LIFE LOCAL ADAPT | Integration of climate change adaptation into the work of local authorities

Risk and Vulnerability assessment Valka municipality

Deliverable to Action C10.1

Due date of deliverable: 31.01.2017
Submission date: xx.xx.xxxx

Project start: 01.07.2016
Duration: 60 months

Version: Draft

CzechGlobe | Das Land Steiermark Erneuerbare Energien und Klimaschutz | GERICS Climate Service Center Germany | LANDESAMT FÜR UMWELT, LANDWIRTSCHAFT UND GEOLOGIE | Freistaat SACHSEN | TECHNISCHE UNIVERSITÄT DRESDEN

Inhoud

1 Introduction

Climate change is a global problem, which requires action at international, national and individual levels. Since the first Global Climate Change Conference in Geneva in 1979, many countries have developed and implemented various projects in order to monitor, research and prevent negative effects of climate change. Certain risks and vulnerabilities have been identified and classified depending on a variety of factors: geographical location, population, socio-economic development, etc.

The European Union has put in place measures to mitigate and adapt to climate change[1]. Latvia has joined this initiative, conducting a number of significant studies on the above-mentioned topics, partaking in discussions about arising problems and potential solutions, and establishing long-term strategies.

The Ministry of Environmental Protection and Regional Development of Latvia (VARAM) has established the Climate Change Department and one of its tasks is to carry out the study "Analysis and suggested proposals for the preparation of an informative report on adaptation to climate change within the framework of the Environmental Policy Guideline Implementation Report for 2009-2015"[2]. The study included climate change risk assessment for Latvia, and recommendations on the required adaptation measures for sectors most impacted by climate change. A risk assessment and vulnerability assessment in context of climate change has been carried out in Latvia in the following areas[3]:

- Biodiversity and ecosystem services,
- Health and prosperity,
- Landscape planning and tourism,
- Agriculture and forestry,
- Construction and infrastructure planning,
- Civil protection and emergency assistance planning.

The municipality of Valka participates in the EU the Covenant of Mayors for Climate & Energy[4]. This initiative brings together thousands of local and regional authorities who voluntarily commit themselves to the EU climate and energy policy objectives in their respective areas.

This risk and vulnerability assessment will examine existing studies and assessments at the national level and evaluate their application in Valka district.

1 Komisijas Zaļā grāmata Padomei, Eiropes Parlamentam, Eiropas Komisijas un sociālo lietu komitejai un Reģionu komitejai, Adaptācija klimata pārmaiņām Eiropā. ES rīcības variant, SEC(2007) 849

2 Analīze un priekšlikumu sagatavošana informatīvā ziņojuma par piemērošanos klimata pārmaiņām izstrādei Vides politikas pamatnostādņu 2009.-2015.gadam īstenošanas ziņojuma ietvaros, PhD cand Ieva Bruņeniece, Baltijas vides foruma projekts 'BaltClim', 2012)

3 Priekšlikumu izstrāde Nacionālajai klimata pārmaiņu pielāgošanās stratēģijai, identificējot zinātniskos datus un pasākumus pielāgošanās klimata pārmaiņām nodrošināšanai, kā arī veicot ietekmju un izmaksu novērtējumu: http://www.varam.gov.lv/lat/fondi/grants/EEZ_2009_2014/nacionala_klimata_politika/?doc=18209

4 Pilsētas mēru pakts enerģētiks un klimata jomā: http://www.pilsetumerupakts.eu/about/covenant-of-mayors_lv.html

2 Climate change

Climate changes are reviewed in contect of climate change effects.

Table 1. Climate change and effects of climate change.

Climate change	Effects of climate change
Annual average temperature increase	Increased variability of snow cover in winter (difference between min and max during January - February)
	Summer mean temperature rise (degrees °C)
	Meteorological summer season extension (days)
	Meteorological autumn season extension (days)
	Meteorological winter season decrease (days)
	Delayed water freezing (days)
	Winter minimum temperature rise (degrees)
	Winter mean temperature rise (degrees)
	Meteorological spring season extension (days)
	Earlier melting of snow cover (days)
	Earlier unfreezing of soil (days)
	Water temperature mean rise (degrees °C)
	Earlier ice meltoff and water release into rivers (days)
Flood risk	Greater precipitation in winter (mm)
	Greater precipitation in autumn (mm)
Extreme weather conditions	Increase in extended periods of high temperature extremes (heat waves) during summer (days / seasons with maximum daily temperature higher than 30 degrees C)
	Increase in sudden and strong thunderstorm possibility in summer (thunderstorm days/ season)
	Wind caused tree toppling
Precipitation increase/decrease	Total precipitation mean decrease in summer (mm)
	Total anual prcipitation mean increase (mm)

3 Risks and Vulnerabilities: definition and terminology

3.1. Risk and vulnerability

Latvian national risk and vulnerability assessments are most often based on the ISO 31010 standard. Consequently, definitions in this document will also be based on those used in the I. Bruņeniece report to the VARAM[5].

- **Risk** is the combination of the probability / possibility of the event (hazard) and its occurrence (ISO 31010, risk management)
- **Risk management** - ISO 31000, an auxiliary document, that provides guidance on the selection and application of systematic techniques for risk assessment.
- **ISO Guide 73** – risk management dictionary (threat, exposure, etc.)
- **Risk assessment steps**: (1) identification, (2) analysis and (3) evaluation:
    - Risk identification is the process of risk detection and description (with data) and scenarious (in a project - sectors, recommended methods - Delphi, causation-consequence analysis, etc.)
    - Risk analysis is the process designed to determine risk nature and its level, analysis of vulnerabilities is performed
    - Risk evaluation is a process in which the results of risk analysis are compared with risk criteria to determine if the risk and / or its level is acceptable or tolerable (Eurocodes may be used) - risk maps, guidelines
- **Risk criteria** are the reference points used to assess the importance of risk
- **Risk assessment participants** - agree on criteria, methods, inclusion / exclusion, value recording, etc.

In this document, the main source of was research conducted by expert teams. Additionally, experts performed risk assessments using following risk-measurement matrix:

[5] Analīze un priekšlikumu sagatavošana informatīvā ziņojuma par piemērošanos klimata pārmaiņām izstrādei Vides politikas pamatnostādņu 2009.-2015.gadam īstenošanas ziņojuma ietvaros, I. Bruņeniece (2012): file:///C:/Users/Gunta_S/Downloads/Petijums_I_Bruneniece_21_12_2012.pdf

Table 2. Risk level evaluation matrix:

Impact / Likelyhood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
	Insignificant risk	Signicant	Moderate	Major	Catastrophic
Very high	5	10	15	20	25
High	4	8	12	16	20
Medium	3	6	9	12	15
Low	2	4	6	8	10
Very low	1	5	3	4	5

Risks are divided into four groups:

- *insignificant risks, which do not require special measures, provided continued on-going risk prevention and monitoring;*
- *significant risks - in this case, risks must be addressed and measures taken in order to reduce or eliminate them;*
- *moderate risks - urgent actions are required to reduce these risks, as well as focusing on risk control measures;*
- *high and very high risks, which are considered to be the most dangerous, and requiring immediate risk reduction measures.*

Vulnerability[6] is is a complex concept that has to be defined in relation to several other concepts. The vulnerability includes three components:

- Exposure to harmful effects - the degree (intensity, duration, etc.) and the nature of the climate change effect impacting a given system;
- System sensitivity - the degree to which the effects of climate change is able to alter (in a disadvantaged or favorable direction) a given system; - Exposure and sensitivity result in a real impact on the system. In this context, adaptation is usually regarded as both the ability of the system to support its own adaptation and the introduction of external adaptation measures. These supportive measures lead to a higher
- Adaptability - i.e. the ability of the system to adapt to climate change, reduce potential damage, exploit new opportunities, or cope with the consequences. Vulnerability is

[6] Šeit tiek izmantota IPCC definīcija (skat. http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch2s2-2-4.html), kas modificēta atbil-stoši EEA materiālos izmantotajai pieejai (http://www.eea.europa.eu/publications/climate-impacts-andvulnerability-2012/at_download/file)

the result of the interaction of all these components and is defined as the extent to which the system is susceptible and incapable of coping with the negative impacts of climate change, including its extreme effects. Vulnerability is closely related to another - essentially opposite concept - resilience.

- Resilience is the ability of the system to withstand exposure, while maintaining a constant basic structure and functioning forms, ability to self-organize, ability to adapt to stress and change. Interconnections between endurance and vulnerability are often forming threshold effects.

