network and other engineering and technical facilities for the settlements in the Municipality and especially for Burgas.
The forest fund occupies 21% of the entire territory of the municipality and covers its northeastern part. On the territory of the municipality, there are 11 dams, which occupy an area of 260 ha.

4. Climate characteristic

4.1 Annual temperatures

The climate of the territory within the Burgas Municipality is Continental Mediterranean.
The main factors determining this type of climate are the location of the municipality in the southeastern part of the Black Sea region and the unimpeded penetration of northwest, north and northeast air masses. The close location of the Black Sea basin has a direct impact on the formation of the climate on the municipal territory due to the prevailing west-east air mass movement.
The temperature regime of the area is typical for the Continental Mediterranean climate - with hot summer and mild winter seasons. The average monthly temperature in the coldest month (January) fluctuates from 2.5 ° C on the south to 0.0 ° C on the northeast.

The average monthly temperature in the warmest month (July) is in the range from +22.0 °C to +23.5 °C, forming an annual amplitude of 21-22 ° C. The continental characteristics of the climate is confirmed by the temperature and the significant deviation of the average monthly maximum and minimum in temperatures, as well as the extreme temperature differences from -18 ° C to over +40 ° C, resulting in an absolute temperature amplitude of over 50 ° C.

Table 1: Weather temperatures and precipitation in Burgas region

	January ° C			July ° C		Precipitation in mm			
Station /analogue/	Average month temperature t°	Average Absolute minimum. t°	Number of snowy days	Average month temperature t°	Average Absolute minimum. t°	winter	spring	summer	autumn
Burgas city	1,5	- 3,3	12	23,4	38,5	115	148	99	162

4.2 Precipitation

The average annual precipitation is in the range between 500-550 mm, with a clear trend of increasing rainfall from northeast to southwest. The distribution of precipitation by months and seasons corresponds to the typical continental climate characteristics with a maximum in late spring and early summer and minimum in late summer and autumn. The relatively flat relief in the municipality contributes to rapid precipitation infiltration, but in case of intense rainfall, the percentage of surface runoff can grow rapidly and cause spills and flooding.

The annual rainfall amount on the seacoast is between 470 and 520 mm. while in the rest of the country it is between 520 and 580 mm. The greatest amount falls in autumn, and the lowest in the summer. All these characteristics put the city area of Burgas in the second zone, according to which the five-minute rate intensity of the rain with annual repetitiveness is: q5, II, P1 = 225 l / s.ha.

4.3 Air masses and currents

During days in distant sea areas, where breeze circulation is strongly expressed, wind currents blow from sea to land (sea breeze), while in height, anti-breeze process is observed in the opposite direction. At night in the ground layers, wind blows from land to the sea (continental breeze), and in the height anti-breeze is in the opposite direction. Due to its greater intensity, the sea breeze spreads inland to 30-40 km while the continental breeze seldom reaches more than 8-10 km in the sea. In the mornings, the breeze is blowing at a slow speed, and at midday, it rises to 3-4 m / s and then goes down again in the afternoon.

5. Texture of the soils

The main soil types in the area covered by the Burgas Municipality are suitable for intensive land use; the most wide spread among them are *Vertisols, Chromic Cambisols* and *Fluvisols.* The other types are not so common in the area. As a relative share on the total arable land in the municipality (25 039 ha) they are distributed as follows:

- ✓ Vertisols - 46%;
- ✓ Chromic Cambisols - 29%;
- ✓ Fluvisols - 16%;
- ✓ Others - 9%.

For the lands and soils in the area of "Vaya" lake, where the target area of "Dolno Ezerovo" district is situated, there are suitable conditions and even manifestations of the process of slight acidification as a result of sulfur compounds emissions in soils from the atmospheric water. The soils of the agricultural lands adjacent to the lake are lightly polluted with zinc, copper, lead and cadmium, mainly due to traffic in the area. The reason for the higher concentration of copper is the natural geochemical influence on soils in the Burgas region.

The soils in the area around the lake area are representatives of Gleysols and Fluvisols. The proximity of the sea in the eastern part is the reason for the formation of sand massifs and deluvial deposits. Three subtypes present the Gleysols: eutric and umbric. The eutric soils spread out on the lake periphery. The umbric soils occupy the area after the eutric soils. A thick, dark coloured surface soil horizon rich in organic matter is the basis in their formation. The eutric soils are composed of alternating clay and sand layers of different power capacity and properties. The heavy metal content values of the sludge samples, taken from the bottom of the "Vaya" lake near the coastline at the point where the drainage water discharges are well below the allowable content of harmful substances in the soil with respect to Pb, Cu, Zn, Ni, Cd, As, Cr, Hg and petroleum products. Only the Mn value is higher, which could be explained by the ongoing oxidative and decay processes phenomenon in the lake.
The geological survey carried out in the target area – "Dolno Ezerovo" district in the city of Burgas shows that in depth the terrain is built from the following layers:

• Layer №1 is build from dark brown to black clay - Vertisols. The soil layer is formed on water-impervious paleogene sediments. Its thickness ranges from 1.00 m. to 1.20m. The predominant involvement of clay minerals from the montmorillonite group determines the specific physico-mechanical properties of the Vertisols. When becoming moist, the soil swells drastically, increases its volume, gains great plasticity and stickiness, and when dries, it collapses, hardens and forms wide cracks.

• Layer №2 - Clay, gray-beige to colorful, medium-plastic (dlQh). It reveals beneath the soil layer and covers all over the researched area. The thickness of the layer is about 1.20 m. in the northern part of the studied area and grows deeper in the southern part, expecting to reach a maximum of 3.0 m depth at the southern end.

• Layer №3 - light brown clay, with limestone particles and rigid plasticity (mgPg). It reveals under Layer №2, and the layer thickness reaches up to 5.0 m in depth. In other researches carried out nearby, was found, that the clay of layer №3 has more than 50 meters thickness. The layer consists of typical Paleogene clays that constitute the texture of the area explored.

Clays from layers № 2 and № 3 were tested to determine their suitability for building flood embankment. The results obtained, show that the soils of both layers could be used to build embankments as long as they are congested to the corresponding density.

6. Hydrology

In hydrological aspect, the area is located in the Black Sea catchment area, with direct outflow of rivers to the Black Sea. The hydrological network is poorly developed. Typical for the researched area is the presence of short and shallow anhydrate gullies, flooded only in heavy rainfall.
Calculation of the maximum water quantities to the researched well with the required facilities for the purposes of the analysis were carried out according to a methodology, which is applied in the absence of direct observations and measurements of the river flow.
The average annual value of the 24-hour maximum of intense rainfall is determined based on elaborations of the National Institute of Meteorology and Hydrology for the observed area. Its reliability is verified by spatial analysis of the rainfall data available for the region.
Another feature of the area is the relatively large number of foggy days compared to other coastal stretches.
The climate characteristics of the territory of Burgas Municipality are a favorable prerequisite for the development of tourism and agriculture.