3.2 Cause and consequence analysis

The cause-consequence analysis is a method based on the causality principle. The principle, the connection that determines that each phenomenon has its own cause, that gives rise to the effect. Various applicable types of methods are used - both qualitative and quantitative. Results of cause -consequence analysis are used to provide a structured insight into:

- the most significant risks and opportunities created by climate change;
- their specific causes,
- emerging secondary issues, including economic and financial losses (or opportunities),
- other side effects,
- synergies,
- a reference system frame required to characterize these processes.

4 Risks and Vulnerabilities

Climate change and the associated risks and vulnerabilities have been the subject of research in Latvia for several years. The following section will list the risks and vulnerabilities that are identified and analyzed in these national-level reports. Currently reports are available in the following areas:

- Biodiversity and Ecosystem service;
- Health and Welfare;
- Landscape planning and Tourism;
- Agriculture and forestry;
- Construction and Infrastructure;
- Civil Protection and Emergency Assistance.

4.1 In the field of Biodiversity and Ecosystem service

The risk and vulnerability assessment for biodiversity and ecosystem services has been carried out by the SIA Estonian, Latvian and Lithuanian environment7. A team of experts participated in this project, including experts in biology, economics, sociology, environmental specialists and biodiversity. At the initial stage of the project, a broad and comprehensive list of risks was drawn up based on brainstorm method results, which was further used to select the most significant risks employing the multi-criteria approach described extensively in the document.

4.1.1 Identified risks

Following risks are listed in The National Report:

- Changes in the species range: they are associated with certain changes in climatic conditions. In particular, it affects ecologically sensitive species whose survival requires specific microclimatic conditions. There is a risk that certain species are not able to adapt to climate change and their populations are significantly reduced or disappearing. Invasion of new species is a possibillity that can have an adverse effect on existing species.
- Seasonal and phenological changes: season creep or changes in the timing of the seasons, as well as different lengths, can affect the life cycle of different species, especially insect species.
- Pest, infection and invasive species risks: due to changing climate conditions, new species may appear and compete with existing species for resources. There are no natural

mechanisms to limit the areal dispersal of such new species, and consequently, the prevalence of non-specific infections will increase, and new pathogens such as H1N1 (avian flu) will appear.

- Changes in ecosystems: during species migration, species that are better able to adapt to changing conditions can become more resilient. This can lead to both to increased biodiversity and reduced biodiversity.
- Impact of geomorphological and hydroecological processes on ecosystems: due to changing climate, nutrient availability and circulation in water bodies can be impacted, affecting habits of different species, for example, changing fish spawning places. Certain areas can be bogged down, hay meadows may become larger or smaller and habitats may change.
- The impact of extreme weather on ecosystems: In some instances such changes may be reversible, however, irreversible changes are also possible.
- Changes in the functioning of ecosystems: Changes in temperature and humidity can cause significant changes in the circulation of nutrients, for example, in soil. This in turn affects almost all food chains.
- Anthropogenic (indirect) impacts of climate change: These processes are largely caused by human activities. For example, introducing climate change adaptation measures and creation of flood prevention infrastructure due to intensification of agriculture.

4.1.2 Risks selected for in-depth analysis

For an in-depth analysis, experts have selected a number of risks, which are described in greater detail in the national report. Each of the risks has been analysed using the risk level evaluation matrix. During risk analysis project experts assessed both the likelihood of occurrence of each risk and the significance of the consequences.

4.1.2.1 Contamination / eutrophication of water bodies

This includes rising water temperature, low water periods in summers, algal bloom, overgrowth of water basins, and oxygen depletion in water. As also indicate increased Increased nutrient drainage can also be a result of an indirect effects (caused by human activities in the context of adapting to climate change) as a result of intensified farming and increased water pollution. According to experts, significant contamination of the water bodies / eutrophication is influenced by the following conditions:

- Increase in water temperature;
- Changes in precipitation;
- Nitrogen cycle acceleration;
- Faster decomposition.

Table 3 Risk assessment: Contamination of water bodies / eutrophication[7]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					x
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is very high - with very high probability of occurrence and very high impact.

4.1.2.2 Ecologically plastic species (generalist species) replacing Ecologically-sensitive species (specialist spieces).

With changing climatic conditions, it's increasingly harder for "specialist species" to compete with incoming generalist species. Therefore, with time ecologically-plastic species can replace non-plastic ecologically sensitive species – thus, changing the species composition and bio-topes, thereby reducing biodiversity. Aggressive species types can include either imported species (hogweed, potato leafworm, etc.), or local species which can become aggressive (sea turtles, various pests).

Table 4. Risks assessment: Ecologically - plastic species replace ecologically sensitive species[7]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4			x		
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with high probability of occurrence and medium impact.

4.1.2.3 Infectious diseases not common to Latvia

With the changing climatic conditions and distribution areas of species, various pest and invasive species can spread in the new territories. They can affect local species, thus affecting biodiversity, and increase the risk of spreading of non-specific infectious diseases (Severe Acute Respiratory Syndrome (SARS), 'swine flu', 'avian flu').

According to experts, the greatest influence here is the increased temperature factor, especially the winter temperature rise. There is a growing risk that favorable conditions and opportunities will arise for the arrival of new species, and the dispersal and viability of pests will increase.

According to experts, the greatest influence here is the increased temperature factor, especially the minimum winter temperature increase. Such changes can create favorable conditions and opportunities for the arrival of new species, and an increased dispersal and viability of pests.

Table 5. Risk assessment: Spreading of infectious diseases uncharacteristic of Latvia[7]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4				X	
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is high - with high probability of occurrence and high impact.

4.1.2.4 Possibility of arrival of new species

Affected by climate-driven change, existing conditions may become inappropriate for native species and favorable conditions might be created for the arrival and survival of other species, including invasive species that can harm other existing species . Consequently, they contribute to the reduction of biodiversity. It is possible that existing species will not disappear, instead changing their genotype and phenotype as a result of hybridization.

Most significant effect on the entry of new species can be attributed to the changes in temperature of environment - the rise in water temperature, the increase in air temperature, the rise in the winter's minimum temperature and the decrease in snow cover.

Table 6. Risk assessment: Opportunitiesfor arrival of new species[7]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4				x	
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is high - with high probability of occurrence and high impact.

4.1.2.5 Increased areal dispersal and viability of pests and pathogens

Possibly, species need to mirate in order to survive climate-driven change. As new species enter, new pest and invasive species may appear, or they can become more viable.

The greatest impact can be attributed to rising air temperatures, wind caused tree toppling, fires, minimum winter temperature rise and decreased snow cover.

Table 7. Increased areal dispersal and viability of pests and pathogens[8]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4				x	
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is high - with high probability of occurrence and high impact.

4.1.2.6 Flood - storm tides on the seashore

The effects of extreme weather can be significant and sometines - irreversible. Negative impact can be caused not only by flooding, but also by coastal erosion. Eco-sensitive species can be particularly vulnerable.

Floods are most affected by extreme weather conditions and, to a lesser extent, by precipitation changes.

Table 8. Risk assessment: Floods - tides on the seashore[7]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4			x		
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with high probability of occurrence and medium impact.

4.2 In the Health and Welfare area

"Estonian, Latvian and Lithuanian environment", Ltd., has carried out a Risk Assessment in the Health and Welfare area[7]. The project was conducted by a team of experts including health experts, social anthropologists, economists and environmental specialists. Similar to previously described study of biodiversity and ecosystem services, part of the risk were chosen for more detailed analysis using a cause-effect model.

4.2.1 Identified risks

- An increase in the average annual air temperature can affect the entry of new species, accelerate the spread of microbes and increase the viability of microorganisms. Temperature rise and drought can lead to increased number of fires, increased prevalence of burns, smoke poisoning, and an increased risk of developing a respiratory system seseases. The warmer weather can also affect seasonal employment – increasing employment in the summer, spring and autumn seasons in agriculture and rural tourism. People's spending habits may change - for example, fruits and vegetables may be available for a longer period of time.
- Increase in the total number of days without precipitation and in the number of sunny days can contribute to the impact of UV radiation on human health. There may be some beneficial effects on the health of the population - vitamin D intake, and negative effects – increased risk of skin cancer.
- An increase in average annual rainfall is associate with a higher flood risk. This, in turn, can lead to a decreased quality of bathing water and disturbance of water drainage and sewage systems. Correspondingly, the risk of infectious diseases increases.
  Flooding can also cause significant material damage to households and contribute to human migration.
- Weather extremes - heat waves, storms and floods can have a significant impact on human health. Exacerbations of chronic diseases and risk of overheating may increase. Densely populated areas are affected the most.

[8] Risku un ievainojamības novērtējums un pielāgošanās pasākumu identificēšana veselības un labklājības jomā (2016), Estonian, Latvian, and Lithuanian Environment

4.2.2 Risks selected for in-depth analysis

4.2.2.1 Increase in acute intestinal infection rate, outbreaks of these diseases

With the changing climate, the risk of infectious diseases is rising, in particular diseases that spread via food and water.

- Due to increased water temperature in water bodies, favorable conditions for the spread of pathogens, viruses, bacteria and protozoa are created - their reproductive capacity, viability, and their pathognicity may change. This can lead to acute intestinal infections.
- With increasing precipitation and heavy rainfall occurrences, the risk of flooding is also increasing. Floods can cause overflow of drainage and sewage systems that affect the microbiological composition of drinking water and can reduce the quality of drinking water. It has a direct link with infectious disease outbreaks.

Infectious diseases, the prevalence and transmission of which is directly linked to food products, are well-known and relevant worldwide. In the event of an increase in temperature, there is a greater chance of proliferation od disease causing agents, especially if hygiene standards are not met. The greatest impact on the number of acute intestinal infections is attributed to the prolonged meteorological summer season, the rise in precipitation and the increase in water temperature.

Table 9. Risk assessment: Increase in acute intestinal infection rate, outbreaks of these diseases[8]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3		x			
Low	2					
Very low	1					

According to expert assessment, this risk is significant - with medium probability of occurrence and significant impact.

4.2.2.2 Exacerbations of chronic diseases (SAS, diabetes, etc.) and mortality rate increase

Extreme heat causes a significant increase in the mortality rate and the number of hospitalized patients due to chronic illness. Prolonged heat partucularly affects several groups of people: elderly, people with chronic illnesses who use medication on a daily basis, especially people with cardiovascular diseases.

The greatest impact on the increase of illnesses and death rate is attributed to the increase in the number of heat waves.

Table 10. Risk assessment: Exacerbations of chronic diseases (SAS, diabetes, etc.) and death rate increase[8]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4			x		
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with high probability of occurrence and medium impact.

4.2.2.3 Increased disease rate and / or endemic infectious diseases spread by carriers

Due to climate change, some species become less competitive, while others spread into new areas or become stronger. Consequently, this affects time and area of carrier - spread diseases.

Most significant vector-borne infectious diseases in Latvia are tick-borne encephalitis (TBE) and Lyme disease. Rate of tick-borne encephalitis infections varies annually, but overall there is a decrease in the incidence of disease, while the incidence of Lyme disease is increasing.

Experts assessing the potential impact of climate change conclude that in Latvia, the tick season can start earlier and end later, and insects can be found in a geographically wider area. In addition, higher minimum winter temperature creates favorable conditions for their viability. According to experts, the frequency of vector-borne diseases is most affected by the prolonged metrological summer and autumn, and shorter winter time.

Table 11. Increased disease rate and / or endemic infectious diseases spread by carriers[8]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3		x			
Low	2					
Very low	1					

According to expert assessment, this risk is significant - with medium probability of occurrence and significant impact.

4.2.2.4 Increased incidence of respiratory diseases and mortality, especially for different risk groups

Along with the changing climate, air quality is impacted , including increased pollution level, allergens and indoor air quality. Ground level ozone and particle count in the air can change significantly. These effects are especially noticeable in the case of prolonged droughts, heat waves and stagnant air mass in urban environments.

Higher air temperature can lead to an earlier plant blooming phase, which, in combination with increased carbon dioxide concentrations, influence the spread of allergens, such as pollen. There is a possiibillity of some allergens becoming even more allergenic.

Air quality can also be affected by naturally occurring emissions such as forest fires, dust, emissions from vegetation.

Decreasing air quality can enhance the emergence of various diseases, the emergence and exacerbation of allergic reactions, reduced work capacity, etc. in particular, when representatives of susseptable risk groups are exposed:

- Unborn babies, newborn babies, infants, young children;
- Elderly people affected by cardiovascular diseases;
- Workers who are exposed to chemical substances and products in the work environment;
- Risk groups of socioeconomic exclusion and poverty.

The biggest impact on incidence of respiratory diseases is attributed to the prolonged duration of metrological autumn and summer and increased number of heat waves.

Table 12. Risk assessment: Increased morbidity and mortality from respiratory diseases, especially within risk groups[8]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3		x			
Low	2					
Very low	1					

According to expert assessment, this risk is significant - with medium probability of occurrence and significant impact.

4.2.2.5 Increased heat stroke incidence

Heat stroke and heat fever are the most severe heat-related illnesses. Different methods of analysis are used to determine the impact of heat wave on the health of the population, however, the most simple mothod is considered to be analysis of the volume of emergency medical services (EMS) provided. According to results of such analysis performed in Latvia, analyzing the total number of EMS calls per 1000 inhabitants, the number of calls is decreasing. Experts have analyzed the correlation between individual diagnoses (sunburn, heat and light effects and unspecified fever) and climatic factors (days in the year when the maximum air t > 25), and observed a coincidence, but no statistically significant correlation was found.

Heat stroke and fever incidence is most affected by the increase in the frequency and duration of heat waves and the prolongation of the metrological summer.

Table 13. Risk assessment: Increased heat stroke incidence[8]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4				x	
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is high - with high probability of occurrence and high impact.

4.2.2.6 Internal and external migration

Climate change can contribute to the movement of the population. People can change their place of residence from one area to another, for example, as a result of a coastal flooding. There is regular seasonal migration, which is historically characteristic to Latvia, but it can increase as a result of climate change - for example, people can choose to leave the cities during heat waves. Finally, international migration must be taken into account, when people are forced to leave their country as a result of climate change (which will also lead to economic and social changes).

National research mentions that up until now there have been no cases of immigrants seeking help due to climate change. While this is possible, especially in case of Valka municipality is very unlikely also because it does not have coastline.

There is not assessment provided for this risk and it is excluded from the further research.

4.3 In the field of Landscape Planning and Tourism

The research on risk and vulnerability assessment in the field of landscape planning and tourism has been carried out by “Baltkonsults", Ltd.8
The study was based on surveyresults obtained from inhabitants of Latvia - travelers (n = 675) and semi-structured interviews of experts (n = 60).
Similar to the previous sectors, the authors of this study first created a broad list of possible risks, and then some of these risks were studied in depth.

4.3.1 Identified risks

Within the framework of the study, initially nine risks were identified that have an effects on landscape planning and tourism:

- flood risk (rising water levels in rivers and lakes);
- risk of decreasing water quality;
- risk of changes in river run-off;
- risk of flooding and erosion of the Baltic Sea and the Riga Gulf coastline;
- risk of storm caused damage to forests (wind caused tree toppling);
- risk of increased incidence of forest fires;

[9] Risku un ievainojamības novērtējums un pielāgošanās pasākumu identificēšana ainavu plānošanas un tūrisma jomā (2016), SIA Baltokonsults

- risk of changing timeframe of summer tourism season;
- risk of changing timeframe of winter tourism season;
- risk of increasing incidence of heat waves.

4.3.2 Risks selected for in-depth analysis

Four risks were identified and assessed that were deemed most relevant to landscape planning and tourism industry:

4.3.2.1 The risk of changing lengths and character of the winter tourism season

With climatic change, there is an air temperature in the winter months affecting snow cover and stability. This affects winter tourism season length and limits possible range of activities.

Such factors influence the choice of winter sports activities of the population of Latvia, habits, as well as trends in the demand of tourist accommodation in the winter season.

Table 14. Risk assessment: Changing the length and character of the winter tourism season[9]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4			x		
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with high probability of occurrence and medium impact.

4.3.2.2 Flood risk (rising water levels in rivers and lakes)

Climate change can affect water levels in water bodies and water courses. The amount of precipitation in Latvia in recent years has increased during all seasons except for autumn. The precipitation level during winter and spring periods will affect the nature of the spring river ice melt, its intensity and flooding of areas surrounding water bodies and reservoirs.

With regard to landscape planning and tourism, the risk of flooding at national level is assessed as significant with a very high probability. In context of tourism and landscape planning area, only those floods were considered that arise from natural weather conditions – caused by ice melt, and not as a result of sea floods.