6.1 Capacity of the surface runoff in the urbanized area.

The urbanized territory of “Dolno Ezerovo” district is intersected from north to south by two parallel gullies - east and west. Both gullies have been corrected within the district regulation. Despite the presence of drainage channels, flooding of the terrains near the water currents continues to present a serious issue during intense precipitation. The last two floods in the district had catastrophic dimension and resulted in significant material damage and psychological trauma to the population.
The eastern gully drains the agricultural lands located between the main road Burgas – “Lukoil Neftochim” oil refinery and „Dolno Ezerovo“ district with a catchment area of

approximately 230 ha. and a valley about 2.2 km in length outside the regulation north of the district. The gully reaches the residential area at the intersection of "Kavakli" and "North" streets and crosses the residential area along “Kavakli” street. Its passage through the district regulation goes through a covered drainage channel, which crosses under the Burgas-Sofia railway line where it passes as an open concrete channel with a composite polygonal section - a trapezoidal base and vertical walls above it. A closed drainage collector with a rectangular cross section was built in 2014 under a detailed design from 1996 in order to lead the water safely from the gully through the residential area. It starts with an entrance facility at the above-mentioned crossroad and ends 20 m. north at the railway line Burgas-Sofia.

The rise of the water level in the lake in recent years has led to swamping of the adjoining territory and overgrowing with marshy vegetation. The lack of manpower and mechanization access in this area, result in changes in the transversal and longitudinal profile of the gully - narrowed sections, reduced depth, overgrowth of the banks and the bottom with marsh vegetation, barrages of retained sediments, etc.

The western gully drains agricultural lands located between the “Thracia” highway and ” Dolno Ezerovo” district with a catchment area outside the regulation of approximately 1780 ha.

The gully reaches the residential district at the junction of “Mladost” and “Dubrovnik” str., north of the local football stadium. It passes through the regulation through a covered drainage channel in several sections:
Section 1 spreads out from a grate entrance facility north of the local football stadium to the crossing of “Dubrovnik” and "Petko D. Petkov" Str. The channel is made of reinforced concrete pipes.
Section 2 spreads out from the above mentioned junction to the crossing of "Petko D. Petkov" Str. and "Pirgos" Str. The drainage channel is built of concrete pipes;
Section 3 spreads out from “Hristo Botev” Primary School to the crossroad of "Petko D. Petkov" str., and “Georgi Dalboshki” Str. The channel has a concrete rectangular cross-section with dimensions 200/80 cm. Two parallel concrete pipes carry out the passage under „Georgi Dalboshki“Str.
Section 4 spreads out from the upper junction to the open trapezoid channel at the crossroads of "Petko D. Petkov" and "Lom" streets. The collector is made of prefabricated reinforced concrete blocks with dimensions 240/120 cm.
Section 5 spreads out from “Lom” Str. to the discharging point in “Vaya” lake. Along its passage under the Burgas-Sofia railway lines, the channel is constructed as open concrete channel with a composite polygonal section - a trapezoidal base and vertical walls above it. Right before reaching the railway lines, an open casting channel discharges into the gully starting its way from a rainfall shaft along the route of the mixed sewerage collector that passes along “Lom” street.

6.2 Status of river beds in the researched area.

On-site surveys showed the following situation:

1.7.1. Eastern gully: Despite the construction of a drainage collector for the gully, the areas around the gully at "Severna" Str. and the upper sections of "Dryanovo" and "Kavakli" streets keep on being flooded during intense rainfalls. This is due to the significant changes in the climate and hydrological characteristics of the region around Burgas city, which have occurred in recent years.

1.7.2 Western gully: With the purpose to investigate the causes of the floods in this part of "Dolno Ezerovo" district, a video showing the state of all the sections of the closed channel was captured displaying the identified narrowing of the gully and a geodesic picture for determining the drainage channel profile has been taken.

Based on these findings, the hydraulic permeability of the above-mentioned sections has been calculated as follows:

Sections 1 and section 2 have conductivity of 1750 l/s;
Section 3 has conductivity of 4500 l/s. and two pipes carry out the drainage of rainwater under the street with conductivity of 2 x 1700 = 3400 l/s
Section 4 has a hydraulic conductivity of 8000 l/s, but the three pipes passing under "Zahari Zograf" street have a conduction capacity of only 3 x 750 = 2250 l/s.
Section 5 - the concrete trapezoidal channel has the required conductivity of 8000 l/s at a normal depth of 1.20 m corresponding to the height of the closed channel in the previous section. After the crossing of the railway lines, the profile of the gully does not allow the unrestricted flow of rainwater to the lake and leads to a considerable water detainment because of which the low-lying properties around the embankment of the railway lines are flooded.

7. Stresses and shocks in the area

"Dolno Ezerovo" is a neighbourhood within the Burgas Municipality that lacks intensive urbanization. Its close proximity to the newly established Burgas industrial park, which attracts local and foreign investors, introducing new services and promoting investment in high value added industries along with the close location of the neighbourhood to the city center, turns it into an area with great potential for development.
Unfortunately, Dolno Ezerovo faces numerous obstacles in the form of stresses and shocks that impede its progress.

Climate change results in various threats challenging the city resilience. The heavy and intense rainfall causes floods, which put at risk the population and the infrastructure in some urban areas in the city of Burgas among which is Dolno Ezerovo district. As a result of torrential rainfall, a lot of private and public buildings were being flooded, road infrastructure was destroyed, there were human casualties and state of emergency was declared. The last disastrous flooding was in 2010, 2013, 2014, and 2015.

7.1 Social and behavioral aspect

When it comes to local people resilience, the main issue of concern is related to the lack of preparation and knowledge of the local inhabitants how to face the changes and to react and adapt adequately when sudden unprecedented events occur like the flooding in the last few years. Due to the insufficiency of information, people have limited, even sometimes no ideas how to protect themselves in case of crisis. They do not realize the importance of behavioural changes that are necessary to be made in order to accept innovative and modern measures improving their environment, social inclusion and resilience. People lack belief that every member of the community is capable to give his own contribution and change the whole picture. The community fails to see itself as a powerful driving force that is able to achieve significant positive results with small efforts. These small steps could be vital for local people capacity to resist the impact of future unexpected negative events and make the living environment a more pleasant and safer place.

Another negative aspect regarding local people's resilience is the lack of social cohesion due to high level of unemployment among young people and growing inequality because of financial issues. All these factors become a prerequisite for lack of education, poor health condition, crime raise and low social mobility.

7.2 Infrastructure aspect

As for the infrastructure, significant part of the "Dolno Ezerovo" area is prone to flooding with probability for tremendous losses due to the type of relief and the presence of large wetlands. The district is built near the largest costal lake "Vaya", which is a catchment area of several rivers. Most of the properties are situated below sea level, which is a basic prerequisite for the presence of floodplain. In addition to this, the rainwater sewage system in the district is not designed to absorb such amount of rainwater, falling in Burgas in the recent years. Weakness of available infrastructure, its exploitation makes it hard to limit the negative effect and consequences of environment and climate changes. What is more, it does not correspond to the current best practice architectural and construction tendencies for flooding prevention. Heavy rainfall causes huge currents of rainwater entering the district unhindered inundating the road infrastructure connecting the different parts of the area, destroying alleys and residential areas, properties and service utilities. It has a devastating effect on the crops raised in the area as well. The area experienced already significant destruction of existing infrastructure in the past years.