Table 15. Risk assessment: Flood risk (rising water level in rivers and lakes)[9]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5		x			
High	4					
Medium	3					
Low	2					
Very low	1					

4.3.2.3 The risk of flooding and erosion of the Baltic Sea and the Riga Gulf coastline

Strong sea winds (20 m / s or more) and low atmospheric pressures on the Baltic Sea cause flood waters into coastal areas. As a result, water levels in rivers and seaside lakes increase, which in turn results in flooding of adjoining areas. Wind turbulence caused by storms is one of the factors contributing to the shrinkage of the seaside and the erosion of the coastline and inland movement of coastal line. Furthermore, due to the degradation of the dunes during the wind caused flooding, areas behind dunes might be affected.

Table 16. Risk assessment: Flooding and erosion of the Baltic Sea and the Riga Gulf coastline[9]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3			x		
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with medium probability of occurrence and medium impact.

4.3.2.4 Risk of changing timeframe of summer tourism season

In recent years, increse was observed in the average air temperature during the summer season, as well as the meteorological length of summer time, which has a positive effect on the summer tourism season, not only in Latvia, but in all the Baltic States. Based on these changes in the summer season, the context of this study this effect is considered to be beneffitial. Research experts have also analyzed the increasing number of heat waves and tropical nights.

Table 17. Risk assessment: Changing timeframe of summer tourism season[9]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3			x		
Low	2					
Very low	1					

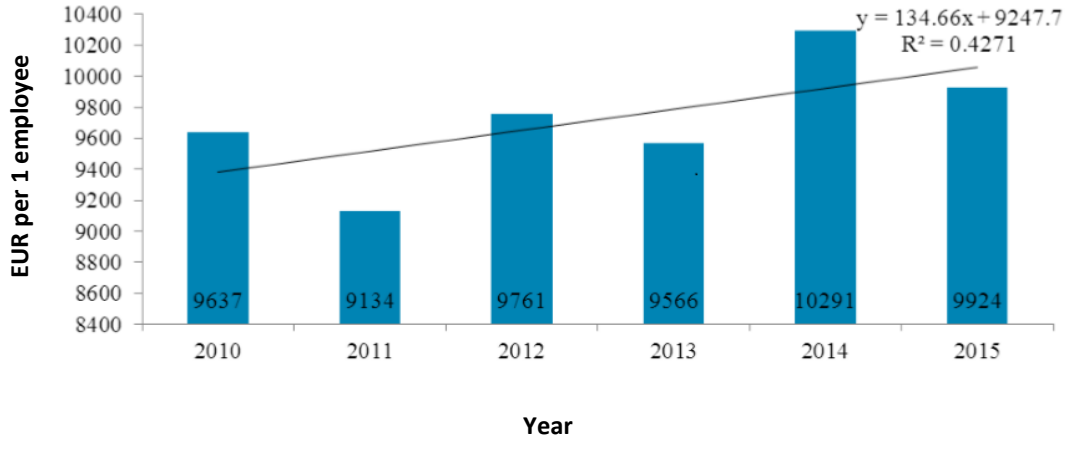
According to expert assessment, this risk is medium - with medium probability of occurrence and medium impact.

4.4 In the field of Agriculture and Forestry

The study "Assessment of Risk and Vulnerability and Identification of Adaptation Measures in the Field of Agriculture and Forestry" was also announced by the VARAM and carried out by Dr.silv. Ari Jansson, Dr.oec. Sandija Zēverte-Rivža, Dr.sc.ing. Laima Bērziņa, Dr.agr. Kaspars Kampuss and Dr.oec. Dina Popluga[10].

Climate change can have a direct impact on both agriculture and forestry. Currently, these areas are relatively stable and significant in the economic development of Latvia. The value added per employee in these sectors is increasing, and the skilled workforce employed these areas is relatively high.

Figure 1. Value added per person employed in agriculture, forestry and fishing in Latvia (EUR), in the year 2010-2013[10].



The authors of the study emphasize that climate change can affect agriculture and forestry in several ways - through unpredictable temperature variations, changes in hydrologic cycles, the frequency and intensity of extreme weather conditions, and the availability of water. Based on predictions, agricultural and forestry production will come across increased volatility or uncertainty, reduce production, and change the geography of production.

4.4.1 Identified risks

Unlike previous studies, this research describes the risks in terms of climatic effects and provides in-depth analysis for all identified risks. The following risks are mentioned:

Risks in agriculture:

Table 18. Risk in agriculture[10]

Climate change	The effects of climate change	Identified risks
Annual average temperature increase	Greater snow cover uncertainty in winter (difference between min and max January-February)	• Risk of harvest loss • Risk of frost caused crop dmage • Risk of damage to fruit tree trunks
	Average summer temperature rise (C degree)	• Risk of insect bites, mosquitoes • More rapid drying of soil / dry plants (evaporation, transpiration) due to higher temperatures (increased risk of drought stress even in the shorter dry period)
	Meteorological summer time increase (days)	• Risk of spreading plant diseases • Risk of plant pest infestation
	Meteorological autumn time increase (days)	• Risk of weed spread
	Meteorological winter time decrease (days)	• Risk of frost and freeze damage to flowers and buds of fruit trees
	Late water freezing (days)	• Warm (> + 5 ° C) periods in the beginning / middle of the winter promote vegetative renewal and loss of winter-hardiness for fruit trees and shrubs - the risk of freezing in the end of winter
	Winter average temperature increase (degrees)	• Loss of harvest due to the insufficient duration / depth of the cold period
	Meteorological spring time increase (days)	• Risk of spring frost damage - Heat waves in the early spring contribute to the development of premature plants and loss of flower / shoot instability • Risk of bud damage caused by early blooming - heat waves in the early spring contribute to blooming of plants, but the subsequent colder period (with positive temp.) Interfere with the pollination and fertilization
	Earlier snow cover loss (days)	

	Earlier soil thawing (days)	• The risk of uneven sprouting of crops - lack of snow cover or early melting reduces water supplies in the soil and underlying layers, and seedlings may suffer from drought
	Early ice melt and metwater entering rivers (days)	
Flood risk	Greater precipitation in winter (mm)	• Flood risk
	Greater precipitation in autumn (mm)	• Loss of crops and crop yield due to rainfall during harvest
Extreme weather ciondition	Increase in prologed periods of high temperature extremes (heat waves) in summer (days / seasons with maximum daily temperature higher than 30 degrees C)	• Risk of wind damage • Risk of frostbite • Hale risk • Risk of storm (for fruit trees) • Decreased productivity and immunity of animals due to heat waves
	Increase in possibility of of sudden and strong thunderstorms in summer (during the day / season)	
Increase / decrease in precipitations	Total precipitation decrease in summer (mm)	
	Total annual rainfall increase	• Excessive precipitation risk
Drought	The probability of more frequent and prolonged periods of drought in summer (vegetation season)	• Drying out

Risks in forestry:

Table 19. Risks to forestry[10]

Climate change	The effect of climate change	Identified risks
Annual average temperature increase	Greater snow cover uncertainty in winter (difference between min and max January-February)	• More rapid drying of soil / plants (evaporation, transpiration) due to higher temperatures (increased risk of drought stress, even during a short time) - significant during the first tree growing season
	Meteorological summer time increase (days)	• Risk of tree desease spred (including new diseases) • Risk of increased tree pest spread and new emerging pest species
	Meteorological autumn time increase (days)	• Warm (> + 5 ° C) periods in the beginning / middle of winter cause loss of winter-hardiness for trees: a decrease in growth (very rare-damage) risk
	Meteorological winter time decrease (days)	• Spring (and autumn) frost damage - Warm waves in the early spring contribute to

		premature plant development and flower / shoot instability loss
	Winter average temperature increase (degrees)	• Increased risk of wind damage (lack of soil hardening)
Extreme weather ciondition	More frequent cyclone storms; increase in possibility of sudden and strong thunderstorms in the summer (during the day / season)	• Risk of wind damage • Increased fire hazard • Increased damage caused by rainstorms

4.4.2 Most significant risks

Taking into account the peculiarities and significant differences of some industries, in this study all the risks identified in the previous section are addressed at the various sectoral context. In order to maintain a common methodology within this document, the evaluation only refers to selected risks that are considered high or moderate in the reviewed areas.

4.4.2.1 Spring frost damage

Table 20. Risk assessment: Spring frost damage[10]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3			x		
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with medium probability of occurrence and medium impact.