With a view to mitigate the high concentration of infrastructure disparities between "Dolno Ezerovo" district and the central urbanized area of the city, Burgas Municipality made investments on the district territory in several directions. Within the area of "Dolno Ezerovo", under the Operational Programme Environment 2007-2013, 10 km of new sewerage system was constructed and accompanying infrastructure for transportation of wastewaters to the central treatment plant of the city of Burgas was built. One of the main streets, "Lom" street, used as a bypass road was renewed and reconstructed under EU Solidarity Fund. The implementation of the road rehabilitation measures is ongoing in the district including other streets in poor condition. Activities for reconstruction of the western gully are envisaged as well.

7.3 Ecological aspect

Floods have negative effect on the ecosystem and could cause severe shocks and stresses. "Dolno Ezerovo" district is located near "Vaya" lake, protected under the EU Directives related to Birds and Habitats. "Vaya" lake is a rich habitat and source of food for birds. There are unique plants, crustaceous and fish that inhabit its waters. Ecosystems depend on a careful balance of factors, and the sudden impact of a flood quickly disrupts this and breaks the fragile ecosystem equilibrium. While floods affect mainly dry land, water-based habitats are at risk from the runoff of the flood. The run-off contains sediment and products such as pesticides and fertilizers, and carry these into the ecosystem. Dangerous chemicals and other hazardous substances end up in the water and eventually contaminate the water. The sediment hide the sun and plants are not able to photosynthesize and may die. Additionally, flooding causes kill animals, and other insects are introduced to affected areas, distorting the natural balance of the ecosystem. While "Dolno Ezerovo" neighbourhood appears to be benefiting from its proximity to a pristine ecosystem (the "Vaya" lake), the access of local inhabitants to the lake is

hindered by derelict industrial infrastructure, and the littered lakefront is a manifestation of the disconnection between the community and its surrounding nature.

7.4 Institutional aspect

Resilience is quite a new concept for the municipal administration. In Burgas Municipality organisational structure, there is „Crisis management, mobilization and defense preparation" department, responsible for crisis in terms of risk management plans and programmes elaboration and implementation. For the implementation process, public volunteering, as well as convicts community service work are widely used methods delivering positive results. For instance, in the field of water risk management, inspections of the water basins and vulnerable areas within the municipality are carried out several times a year. As a result of these inspections, overall scrubbing of the water basins, canals and gullies is executed on a regular basis in order to prevent high water level formation and possibilities of flooding.

Despite the substantial progress in dealing with the unexpected negative impacts, caused by climate changes, the city administration is still not fully prepared and adapted to the altering environment, conditions and evolving community. A clear evidence of that fact were the losses during the last devastating flooding and the difficulties in the process of recovery afterwards. There is a certain lack of awareness of the horizontal meaning of resilience on political, strategic and operational level.

Once the wide spread low level of confidence in the institutions for years on end, became a small scale but still present issue for the municipal administration due to its assiduous work and efforts in the past years. In the time 2007-2017, a significant part of the measures, implemented in the sphere of water risk management was conducted with active civil participation due to citizens' complaints and alerts submission. What makes impressions is that there is still a fine line of mistrust in the public bodies in view of their ability to address citizens' needs in a proper way, without the presence of a bureaucratic element. This in turn, leads to some difficulties in the relationship between institutions and citizens, which is an obstacle to the adoption of adequate resilient measures based on consensus and public private partnership.

8. Risk and negative impact analysis on the target territory

8.1 Risk identification and potential risk areas

Risk identification is a process that defines possible risk causes, as the risks themselves are being identified and described. Few types of risks are identified for the residential territory of "Dolno Ezerovo" district in the city of Burgas, depending on the causes of the negative effect: natural and anthropogenic.

In order to correspond to the purpose of the current analysis, priority will be given to potential risk causes that are beyond the direct dependence on anthropogenic actions, those that could not be directly influenced, and in respect of which only preventive and

corrective measures could be envisaged, not measures designed to minimize or completely eliminate the risk.
Expert analysis of past floods and spatial likelihood modeling of floodplains in areas with increased water levels at critical points were conducted on the territory of Burgas Municipality identifying the following areas with significant flood risk:

"Lozovo" district
"Dolno Ezerovo" district
“Ravnets” village
“Izvor” village
“Marinka” village

Presently, all rainwater from the catchment area located north of “Dolno Ezerovo” district directs to the urbanized area, threatening housing estates and infrastructure. In case of heavy rainfall, high waters are capable of causing significant material damage.

8.2 Scope and causes of potential threats and their impact.

Flooding as a natural disaster, even with local manifestation, can indirectly lead to disruption of the socio-economic life of a large part of the population, although causing social and household impediments to a significantly smaller number of individuals.
The flood threat does not extend only to the physically affected area. Such disasters usually put at risk infrastructure and business, social services and normal living conditions.
For "Dolno Ezerovo" district in the city of Burgas, the floods of the so-called "Flash floods" type are characteristic of the area. Such floods often occur in smaller rivers, rivers running along steep valleys, which in most of their length, flow into impermeable terrain or dry canals. They are the result of sudden intense thunderstorms, heavy and continuous rainfall, or the sudden release of water from a dam in the upper reaches of rivers. Floods in residential areas are mainly caused by rainfall that exceeds the capacity of drainage systems and rainwater drainage.

Although sometimes urban flooding is triggered by events such as rainfall or snowfall, it is a condition characterized by its recurrent and systemic impacts on the population and can occur irrespective of the affected population location whether it inhabits regions close to particular floodplains or next to a water basin.

The floods in the area around “Severna” street in recent decades are mainly caused due to the fact that the entrance drainage facility has not been dimensioned and adjusted to the changing high wave characteristics of the rainwater in the eastern gully in case of intense rainfall - a very short upsurge and extremely high water level . The characteristic

indicators of the high water level (high wave) defining its propagation over time [Q = Q (t) stands for water quantity and H = H (t) for high water mark] are the following: beginning, uplift, peak, fall and end of the high wave. The basic parameters relevant for hydrological calculations derive from the hydrograph of the high wave and are the following:

- ✓ maximum water quantity Qm (m3/s);
- ✓ maximum water mark Hm (m);
- ✓ high wave volume W (m3);
- ✓ duration of the high wave T (h);
- ✓ shape of the high wave

The likelihood of high wave occurrence measured with definite parameters that characterize the maximum flow as a random magnitude should be added to the above-mentioned parameters.
The western gully, on the other hand, drains agricultural lands located between the "Thracia" highway and "Dolno Ezerovo" with a catchment area of approximately 1780 ha which are out of regulation.

The reason for the high wave formation in the urbanized territory lies mainly in two basic facts: the area north of "Dolno Ezerovo" district is a cultivated agricultural with a type of soil that favors the surface drainage of the rainwater to the lowest point in the territory. The relatively flat relief facilitates rapid precipitation infiltration in times of moderate rainfall, but in case of intense rainfall, the percentage of surface runoff increases rapidly, causing spills and flooding. On one hand, the wide spread silty soils, favor intensive farming but on the other hand increase the surface runoff and poor infiltration in the soil. These soils are formed on Pliocene clays with a high concentration of montmorillite clay. Silty soils located at low sea level and extensive accumulation plains with weak drainage capacity, combined with the presence of annual crops such as wheat, barley, oats, corn, sunflower, cotton, beans, vetches etc. create suitable conditions for directing the water streams through the dry gullies to the low-lying parts along the shores of "Vaya" lake.

8.3 Intensity of negative impacts

Intensive rainfall is one of the main features of the climate. Torrential rainfalls or heavy rainfalls and intense snowfall, are prerequisites for increasing silty soils moisture level, which leads to high values of all hydrological parameters higher than all other soils in the country. The wilting point in the surface soil horizons ranges most frequently from 19 to 25%. The marginal soil moisture fluctuates from 32-40%. Significant amounts of water accumulate in the one-meter soil layer about 150-170 mm. The combination of surface accumulation of snow (new snow cover on old one), subsequent spring rainfall without the possibility of gradual melting generate high risk of flooding.

A clearly expressed trend over the past 7 years is the high intensity of flooding events. The following major floods have occurred:

- Ring road E-87 along “Vaya” lake near “Dolno Ezerovo” district was flooded on February 09 th. 2010;
- A large part of "Dolno Ezerovo" district was flooded on December 12th. – 13th. 2010 due to the accumulation of vast amounts of snow, in combination with temperatures below 0° C and subsequent heavy rainfall;
- Properties and road infrastructure was flooded in “Dolno Ezerovo” district in the period from June 18th. -20th. 2014 as a result of intensive rainfall;
- Critical situation emerged on September 5 th. 2014 when extremely heavy and continuous rainfall about 240 l/m^2, caused flooding on the territories of “Marinka” and “Izvor” villages. The life of local inhabitants was threatened. There was no such a disasterous event on the territory of Burgas Municipality in the recent years. The intensive rainfalls formed lush streams in the streets, that took away human life and caused considerable damage to movable and immovable property. The high waters of the rivers flooded over the bridges, destroyed road infrastructure, farmland, livestock farms.
- Another extensive flooding occurred on 31st. January 2015 when over 70 properties were inundated after heavy rainfalls and snow melting;
- High tidal waves formed due to intensive rainfalls flooded roads and residential buildings in the villages of “Polski Izvor”, “Livada”, “Trastikovo” and “Cherni vrah” and some districts of the city of Burgas - "Meden Rudnik" residential area, "Gorno Ezerovo" and "Dolno Ezerovo" districts on October 25 th.. 2017.

8.4 Predictability of negative events

Following the implementation of the measures envisaged in "Integrated management of flood risk in Burgas Municipality" project (IMFR), executed with the financial support of Programme BG02 "Integrated marine and inland water management" of the Financial Mechanism of the European Economic Area " a monitoring station for water level observation was installed on the territory of “Dolno Ezerovo” district on the western gully. The station sends regular data every 15 minutes to the Surveillance Center of Burgas Municipality regarding the water level on site. An image is sent every 30 minutes presenting the current state of the gully. In case of emergency situation, there is an option for remote switch to video mode for video observation. Incoming data and images are public and can be viewed at https://wms.burgas.bg/wmis-portal/ or via a mobile application developed for Android and IOS (Water Monitoring System Burgas).
Three threshold (safe, dangerous and threatening) are defined for each of the monitored sites within the project. In the system, they are marked respectively in green, orange and red. If the water level or amount of rainfall reaches critical levels, the color of particular

station changes from green to orange and then red. In this way, attention is drawn to a particular area where prerequisites for disaster are arising.

8.5 Mitigation measures of negative impacts

In accordance with the Disaster Protection Act, flood protection is implemented through:

- Carrying out preventive activities;
- Conducting protection activities;
- Coordination of the single rescue system actions;
- Support and recovery in case of flooding

Preventive activities are carried out to reduce flood risk. They include flood risk analysis and assessment, risk mapping, and a number of organizational measures to protect the population.

According to the Water Act, permanent protection from the harmful effects of water includes:

- Construction and maintenance of dykes, corrections of river courses and gullies and other hydro technical and protective facilities;
- Establishment and maintenance of observation, forecasting and warning systems;
- Regulation of groundwater level when reaching dramatic increase or decrease in levels;
- Protection activities of drainage basins against water erosion;
- Maintenance of river bed's conductivity;
- Construction and maintenance of defensive or coast reinforcing facilities along the seacoast against wave impact;
- Preventive and limitation measures to restrict damage caused by natural floods conducted in accordance with flood risk management plans. They comprise dispatching of potentially hazardous dams whose technical condition prevents their further exploitation.

Two types of measures are envisaged some of which already taken in order to overcome the flood risks in the surveyed area: infrastructure – correction of gullies and institutional: establishment and maintenance of monitoring, forecasting and population warning systems.

Two additional measures apart from the above-mentioned are outlined in the present analysis:

✓ **Agromeliorative**

Regarding the task of limiting flood risk, when taking agromeliorative measures, two main considerations have to be taken into account: land ownership and state policy in the "Agriculture" sector.

What can be done?

Restoration of old riverbeds and fluvial in order to reduce the flow rate. Maintaining riverbed vegetation is necessary to ensure rich biodiversity as well as to reduce the negative effect of floods.

Deforestation of catchment areas as a result of excessive cutting, fires, etc. or afforestation with inappropriate species proved in recent years to be the cause of a large percentage of floods in urbanized areas. Deforested terrains and impaired forests are much more pervious to water and direct it right to the rivers and gullies after precipitation, and snow melting.

What can be done?

Conservation and restoration of natural forests in the catchment areas of rivers and gullies. Developing agriculture with perennial species of fruit trees that not only reduce the surface water flow that brings about flooding, but also provide significant quantities of water, in periods of drought that tend to be more frequent and prolonged due to climate change.

- ✓ **Infrastructure**

The investment measures have been developed in two main directions: improving the existing infrastructure and building new facilities.

The existing drainage infrastructure is in unsatisfactory condition. In the process of designing the western gully and determining the maximum water capacity conductivity, some mistakes have been made. Sections 1 to 3 have several times less hydraulic conductivity than section 4, thus limiting the last section efficiency to 20%. Consequently, during intensive rainfall, forming a runoff over 1750 l / s, the gully over the entrance facility overflows and the water moves along one of the district's main streets - "Petko D. Petkov" Street, flooding the adjacent properties.

What can be done?

To overcome this discrepancy, it is necessary a duplicate of the existing closed channel to be designed and constructed. It should be dimensioned to compensate the inconformity in the capabilities.

The existing drainage culvert at „Zahari Zograf" and „Petko D. Petkov" streets should be dimensioned for the conductivity of the existing channel passing before and after it.

What can be done?

Regarding the option for construction of new facilities, which minimize the risk of floods in the affected area, a detention basin north of "Dolno Ezerovo" district in the "Golemiya Mihalich" area is planned to be built. This facility will accumulate the water as a result of

intense rainfall, thus increasing the environmental security in the area and mitigating the risks of floods, that respectively could bring about environmental and material damage. Through implementing specific investment measures outside the urbanized territory, the maximum conductive capacity of the existing covered drainage channel (8000 l/s) will be restored within the district residential area. The permanent increase in rainwater permeability will drastically reduce the flood rate in the district.