4.4.2.2 Distribution of tree pests (including new species)

Table 21. Risk assessment: Distribution of tree pests (including new species) [10]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3				x	
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with medium probability of occurrence and high impact.

4.4.2.3 Storm risk

Table 22. Risk assessment: Storm risk[10]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3				x	
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with medium probability of occurrence and high impact.

4.5 In the field of Construction and Infrastructure

A risk and vulnerability assessment was carried out in the field of construction and infrastructure planning in order to create a climate change adaptation strategy for Latvia. The research was conducted by the association "Zaļā brīvība" and its associated experts. Analysis was based on the following aspects: buildings, transport, energy and other infrastructure.

4.5.1 Identified risks

- In the construction industry - Increased climate variations, humidity and temperature rise will accelerate the deterioration of stone and metal structures [(1)]. Buildings that are built using unapproved building materials and methods that are not compliant with safety standards [(2)] will be most affected when exposed to the extreme weather conditions.
- In the transportation industry - in Latvia, the vulnerability of this sector is associated with precipitation and temperature changes. Heat periods can lead to melting of the road coating and the degradation of asphalted roads. In addition, intense rainfall causes damage of non-asphalt roads and leads to service breaks (3). Significant damage to bridge infrastructure is expected, which is subject to long-term flood and river flood effects.

- In the energy industry - The impact of climate change on energy demand in developed countries is likely to be minimal [4]. As a consequence of the gradual increase in temperature, indoor heating energy demand may decrease during the winter, while rising in summer, for example to ensure the functioning of the cooling systems.

4.5.2 Risks selected for in-depth analysis

4.5.2.1 Storm damage to the roof covers

Although the total number of stormy days in the future is projected to decline, storm gust speed is expected to increase. Accordingly, there is a risk of storm damage, especially in the vicinity of Ventspils. Even though the total number of endangered buildings does not exceed 1%, analysis of historical data shows that damage to relatively large public buildings with flat roofs (for example, the roof of a hospital in Ventspils) can be expected.

Table 23. Risk assessment: Storm damage to the roof covers

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is insignifficant - with very high probability of occurrence and insignificant impact.

4.5.2.2 Increased damage to buildings by rainfall-caused floods

According to the forecasts made by the LVĢMC, maximum precipitation is expected to increase over the entire territory of Latvia. The relatively high threat is identified at the seafront, in Latgale and Vidzeme highlands.

One of the main vulnerabilities is the capacity and quality of the available rainwater drainage systems, especially in cities where there are other major types of flood hazards. Detailed flood risk assessments were carried out in Riga and Ventspils, and possible preventive measures were identified.

According to a study on the risk of flooding and snowmelt flooding in Riga [5], currently, 15 social infrastructure objects are under threat of with various probability. In the future, 36 social infrastructure objects, including 12 educational establishments, could be under threat of flooding, with highest risk probability of 0.5%.

Table 24. Risk assessment: Increased damage to buildings by rainfall-caused floods

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

4.5.2.3 Increased snow cover load on the roofs

Taking into account the projected increase in temperature and snow cover, the risk of increased snow cover load on building roofs depends on whether higher snow fallout will occur in the winter. The danger is in the rapid formation of a thick snow cover, followed by a temperature increase above zero, thus increasing the snow load several times.

The endangered objects are buildings with large flat roof surfaces, as well as unapproved structures that are not built in accordance with the existing building regulations - sheds and similar auxiliary buildings.

Table 25. Risk assessment: Increased snow cover load on the roofs

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is insignifficant - with very high probability of occurrence and insignificant impact.

4.5.2.4 Increased indoor overheating

Concerning forecasted rise in temperature, the LVĢMC study identified two contributing factors - the extension of the summer period and the increase in the number and intensity of heat waves that will lead to indoor overheating above the prescribed standards. Although this does pose a danger to the building construction, this risk is significant in a socio-economic context. Adaptation measures include introduction and improvement of adequate ventilation

and air-conditioning equipment for the premises, as well as modifications to building constructions.

The most vulnerable are groups in densely populated public spaces, especially those with limited mobility - in teaching and health care facilities. Significant amount could also be constituted by workers in specific work places, where the employer does not ensure the relevant indoor temperature conditions in a timely manner.

Increased indoor ovweheating is more likely to happen in Souther Europe and less in Northern Europe. Since Valka is located in a region of Latvia where the extreme temperatures are uncommon this risk is not relevant.

Table 26. Risk assessment: Increased indoor overheating

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

4.5.2.5 Increased road damage due to rain caused flooding (along with decreasing of road freezing period)

Very wet conditions have an adverse effect on the gravel road surface [(6)], which is partially washed away, and is subject to higher transport damage due to reduced carrying capacity. In Latvian conditions, the most intense moisture is caused by melting snow and ice. However, given the expected increase in temperature over winter, the overall decline in ice and snow amount is expected.

Uncovered roads, for example, forest roads, are more susceptible to damage caused by the transport movement in wet conditions. Currently, the development of many wetlands in Latvia occurs only in frost conditions in winter, but, with shorter periods of frost, logging is more likely to be carried out in weather conditions that cause more damage to roads. With the increase in the total rainfall, it becomes increasingly more difficult to find suitable weather conditions for forestry.

Table 27. Risk assessment: Increased road damage due to rain caused flooding (along with decreasing of road freezing period)

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is insignifficant - with very high probability of occurrence and insignificant impact.

4.5.2.6 Damage to electric distribution networks due to wind gusts

Based on historical data strong wind conditions, including storms, hurricanes and tornadoes, have caused most of the network interruptions, mainly causing damage to energy distribution networks (most of the damage is caused by trees). Breakdowns of distribution networks cause losses to both power supply companies and their distribution networks as well as their customers, consequently, resulting in loss of production, delayed delivery of products, etc. These losses can be mitigated by improving energy efficiency by providing autonomous electric power generators and taking preventive measures for the clearing and cable-laying of electricity supply lines.

Table 28. Risk assessment: Wind caused damage to energy distribution networks

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4			x		
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with very high probability of occurrence and medium impact.

4.5.2.7 Increase in electricity demand during summer and reduced demand in winter

Table 29. Risk assessment: Indoor overheating and increased demand for electricity during summer period

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is insignificant - with very high probability of occurrence and insignificant impact.

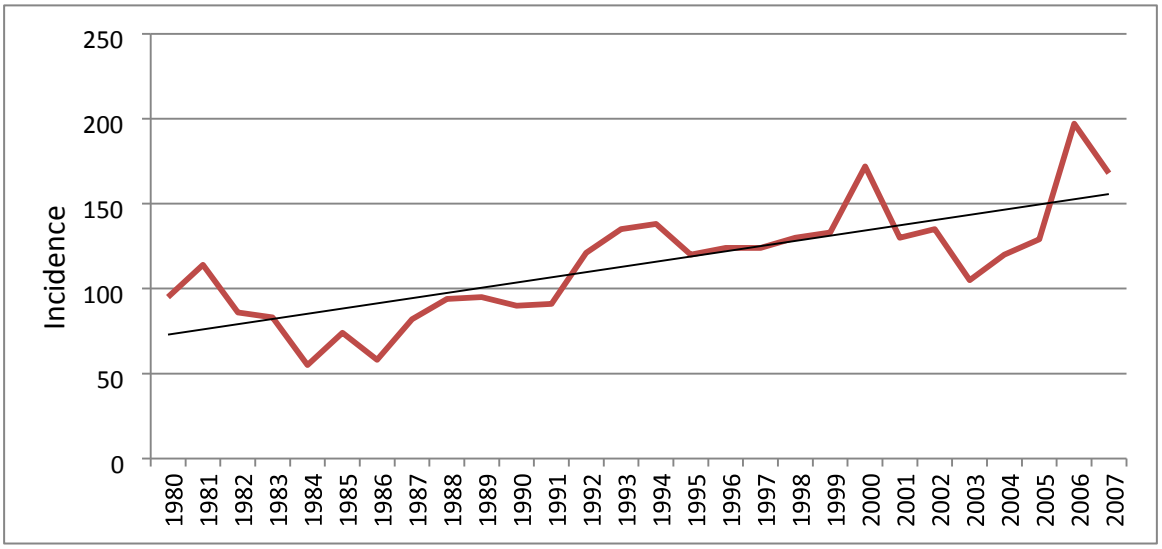
Although a drop in demand may cause losses for the energy suppliers, this risk is not relevant in the context of physical infra-structures and will not be analysed.