III. OBJECTIVES AND METHODOLOGY FOR DEVELOPMENT OF THE INTEGRATED ACTION PLAN FOR URBAN RESILIENCE OF BURGAS MUNICIPALITY

1. Objectives

The Integrated action plan for urban resilience of Burgas Municipality is a policy instrument which main objective is to help the city planners build the city capacity to cope with unexpected change. Becoming a more resilient city will provide the ability of the city of Burgas to maintain its functions and keep its identity despite the occurrence of unforeseen challenges. The current document aims at promoting the resilience as imminent priority of the city, giving new directions in view of local policymaking and urban planning through the resilience perspective. The Burgas Integrated Action Plan for Urban Resilience strives to introduce a framework that creates a new concept about the challenges the city is facing and presents a proactive way of thinking for the shocks and negative impacts that lie ahead. The plan aims at shedding light on the methods how to utilize the strong assets of natural capital, local community and institutional capacity to alleviate stresses and develop a city for the future with the ability to be prepared for and thrive despite eventual unforeseen events.

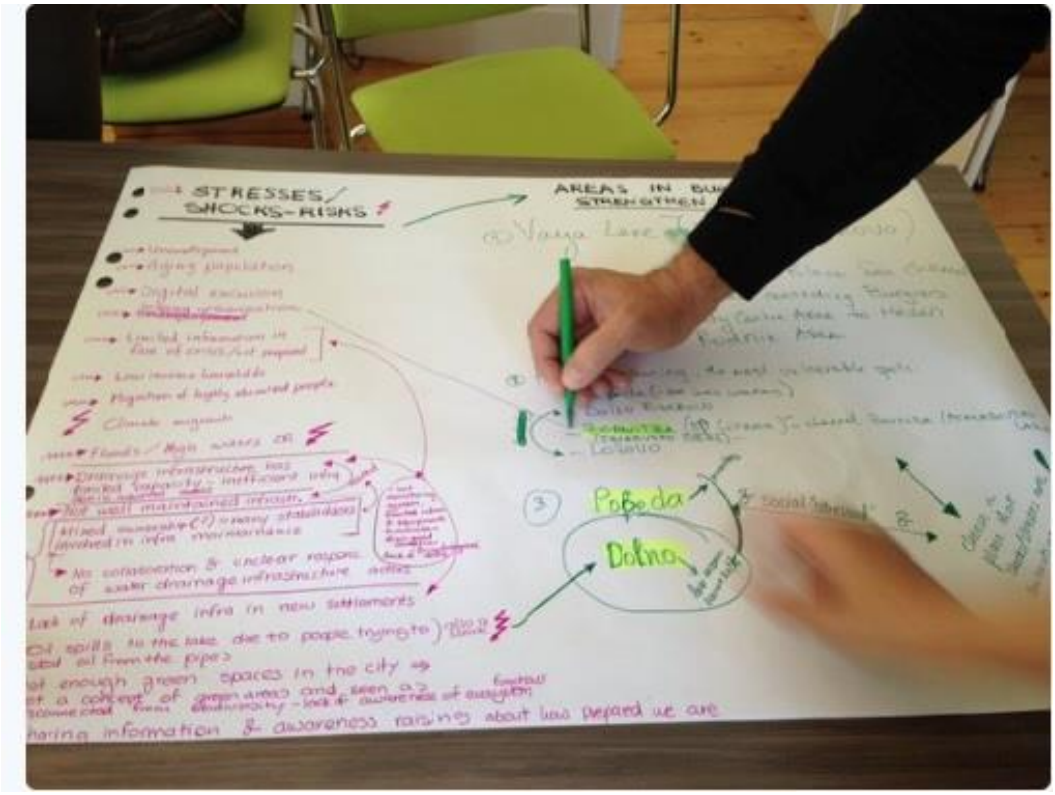
2. Methodology

Key local stakeholders setting up Urbact Local Group (ULG) were engaged during the first phase of the RESILIENT EUROPE project to develop the Integrated Action Plan for Urban Resilience of Burgas Municipality The ULG was based on existing Consultative Council carrying out public discussions related to climate adaptation established within another project. The group comprised policy officers from different departments of the local city and government administration, representatives of NGOs, the local Salina business, the Fire safety and Civil protection department, representatives of public and private sector. The ULG was led by a coordinator with solid experience related to the management and implementation of EU funded projects, mainly in the fields of environmental protection, energy efficiency and waste management. The coordinator was responsible for performing the activities within the group and guide the whole process of exchange, contribution and elaboration of the plan. In the process of the

ULG meetings organization, the group increased its scope by including members of "Dolno Ezerovo" local community, directly affected by the addressed stresses and shocks pointed out within the Action plan.

During the first ULG meeting that went as an open discussion "Dolno Ezerovo" district was identified as an area for intervention and experimental site for strengthening urban resilience – Urbact local lab. The area, situated in immediate proximity to Vaya Lake, was the biggest village in South-East Bulgaria with 5700 people until its incorporation in Burgas Municipality in 1991. For that reason, its appearance has not changed and consists of two level houses, open spaces and broad streets. Within this suburb, a concentration of stresses and shocks has been identified, some of which have been already mentioned in part **II. CHARACTERISTICS OF THE TERRITORY AND CURRENT SITUATION ANALYSIS 7. Shock and stresses in the area.** of the current document representing serious threats with human, social, environmental and physical dimension:

- Extreme floods during the last few years
- Poor air quality due to the proximity of Lukoil refinery and to the heating of residential buildings with coal.
- Aging infrastructure
- High unemployment rate among the young population
- Social and digital exclusion
- Low incomes



Due to the extending of the problem with the flooding events in the past 10 years and its large scale negative effect on the area, people living in it and the surrounding environment the ULG decided to prioritized this issue and address it in the current Integrated action plan for urban resilience of Burgas Municipality.

During the process of Burgas Integrated Action Plan for Urban Resilience elaboration five ULG meetings were held that contributed to the co-creation of the plan. The gatherings allowed their participants to brainstorm, share ideas and information in open dialogue which were transformed into concrete objectives and measures for their realization, included in the integrated action plan. The objectives and measures were focused on tackling environmental and social problems thus enhancing the self-reliance and the resilience of the Burgas city.

Transnational exchanges and local policy learning activities provided within the URBACT network were quite beneficial in the process of the Integrated Action Plan development. The participation of the Burgas city in four transnational meetings under the Resilient Europe project enriched the horizons of the city experts and ULG members when it comes to urban challenges adaptation. During the transnational meetings, the Burgas Municipality gained valuable experience from the success stories of other partner cities frontrunners in the urban resilience. Due to the participation of the city in the events on transnational level, Burgas municipality adopted up to date methodology and approach to strengthen city resilience in dealing with common challenges. In the transnational meetings, members of the ULG group took part, thus contributing to the exchange and

learning activities at transnational level. The experience obtained was brought back home and turned out into a valuable asset, used in the process of the Integrated Action Plan elaboration.

External expertise was used for the elaboration of the Integrated action plan for urban resilience. A company specialized in analyzing catchment areas and designing water supplying and plumbing infrastructure was assigned to make analysis of the territory of "Dolno Ezerovo" neighbourhood. In addition to that, the company collected and generalized all the data and information produced in the process of Resilient Europe project implementation to create the current integrated action plan for mitigating climate change consequences.

IV. VISION AND OBJECTIVES FOR URBAN RESILIENCE

The Urbact local group formulated a vision in the course of discussions during the ULG meetings that outlines the priority objectives and directs towards the actions that should be taken for its materialization. The vision sets out the ambitions and aspirations for the development of the "Dolno Ezerovo" suburb in the close future in terms of people, infrastructure, ecosystem and institutions in view of increasing the urban resilience on local and whole city level. Urban resilience is the capactiy of urban systems, communicties, individuals, organisations and businesses to recover, maintain their function and thrive in the aftermath of a shock or a stress, regardless its impact, frequency or magnitude.

„Dolno Ezerovo" suburb is a fast growing and well developing area where the local community is a main priority. People living in the district feel aware and well informed about future unexpected disasters and have the knowledge how to deal with them for their own safety. "Dolno Ezerovo" is a place where people are committed to give their own contribution for their living area to be more attractive and safe. Volunteering is widely practiced and successful method in the area for maintaining public spaces and introducing green measures for mitigating climate change risks.

Priority objectives

1. Build awareness in local community about the future stresses and shocks.
2. Increase community capacity for dealing with unexpected changes.
3. Encourage local community engagement in local authority supported initiatives
4. Raising the awareness of local people of the importance of their own contribution for the wellbeing of the area and themselves as part of the environment.

„Dolno Ezerovo" district is a fast growing and well developing area where urban infrastructure is reconstructed and renovated and makes the area a good looking and attractive for people to settle and live in. Innovative and sustainable solutions for treating rainwater sewage in compliance with the highest European standards and best practices for flooding prevention are adopted in the area. The suburb disposes of large green areas that provide a pleasant and eco-friendly environment capable to withstand the future challenges.

Priority objectives

1. Enhance the infrastructure capacity to mitigate the risk of flooding.
2. Increase the resistance of physical environment against the negative effects of nature cataclysms.
3. Adopt innovative and sustainable solution in treating urban rainwater sewage system.
4. Increase the attractiveness of public spaces for recreation and leisure activities.
5. Facilitate the usage of green measures to withstand the negative impacts of climate change

"Dolno Ezerovo" suburb is a fast growing and well developing area where the ecosystem is well preserved and provided with all the necessary conditions to evolve. Local agriculture is flourishing. Agriculturists raise favourable species of crops for the area that have positive effects on mitigating the risks of flooding. People have free access to the neighboring lake where they do many outdoor leisure activities. They go for a picnic, walk, enjoy and watch the rich abundance of protected bird species, go fishing in the clear and well maintained water of the lake. The community life is strongly linked to the lake and local citizens take care for its maintenance and cleaning together with the local authority in view of preserving the rare flora and fauna.

Priority objectives

1. Better protection of the Vaya lake ecosystem.
2. Encourage the local agriculturists to change their habits.
3. Ensure accessible and attractive environment for local people to the Vaya lake waterfront.
4. Encourage the community to use the resources of the lake environment for leisure activities, sport and recreation.

5. Build awareness in local people of the importance of keeping the waterfront clean and well maintained.

"Dolno Ezerovo" district is a fast growing and well developing area where Burgas Municipality set urban resilience as one of the main priorities in the process of local policy development and implementation. The local authority pays special attention and invest resources in analyzing, gaining knowledge and seeking effective measures to mitigate future stresses and shocks due to unforeseen events and crisis. The local administration work in tight cooperation with the local community for its policy implementation regarding urban resilience. People trust and receive adequate support from local authority in risk situations.

Priority objectives

1. Putting urban resilience as a main priority in the political agenda of the local authority.
2. Enhancing the institutional capacity of local administration in adopting resilient approach in urban planning and development.
3. Building stronger connections and a bridge of trust between local authority and citizen of the area in coping with unexpected events and crisis situations.
4. Improving the preparedness and adaptation of local administration towards the changing environment, conditions and evolving community.
5. Adopting the resilient thinking on a horizontal level - political, strategic and operational level.

V. PATHWAYS TO URBAN RESILIENCE

Pathway 1 – Creating resilient society.
Actions

- ✓ Training courses and lectures for local citizens on the territory of Dolno Ezerovo suburb, devoted to the resilience topic and in particular how to be prepared and survive in crisis situation and mitigate shocks and stresses, organized by the local authorities, NGOs and relevant institutions.
- ✓ Organisation of public initiatives/project/campaigns with wide participation of the local community, focused on changing the surrounding environment into a shock resistant and appealing place for a living.
- ✓ Brainstorming events and exposition of innovative solution regarding urban development with participation of relevant experts and local community members.
- ✓ School policy modification of "Hristo Botev" primary school in "Dolno Ezerovo" district by means of introducing the "resilience subject" in tutor sessions

Pathway 2 – Enhancing the quality and resilience of the place
Actions

- ✓ Conservation and restoration of the green belts in vulnerable areas (catchment areas of rivers and gullies) - with the active participation of local community following the principle "Give people the right to decide"
- ✓ Construction of detention basins to store the advancing rainwater, as well as used for irrigation purposes of nearby agricultural lands.
- ✓ Construction of sustainable new drainage system with greater capacity to properly treat rainwater
- ✓ Restoration of old riverbeds and fluvial in order to reduce the flow rate of rainwater
- ✓ Construction and maintenance of dykes, corrections of river courses and gullies and other hydro technical and protective facilities;
- ✓ Regulation of groundwater level when reaching dramatic increase or decrease in levels;
- ✓ Protection activities of drainage basins against water erosion;
- ✓ Establishment and maintenance of observation, forecasting and warning systems;
- ✓ Dispatching of potentially hazardous dams whose technical condition prevents their further exploitation.
- ✓ Mapping and digitalization of existing networks in order to facilitate the master and spatial planning of the city.

Pathway 3 – Caring and supporting the ecosystem equilibrium
Actions

- ✓ Prevent the raising of the water level of the lake as a result of rainwater flow into the lake.
- ✓ Construction and maintenance of defensive or coast reinforcing facilities along the water basins coastline.
- ✓ Replacement of non-perennial with perennial plants (fruit trees) with the active participation of local agriculturists encouraged by the local administration.
- ✓ Encourage local community to use the lake waterfront in compliance with its needs and desires considering the preserved status of the lake and its species.
- ✓ Development of alleys, recreational areas, bird watching zones along the lake bank.
- ✓ Organisation of lectures raising the awareness of young students about the importance of natural assets in the area and the need to preserve them.
- ✓ Organisation of public events like concerts or Lake Coastline cleansing campaigns with the volunteering of local citizens along the lake waterfront.