4.6 In the field of Civil Protection and Emergency Assistance

Research was carried out by „Procesu analīzes un izpētes centrs", Ltd., determining risks, carrying out vulnerability assessment and identifying adaptation measures in the field of civil protection and emergency assistance.

Rare extreme weather events play an important role in the area of civil protection and emergency assistance - such events that cause the greatest damage to human health and well-being. In the context of climate change, climate extremes are analysed from perspective of increased frequency, duration, intensity and seasonal aspects, compared with the earlier period.

Figure 2. Number of extreme climate events in the EEA Member States and the trend line of their occurrence



4.6.1 Identified risks

The research included disaster risks that are directly related to civil protection and emergency assistance. Considered were disasters caused directly by extreme weather events (such as storms or floods) rather than long-term, moderate effects (i.e. landslide caused by coastal erosion).

In the context of climate change and meteorological / hydrological conditions, two types of categories were identified:

- direct risks or natural disasters;

- secondary risks, or other disasters caused by weather conditions.

Table 30. Direct risks in the field of civil protection and emergency assistance and assessment of their relevance.

No	Natural disaster	CAKP* law	Current risk (1-3)
1	Spring ice melt flooding	X	3
2	Wind caused coastal flooding	X	3
3	River flooding	X	2
4	Rainfall	X	1
5	Hail	X	1
6	Lightning	-	1

7	Snow cover	X	1
8	Storm	X	3
9	Draught	X	2
10	Heavy frost	X	2
11	Heavy heat	X	3
12	Icing	X	1
13	Forest fire	X	2
14	Natural disasters abroad	-	1

According to experts, most relevant risks are spring ice melt flooding, wind caused coastal flooding, storm and heavy heat.

* The Civil Protection and Disaster Management (CAKP) Law covers almost all direct risks associated with climate change and meteorological / hydrological conditions. Risk listing in the CAKP law was determined by its significance and based on an expert assessment.

4.6.2 Risks selected for in-depth analysis

- **Icemelt water floods and ice congestion** - includes melt water and ise congestion (jamming) caused flooding. This risk is related to snow cover thickness, air temperature (snow cover), ice amount and duration, ice break and run time. The secondary impact on such flood is based on the river basin relief, overgrowth, land use, soil characteristics, engineering structures (reservoirs, dams, etc.). The impact of the flood depends on whether flooded areas were populated.
- **Flooding caused by heavy rainfall**: Includes direct hazards caused by heavy rainstorms and floods caused as a result of heavy rainfall. The secondary effects of such flooding is based on the characteristics of the river basin and engineering structures. The impact of the flood depends on whether flooded areas were populated.
- **Storm and sea winds**: Includes hazards of wind storms and wind caused flooding, especially in coastal areas and river mouths. In case of heavy storms, the pozed threat posed is significan in the whole country.
- **Forest and peat fire**: Includes fire hazard, which is directly related to drought. This threat depends on both weather conditions and the land use, mainly the density of forests. Fires are usually caused by human activities.

4.6.2.1 Ice-melt water floods and ice congestion

Considering the increased latency in ice formation and earlier melting, a decline in the maximum runoff of rivers is expected in the future, resulting in a decreased melt water volume and frequency of flooding[(2)].

Table 31. Ice melts water floods and ice congestion risk matrix – currently and in the future.

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4			x		
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is medium - with high probability of occurrence and medium impact.

4.6.2.2 Flooding caused by heavy rainfall

According to prognosis there occurrences heavy rainfalls will increase in the future and therefore more frequent floods caused by such rain are expected [(2)].

Table 31. Heavy rainfall and resulting flood risk matrix – currently and in the future.

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5	x				
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is insignificant - with very high probability of occurrence and insignificant impact.

4.6.2.3 Storm and sea winds

The conclusions of the current research on the impact of climate on the nature and reccurance of storms are ambiguous. As the sea level is expected to rise in the future[(3)], the sea wind turbulence and wind caused flooding is likely to increase.

Table 32. Storm and wind caused flood risk matrix – currently and in the future.

[Type text]

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5					
High	4					
Medium	3				x	
Low	2					
Very low	1					

According to expert assessment, this risk is high - with medium probability of occurrence and high impact.

4.6.2.4 Forest and peat fire

The conclusions of the studies on the effects of climate change available at present are ambiguous. In order to assess the impact of climate change on the risk of forest and peat bog fires, the Canadian Fire Risk Index UBI was used istead, which was deemed to be characteristic of Latvian conditions [(4)].

Table 33. Forest and peat fire risk matrix – currently and in the future.

	Likelihood	Insignificant risk	Significant risk	Medium risk	High risk	Very high risk
Very high	5		x			
High	4					
Medium	3					
Low	2					
Very low	1					

According to expert assessment, this risk is significant - with very high probability of occurrence and significant impact.

5 Valka district situation

Valka district is located in the north-east of Latvia. It includes five parish territories and the city of Valka. The administrative center is the city of Valka, located in the hillocks of Ērģeme, in the Sakala Highlands. The valley slope stretching throug cities is crossed by Pedele River. In the western part of city in the hillocks of Burgas, highest points can be found elevating up to 90 m a.s.l.

In the beginning of 2015, the population of Valka County was 9670 (incl. 5590 in Valka), but in recent years it has decreased by about one hundred per year. The average population density in the district is 10.7 inhabitants / km^2.

Valka County's vision is a favorable, clean and tidy forest-rich environment with quality infrastructure for living and conducting business in Northern Vidzeme.

There are no meteorological observation stations in Valka district. Therefore it's relatively difficult to identify climate change.

While writing this section, several documents developed by the Valka County Council have been used, where from more detailed information on different areas and the environmental situation in general was obtained.

- Environmental Review (2016), Valka County Council
- Valka County Regional Planning 2016-2017. Valka Dome (2015)

5.1 Environmental characteristics

5.1.1. Air temperature

In the Valka district, the average annual air temperature ranges from + 4.6 °C in the southern part of the region to 5.0 °C in the northwest of the region. In the course of the year, the coldest month is January with an average air temperature from -7.0 in the southeast to -6.6 °C in the northwest and an average minimum air temperature from -9.5 °C to -10 °C. The warmest is July with a monthly average temperature of +16.1 to + 16.5 °C and an average maximum of +21.2 to + 21.9 °C. To this day, the absolute minimum air temperature is -40 to - 42 °C, the absolute maximum air temperature is +33 to + 34 °C.

Compared to other regions of Latvia, Valka region has a short vegetation period. In the summer of 2015, the temperature exceeded +30 degrees for several days, but in the third week

of August the temperature was slightly above 0 °C, and frosts were couild be observed in some places.

5.1.2 Precipitation

On average, precipitation can occur every other day. The annual rainfall is 670 to 710 mm. The highest precipitation is in July and August (monthly precipitation is 85 to 95 mm), the least - in February and March (monthly precipitation is 25 to 35 mm). Generally, the prevalent are winds from the south, southwest, and west directions. The highest wind speed is in November-January (with monthly average of 3 to 5 m/s), the lowest - in July-August (monthly average of 2-3 m/s).

5.1.3 Water bodies

Valka district is located more than 100km from the sea coast.

Surface waters in Valka County occupy an area of 5278.8 ha. Based on the hydrographic breakdown, the watercourses and water bodies in the territory of Valka are located in the Gauja River, Salaca and Emajõgi river dranage basins.

The main part of the hydrographic network in the Valka area is the rivers that represent the 3 river mouth areas - Gauja, Salaca and Emajõgi (flowing through Estonia to the Gulf of Finland). There are 46 rivers in the district, of which 18 are longer than 10 km. The largest is the Gauja (about 80 km flowing through in the district). Vija, Seda, Pedele and Omuļupe are from 25 to 100 km long.

The **Gauja drainage basin** (its tributaries and their basins) occupy mainly the depression of Vidusgauja, Aumeistar valley and part of Vidzeme highlands. Gauja has the largest left tributary of Vija, while others are considerably smaller. The upper reaches of the tributary basins on the left bank of the Gauja are located in the northeastern part of the Vidzeme upland. The river depressions are relatively small. For the largest rivers in the upper reaches they usually exceed 4 m/km, for lower reaches they are smaller- 1-2 m/km. For some of the smaller rivers in the upper reaches drop can range from 8-11 m/km to less.

The northern part of the district is located in the **Salaca drainage basin**, whose rivers are primarily characterized by the tributaries of the Burtnieks (Lake Burtnieki, Seda etc.). These river basins are mainly in the North Vidzeme lowland, with the lower part of the central part forming Burtnieks. The river depressions are not particularly large (0.1 - 0.2 m / km), which complicates the drainage and contributes to marsh formation. So the marsh proportion of basin of the Sedas River is 10% (in Latvia, on average - 9.9%). River network density - 0,4 km/km2.

In the north-eastern part of the region, the rivers - Omuleupe and Pedele belong to the Emajõgi (Estonia) drainage basin.

Valka region rivers belong to the flat water type. During summer groundwater is the main source for the rivers, while in other seasons, Melting snow and rainwater are primary sources.

From the rivers found in the Valka district, only the Gauja is included in the public river list.

5.1.4 Characterization of different areas

This sub-section will describe the areas that were included in national climate change studies.

5.1.4.1 Biodiversity and ecosystem services

The biodiversity of the Valka district area is linked to a number of protected areas.

The following specially protected nature territories are located in Valka district:

- North Vidzeme Biosphere Reserve;
- Protected Landscape Area North Gauja - NATURA 2000 Territory;
- Nature Reserve "Kārķu Swamp" - NATURA 2000 territory of 292.5 ha;
- Nature Reserve "Bednes Swamp" - NATURA 2000 territory of 22 ha;
- Nature Reserve "Vadaiņu Swamp" - NATURA 2000 territory of 221.4 ha;
- Nature Reserve "Sedas Swamp" - NATURA 2000 territory 330.1 ha;
- Nature Reserve "Burgas Meadows" - NATURA 2000 territory of 183.3 ha;
- nature reserve "Lapinu lake" - NATURA 2000 territory of 0.8 ha;
- Nature Reserve "Taurīšu lake" - NATURA 2000 territory of 1.6 ha;
- 85 Micro nature reserves

266 protected trees (Great-trees, according to the criteria set by the Cabinet of Ministers) grow in the Valka region and are listed in Annex 3 to the Explanatory Memorandum of the Valka County Spatial Planning.
The Great-/Heritage trees play an important role in maintaining overall biodiversity, as the diversity of their habitat is an important environmental quality characteristic. The Great tree is perceived as an independent ecosystem, a living space for many rare and endangered species of mammals, birds, insects, mushrooms and other organisms. The most important regulation defining the status of the Great-tree and its management is the Law "On Specially Protected Nature Territories" ("LV", 5, 25.03.1993), issued in 1993, and Cabinet of Ministers Regulations No. 16 of March 16, 264 "General rules for the protection and use of specially protected nature territories", with the criteria of the Great-tree listed in Annex 2.

5.1.4.2 Health and welfare area

There are 8 family doctors available in the Valka district (7 in Valka, 1 in Kārķi). Emergency medical care can be obtained at the Emergency Medical Care Center, where the assistance is provided by a doctor and a nurse or „Vidzeme Hospital", Ltd. In Valka there is one emergency care paramedic team on duty[9].

[11] Informācija no Valkas Novada Domes (2017), Veselības organizators Edīte Balode

Health and welfare data is available for the whole Vidzeme region, including Valka district information[10]. In the Vidzeme region, similar to Latvia as a whole, the most common causes of death are: cardiovascular diseases (60% of all deceased in 2014, 35% of all deceased), malignant tumors (21% in 2014) , up to 64 years old - 27% of all dead) and external causes of death (5.8% in 2014, up to 64 years old - 18% of all deceased).

5.1.4.3 Landscape planning and tourism

There are several local architectural, cultural and historical objects in the Valka area.

Valka county has a specially protected landscape area of national significance "Northern Gauja". Its territory includes Valka, Vijciems and Zvartavas parishes. The North Gauja Valley has a mosaic landscape with a great diversity of habitats and species.

Vijciems parish is a meadow-rich territory with elements of economic activity dating to varius periods of history: plantations (groups of trees) around courtyards, old alleys, masonry buildings, crooked rural roads, manor houses. The most valuable landscape of the countryside is the North Gauja Protected Landscape Area (NATURA 2000).

The most valuable landscapes of the Kārķi parish include the road section from the „Naglas" to the„Vēveri", the surroundings of Lake Cēsis, the surroundings of Lake Cepšu, the surroundings of Lake Bezdibeņa, the High (White) Mountain, the Spaļu alleys, the old tree line along the road before Kārķu center border, arriving from Rūjiena side.

The contrasting landscape of Zvārtava parish is determined by the distribution of tree species and the aeolian dunes. Visually appealing forest landscapes can be admired along Valka - Virešu road. 4915 ha of Zvārtava parish territories (28.9% of all parish territories) are included in the Protected Landscape Area "North Gauja". The wide view of the Gauja valley landscape opens in Zvartavs parish near the Valka - Virešu road, in the Cirgala forest. Landscaping would be desirable in several places. Park-like meadows in Valka and Zvartava parishes, inland dune array in the vicinity of Cirgala, and Gauja coastline can be included in the list of significant landscape elements

In Ērģemes parish, the structure of the landscape is determined by the detailed mountainous terrain of Ērģeme hillsides. The aesthetically and historically significant elements of the landscape - oak alleys, manor and old-town buildings and parks, masonry buildings and their ruins, farmhouse greenery - are typical for North Vidzeme. Great landscape value is attributed to unstraightened, unregulated small rivers.

[12] Vidzemes Reģions veselības profils (2015), Slimību profilakses un kontroles centrs

There are seven guest houses, four country houses, one farmhouse, one recreation center and two youth hostels in the county. As an additional service, accommodation providers offer tent and caravan sites.

5.1.4.4. Agriculture and forestry

In general, 58.57% of the area is covered by forests. They are considered to be the largest treasure of the region. Forests area in Valka are expected to increase, due to natural over-growing of non-agricultural land as well as artificial afforestation.

5.1.4.5 Civil protection

In accordance with Article 17 of the Law "Civil Protection Law", objects of increased danger are identified in the Valka region.

The list of high-risk industrial accidents at the national level of prospective national importance includes:

- "Tīne", Ltd., (Valka, Tālavas 35a) - petrol station (Cabinet Regulation No. 532 of 19.07.2005 "Regulations on the Procedure for the Evaluation of Industrial Accident Risk and Risk Reduction Measures").

High-risk areas of potential national significance include fire-hazardous areas:

- Seda peat bog,
- Forests located along the railway between the Valmiera and Smiltene roads up to the Gauja River.

Prospective flood areas of national significance:

- Valka town - the dam on Pedele river, Zāģezera and Sēlijas Street. In the event of an emergency, bordering areas are flooded.
- Gauja River overflowing during spring floods woll couse flooding in:
    - In Valka parish area houses: "Vekši", "Krastiņi", "Marsi", "Mezaparks" and woodworking company "Ievinas".
    - In Zvārtava parish area houses: "Jauntillikas", "Rāmnieki", "Pedraudzes" un "Klajumi".

In the event of overflow of these high risk areas, access roads, production facilities and public housing will be damaged.

District level significe territories and objects:

- Former Siberian Pague Cemeteries: Valka Parish "Vēverzemnieki".
- Explosive objects:
    - gas filling station in Valka;

- the largest petrol stations in the territory of Valka.

- Fire hazard sites and areas:
  - petrol stations;
  - gas filling stations (Valka);
  - wood processing companies;
  - peat bog; meadows on peat layers;
  - forest area;
  - former municipal waste dumps.
- Among the potentially most dangerous motorways in the Valka district:
  - National Highway A3;
  - Railway Riga - Tallinn and St. Petersburg.

5.1.4.6 Construction and infrastructure

Valka district occupies territory of 906.8 km², including the district center - the city of Valka and territories of 5 parish administrations. The region is crossed by main road A3 / E264 Riga - Tartu, and the Riga - Tallinn railway, running via Valka and Valka parish.

Valka county territory is crossed by 110 kV and 330 kV overhead power lines. Electricity transmission network substation "Valka" is located in Valka, Raiņa street 90. "Latvijas propana gāze", Ltd., Valkas Liquefied Gas Supply Station is providing gas for Valka region. Residents use liquefied central gas systems and gas cylinders. Telecommunications in yhe country are ensured by fixed and mobile network infrastructure. „ Lattelecom", Ltd., is the main fixed phone network provider. The company owns 91% of shares in the communications market. The rest of the market is occupied by alternative operators. Most areas, including the largest populated areas, have mobile coverage. The Internet is available in almost all requions of Valka district. In all parishes, it is provided via radio waves.