Pathway 4 –Increased capacity of municipal administration to resist the upcoming challenges
Actions

- ✓ Adopting resilient approach in the process of local policy planning and development (analyzing current situation, identifying possible risks, outlining future shocks and stresses, laying down measures for mitigating the risks or dealing with the shock and stresses in worst-case scenario, implementation of the measures).
- ✓ Setting up ad hoc municipal expert/experts dealing with resilience within municipal administration
- ✓ Develop a strategic vision and concrete objectives to fight the consequences of climate change, by imposing effective infrastructural and administrative measures.
- ✓ Adopting close method of communication - door-to-door conversation between experts of the city administration and local community members in terms of issues affecting their living conditions, environment and their personal wellbeing.
- ✓ Planning and carrying out preventive activities;
- ✓ Conducting protection activities;
- ✓ Coordination of the single rescue system actions;
- ✓ Support and recovery activities in case of flooding

VI MONITORING AND ASSESSING THE PROGRESS TOWARDS URBAN RESILIENCE

Result framework			
	Specific objective	**Result indicator**	**Output indicator**
Society	**1.** Build awareness in local community about the future stresses and shocks.	50 % of local community members (1 member from each household) participating in the training courses/lectures/ seminars.	20 training courses/ lectures/ seminars organized for "Dolno Ezerovo" district community members about climate changes adaptation and crisis situation preparedness until 2023.
	2. Increase community capacity for dealing with unexpected changes.	Better informed and trained local population for reacting and dealing with potential flood threats. Improved abilities of citizens for using the web based Water Management Information System and the corresponding mobile app. according to their needs	A municipal website developed accumulating and presenting up do date free public information and data from the monitoring stations and sensors installed in the flood risk zones part of the Water Management Information System A mobile app developed for IOS and Android presenting up do date information and data from the monitoring stations and sensors installed in the flood risk zones Free public access to a web based information system for flood risk warning
	3. Encourage local community engagement in local authority supported initiatives. **4.** Raising the awareness of local people of the importance of their own contribution for the wellbeing of the area and themselves as part of the environment.	50 % of local community members (1 member from each household) participating in public initiatives/projects/ campaigns on enhancing the natural and infrastructure resistance against shocks and stresses.	5 municipal initiatives /projects/campaigns carrying out measures for enhancing the natural and infrastructure resistance in "Dolno Ezerovo" district against shocks and stresses held/implemented until 2023 with tight cooperation and participation of the local community.

		10 % of local community members participating in exposition events and small-scale experiments.	5 expositions /small-scale events demonstrating innovative solution regarding urban development held until 2023 in "Dolno Ezerovo" district with participation of relevant experts and local community members.
		20 % of citizens taking part in public consultations	5 public consultations with stakeholders and community members about "Dolno Ezerovo" district development until 2023 .
		80 % of pupils attending tutor sessions on "resilience" subject	20 tutor sessions devoted to "resilience" subject held in "Hristo Botev" primary school in "Dolno Ezerovo" district every school year.
Places	**1.** Increase the resistance of physical environment against the negative effects of nature cataclysms	20 % reduction of rainwater overflow at the entrance drainage facility	A duplicate drainage channel constructed covering the area from section 1 to section 3 of the Western gully with a rectangular cross-section with 6150 l / s. rainwater conduction capacity.
	2. Enhance the infrastructure capacity to mitigate the risk of flooding.	20 % reduction of rainwater overflow at the drainage culvert at the crossroad of „Zahari Zograf"str and „Petko D. Petkov"str.	Reconstructed drainage culvert at the crossroad of „Zahari Zograf" str and „Petko D. Petkov" str. into two parallel channels with rectangular cross-section dimensioned for 8000 l/s rainwater conduction capacity.

	3. Adopt innovative and sustainable solution in treating urban rainwater sewage system.	50 % better accumulation of rainwater from the agricultural land in the northern part of the district. Increasing the resistance to flood threat by 50 % of the northern part of the district	A detention basin is planned to be built in the northern part of "Dolno Ezerovo" district in the "Golemiya Mihalich" area. The facility will accumulate the rainwater as a result of intense rainfall.
	4. Increase the attractiveness of public spaces for recreation and leisure activities.	3000 liters per day greater water absorption in the planted area in 10th. Year (303 -379 liter/day is the average consumption of full grown willow tree)	20 aquatic tree species planted along the Western gully
	5. Extend the usage of green measures to withstand the negative impacts of climate change.	30 % improvement in rainwater conductivity along the gully	70 % of the western and eastern gully areas cleansed on yearly basis
Ecosystem	1. Encourage the local agriculturists to change their habits.	5 % greater water absorption in the area	10 ha. of agricultural land planted with perennial plants Financial support for agriculturists for planting orchards or other aquatic crops.
	2. Better protection of the Vaya lake ecosystem.	Decreasing with 10% the water flow to the "Vaya" lake	Conservation and protection of the biodiversity in the lake

	3. Ensure accessible and attractive environment for local people to the "Vaya" lake waterfront. **4.** Encourage the community to use the resources of the lake environment for leisure activities, sport and recreation.	Number of visitors attending the "Vaya" lake waterfront for recreational and bird watching activities	Reconstructed adjoining area near "Vaya" lake within "Dolno Ezerovo" district A recreational area including a bird watching zone created for visitors on the lake coastline.
	5. Build awareness in local people of the importance of keeping the waterfront clean and well maintained.	70 % of the participants in the event to be local citizens	1 public event for cleaning the lake coastline held per year with the voluntary participation of local citizens and the support of municipality
Institutions	1. Adopting the resilient approach on a horizontal level - political, strategic and operational level.	At least 4 objectives from the IAP fitted in the priorities of the Municipal development plan 2021-2027 with corresponding actions for every resilient axis (people, places, ecosystem, and institutions).	At least 6 actions implemented for the achievement of the corresponding IAP objectives until the end of 2027
	1. Enhancing the institutional capacity of local administration in adopting resilient approach in urban planning and development.	Well-developed and integrated action plan for urban resilience in all relevant municipal plans and strategic documents related to climate changes adaptation, action plans for natural disasters and crises.	An ad hoc municipal expert was set up dealing with resilience within municipal administration
	2. Building stronger connections and a bridge of trust between local authority and citizens of the area in coping with unexpected events and crises.	50 % of the local community members (1 member from each household) were personally consulted in areas affecting their living conditions, environment and their personal wellbeing until 2023.	Close contacts and individual consultation practice established between municipal administration and local citizens of "Dolno Ezerovo" district was established

	3. Improving the preparedness and adaptation of local administration towards the changing environment, conditions and evolving community	12 hours earlier prediction of natural disasters (flood) before happening. Enhanced monitoring quality, up to date receipt of information and data of the water level in areas vulnerable to flooding.	Establishment of a complete and well-functioning network of monitoring stations equipped with sensors and cameras in flood risk zones (for "Dolno Ezerovo" district - 1 station for measuring the water level of the western gully; 1 station for measuring the water level of "Vaya" lake) comprising the Water management information system covering the territory of Burgas Municipality. A web-based platform (municipal website) developed and functioning accumulating and presenting information from the monitoring stations. Establishment of a unit for monitoring and processing data entry and administration of the Water Management Information System
		Improved and updated documentation framework regulating current measures and actions that should be taken in case of disaster and crisis events	Updated flooding section of Municipal disaster and crisis situation action plan.

VII EXPERIMENTING FOR URBAN RESILIENCE

In order to achieve key targets and priorities part of the main strategic documents of Burgas Municipality related to the balanced and sustainable development of the territory, the city decided to carry out an experiment providing resilience of a selected vulnerable part of its territory[1]. A small-scale experiment was organized and held within the "Resilient Europe" project on the territory of the Urban Living Lab ("Dolno Ezrovo" district) as an output of the Urbact contract delivered by the Burgas Municipality. During the second Urbact local group meeting, the idea about the nature of the experiment was born. All the members of the ULG shared a common opinion that lack of vegetation and

[1] All relevant strategic framework is described in detail in the conclusion of the IAP.

deforestation of the areas around the gullies and the adjacent agricultural lands contributed to a significant extend for flooding occurrence. From that moment, this issue became the anchor point of the experiment. Its basic aim was to demonstrate easy to implement, low cost and effective green measures in fighting the consequences of climate change and flooding prevention in particular. In addition to that, the experiment was focused on local citizens engagement in the process of green measures implementation.

The objectives of the experiment directly addresses the following pathways:

Pathway 1. Creating resilient society, ***Action 2 Organization of public initiatives/project/campaigns with wide participation of the local community, focused on changing the surrounding environment into a shock resistant and appealing place for a living***.; **Pathway 2 – Enhancing the quality and resilience of the place;** ***Action 1 Conservation and restoration of the green belts in vulnerable areas (catchment areas of rivers and gullies)with the active participation of local community following the principle "Give people the right to decide"*****;**

Pathway 4. Increased capacity of municipal administration to resist the upcoming challenges. Action 4 ***Adopting close method of communication - door-to-door conversation between experts of the city administration and local community members in terms of issues affecting their living conditions, environment and their personal wellbeing*** within the Integrated action plan for urban resilience of Burgas Municipality.

Such experimental event was quite innovative and provocative in its context for the municipal policy as it involved people from the area who carried out its implementation on their own, rather than the old traditional way in which the public administration took decisions and carried out such initiatives with its own resources. Local people were given the option to choose a site where they would like to plant aquatic tree species. The municipal support was expressed in providing the tree species from local nursery garden fostering the local production. The emphasis was put on provoking citizens mind and make them believe that simple solutions and little steps carried out with the voluntary participation of the community and the support of local institutions have the ability to change the whole picture. Local people had the opportunity to see how their own efforts could turn the surrounding environment into more attractive and safer place to live in.

Through the active devotion and commitment of the ULG members and the head of the "Center for administrative services "in" Dolno Ezerovo district, a few meetings and consultations with members of the local club of retired people and teachers from the local school were held who subsequently gave their active support for the implementation of the experiment. Members of the club together with civil servants comprising the ULG group held door-to-door conversation with local community members. Teachers explained to their pupils in classes the idea of the experiment and the resilience topic and in return had very positive feedback. The municipal administration provided five willows for the people living in the most vulnerable to flooding areas. They unanimously decided to plant the trees in the park area around the church in the district center. This area used to be an attractive and relaxing one in the past preferred for outdoor activities by locals. Since the severe flood events occurred, the identified area has often been waterlogged and the public infrastructure has been badly damaged due to the collection and detainment of rainwater.

The experiment took place on May 10 $^{th.}$ 2017. Pupils from the local school, their parents,

local citizens, ULG members and the Deputy Mayor of "European policies and programmes and ecology department" took part in the experiment. The ULG members seized the opportunity to remind the citizens about the lovely functions of the central district area in former times by organizing European picnic as part of the event that was called Resilient picnic. Local food producers were encouraged to prepare different kinds of typical European dishes. Local inhabitants also participated in the culinary challenge bringing homemade food. The event was a favourable opportunity for the ULG members to put the resilience topic and the significance to be prepared for future unexpected disasters and negative impacts in front of the local community. People were quite enthusiastic of having the chance to give their opinion and the informal atmosphere provoke them to exchange ideas how their living area could be transformed into more socially attractive and safer place. They expressed the idea to make the implementation of green measures a wide spread method for mitigating flood risk in "Dolno Ezrovo" district and carry out the next step which was to plant tree species along the both banks of the Western gully, one of the most vulnerable to flood area. The representatives of the municipal administration on the other hand expressed willingness to support such initiative. The experimental event gained large popularity through the municipal website, which published images and disseminated details regarding the essence of the event and its successful implementation. The conduction of the experiment outlined people readiness to volunteer and support the city administration in the realization of projects and campaigns of common interest. It demonstrated a notable improvement of stakeholders' engagement and building relationship of trust between citizens and institutions. Still there are further efforts that need to be taken in terms of raising local citizens' engagements and volunteering. The individual approach of the administration towards citizens need to be improved. Further investment for rehabilitation and restoration of public infrastructure should be carried out in the residential area. The experiment was a successful example and a starting point for building the foundations of the three resilient pillars – resilient people, resilient places, resilient institutions in the city of Burgas. The next step is to use the existing potential and build on this foundation to turn the city into shock resistant and well prepared for the upcoming challenges city agglomerate.


Untitled Map
Small-scale experiment area, Dolno Ezerovo district
Legend
Google Earth
153 m

VIII CONCLUSION

Burgas Municipality has developed the Integrated action plan for urban resilience in order to supplement and contribute for the realization of main priorities defined in existing key strategic documents and pave the way for further steps up to 2020 focused on the city's sustainable development and growth:

Burgas Master Plan– this document provides basis for sustainable development and spatial planning of the city and its territorial waters, respecting natural and social economic characteristics of the territory. This plan is essential for the development of all other strategic documents related to balanced infrastructure and environmental development of the territory.

Integrated plan for urban regeneration and development of Burgas - instrument for urban planning for sustainable and balanced development of the urban territory of the city. Three zones of intervention are identified within this document: zone of public, economic and social impact.

Municipal Development Plan 2014 – 2020 - major strategic document that sets up objectives and priorities for sustainable and integrated social and economic development of the Municipality for the following 7-year period. Priority 1 and 2, related respectively to environment and integrated territorial development define provisions concerning water, flood and erosion, biodiversity and integrated management of natural resources, balanced renovation of the territory, suburban areas integrated management accessibility etc.

Investment program 2015-2020 highlighting the priority sites for intervention in Burgas Municipality in terms of five investment priorities: "Energy efficiency in administrative

and residential buildings", "Integrated urban transport", "Urban environment", "Social infrastructure", "Educational infrastructure".

All of these planning documents define the objectives, investment potential and priorities for sustainable and integrated socio-economic development of the municipality for the period 2014-2020 aiming to achieve a major transformation of the city and its urban environment, creating a smart and resilient city. The measures stressed in the Integrated action plan for urban resilience of Burgas Municipality relate directly to the sustainable development of a selected territory in order to prevent consequences of climate change but also do strengthen its resilience involving people, ecosystem and institutions.

Burgas Municipality has experience in realising more than 50 projects financed under operational programmes and various other European programmes and funding mechanism. On account of that, the administration will seek available possibilities for funding the implementation of the Integrated Action Plan through external financial instruments and public funding where it is necessary.

As far as Operational Programme Environment is concerned, under Priority Axis 3 – "Biodiversity" and Priority Axis 4 "Flood and Landslides Risk Prevention and Management" different measures will be undertaken to deliver integrated solution to identified resilience failure of the city. Funding from "Environmental protection and climate adaptation" programme under the "Financial mechanism of the European economic area" and the "Norwegian financial mechanism" 2014-2021 will be utilized for financing the implementation of measures orientated towards enhancing the city resilience to future stresses and shocks. The LIFE programme 2014-2020 and particularly the 'Environment' and 'Climate Action' strands will be used as instruments to carry out the objective of the municipality in the area of nature and biodiversity, environmental and climate governance, climate change mitigation; climate change adaptation; and climate governance and information.