Valka Town, Valka Parish Village, Kārķi Parish Village, Ērģeme Parish Village, Zvārtava Parish, Vijciems Parish Village People use centralized water supply system. In Valka Town, Valka Parish Village, Kārķi Parish Village, Ērģeme Parish Village, Vijciema Parish Village, centralized sewage systems are installed.

The heat production in the Valka region is organized in three ways:

- Central Heating Systems: in Valka city and Ērģeme (Ērģeme parish), which provides centralized supply of heating and hot water to the population;
- Local heating systems: each customer (building or building complex) has a separate heat energy production facility for providing hot water and heating (for example, a pellet boiler in Valka kindergarten "Pumpuriņš", wood heating in Sēļi village, etc.);

- Individual heat supply: the inhabitants have installed a hot water and heating supply system in their apartments, in isome cases individual heating system is installed in the municipal buildings (for example, a school building in Kārķu parish, a multi-apartment building in Zvārtava parish, etc.).

6 Identified Climate Change Risks & Valka District Situation

The first part of this report describes risk and vulnerability studies conducted by experts from different fields at national level. The situation in the Valka region is described on the basis of environmental aspects and areas that are affected by climate change risks analyzed at national level.

All identified risks are listed below and based on available information on Valka district situation, risks applicable to Valka district were determined.

Table 34. Identified risks and impacts in Valka district situation

#	Risk	The effects of climate change	Relevant to Valka district Yes/No
1. In the field of Biodiversity and Ecosystem service			
1.1	Contamination / eutrophication of water bodies	Increase in average water temperature, annual total precipitation increase (mm), total precipitation decrease in summer (mm)	Yes
1.2	Ecologically plastic species (generalist species) replacing Ecologically-sensitive species (specialist spieces)	Combination	Yes
	Infectious diseases not common to Latvia	Annual average temperature rise, winter temperature rise	Yes
1.3	Possibility of arrival of new species	Increase in average water temperature (degrees), winter temperature rise (degrees), decrease of snow cover thickness in winter (difference between min and max January-February)	Yes
1.4	Increased areal dispersal and viability of pests and pathogens	Average summer temperature rise (degrees), winter minimum temperature rise, higher variability of snow cover thickness in winter (difference between min and max January-February), wind caused tree toppling, fires	Yes
1.5	Flood - storm tides on the seashore	Increase in sudden and strong thunderstorms duringsummer (storm days / season)	Yes
2. In the Health and Welfare area			
2.1	Increase in acute intestinal infection rate, outbreaks of these diseases	Increase in meteorological summer time (days); Total annual rainfall increase; Average summer temperature rise (degrees)	Yes
2.2	Exacerbations of chronic diseases (SAS, diabetes, etc.) and mortality rate increase	Increase in longer periods of extreme high temperatures (heat waves) in summer (day / season with maximum daily temperature higher than 30 °C)	Yes

2.3	Increased disease rate and / or endemic infectious diseases spread by carriers	Meteorological autumn period increase (days), meteorological summer period increase (days), meteorological winter period decrease (days)	Yes
2.4	Increased incidence of respiratory diseases and mortality, especially for different risk groups	Meteorological autumn period increase (days), meteorological summer period increase (days), increase in longer periods of extreme high temperature (heat waves) during summer (days / seasons with maximum daily temperature higher than 30 °C)	Yes
2.5	Increased heat stroke incidence	Increase in longer periods of extreme high temperature (heat waves) during summer (days / seasons with maximum daily temperature higher than 30 °C)	Yes
2.6	Internal and external migration	Combination	Yes
3. In the field of Landscape Planning and Tourism			
3.1	The risk of changing lengths and character of the winter tourism season	Meteorological winter period decrease (days), earlier snow cover loss (days)	Yes
3.2	Flood risk (rising water levels in rivers and lakes)	Annual total precipitation increase (mm)	Yes
3.3	The risk of flooding and erosion of the Baltic Sea and the Riga Gulf coastline	Increase in sudden and strong thunderstorms during summer (storm days / season)	No
3.4	Risk of changing timeframe of summer tourism season	Meteorological summer period increase (days)	Yes
4. In the field of Agriculture and Forestry			
4.1	Distribution of tree pests (including new species)	Meteorological summer period increase (days)	Yes
4.2	Spring frost damage	Increase in longer periods of extreme high temperature (heat waves) during summer (days / seasons with maximum daily temperature higher than 30 °C)	Yes
4.3	Storm risk	Increase in longer periods of extreme high temperature (heat waves) during summer (days / seasons with maximum daily temperature higher than 30 °C)	Yes
5. In the field of Construction and Infrastructure			
5.1	Storm damage to the roof covers	Increased speed of wing gusts	Yes
5.2	Increased damage to buildings by rainfall-caused floods	Maximum rainfall increase, limited sewage system capacity and quality	Yes
5.3	Increased snow cover load on the roofs	A larger amount of precipitation during the winter forms thicker snow cover, which, when melting, increases the snow load	Yes
5.4	Increased indoor overheating	Temperature rise, summer period prolongation	Yes
5.5	Increased road damage due to rain caused flooding (along with decreasing of road freezing period)	Precipitation increase, shortening of frost periods	Yes
5.6	Damage to electric distribution networks due to wind gusts	Increased speed of wing gusts	Yes

5.7	Increase in electricity demand during summer	Temperature rise, summer period prolongation	Yes
6. In the field of Civil Protection and Emergency Assistance			
6.1	Ice-melt water floods and ice congestion	Thicker snow cover caused by increased winter precipitation	Yes
6.2	Flooding caused by heavy rainfall	Greater total rainfall	Yes
6.3	Storm and sea winds	Increase in the speed of storms, the risk of flooding caused by a sea-storm	No
6.4	Forest and peat fire	Drought periods caused by temperature rise	Yes

7 Prioritization of Risks according to the Valka situation

Previous sections list a high number of risks that have been determined by several country-wide research projects. This was used to identify and analyse the risks.

In order to discuss and evaluate the risks and preventive measures for Valak situation specifically a group of local specialists were gathered in Valka City Council to attend a meeting on 8th of September, 2017. Representatives from various fields were invited – health and welfare, construction, tourism, civil protection and work safety, county planning and development, as well as management. Complete list of participants and invitations issued, agenda and summary of covered topics can be found in attachment.

Several weeks prior to meeting specialists were supplied with reports on identified risks and adaptation activities to prevent these risks or reduce the impact ("C10 Climate Change Risks and Vulnerabilities un C10 Climate change adaptation activities" in Latvian). Participants were asked to familiarize themselves with the documents in order to prepare for a discussion, and provide constructive comments and suggestions on the topic.

Goal of the meeting was to exchange information in various fields of expertise and how the latter can be affected by climate change, and what kind of adaptive measures are required and can be implemented. Two methods were employed:

- discussion, where all identified risks were analysed and main risks were identified;
- written survey, that was filled in individually

7.1 Discussion

Participants were involved in open discussion and share their opinion on what are the main risks of climate change, and what should be the main focus of the project going further. Following risks were highlighted:

1.2. Generalist species replacing specialist species.

Experts pointed out a hogweed invasion as one of the main concerns. Mapped spread of hogweed in Valka district in attached to the report.

Suggestions: Herd grazing in hogweed spread territories, mowing, chemical control (herbicides)

2.2. Chronic diseases flare (CVD, diabetes etc.) and increase in mortality rate.

Including acute viral infection outbreaks in organized groups.

Suggestions: Informative seminars, raising awareness of and educating medical personnel and social workers.

2.3 Increased incidence of diseases and/or endemic occurrence of insect-born infections.

Particular emphasis was placed on the increased tick distribution area and prevalence of tick-borne diseases. Based on data from The Centre for Disease Prevention and Control, Valka district is not an endemic region for Tick-borne encephalitis, therefore children under 18 years cannot avail of publicly-funded vaccination scheme.

Suggestions: Informative seminars, raising awareness of and educating medical personnel and social workers. Increase public awareness of non-specific preventive measures and their significance.

3.2 Flood risk (rising water levels in rivers and lakes), 5.5 Road damage caused by rainfalls and 6.2 Flood risk caused by heavy rainfalls

Flood affected areas were identified; risk area map was added to the report.

Suggestions: (1) Improve pumping station operation. The problem of capacity has been identified, as in the case of heavy rainfall, it's not sufficient to pump large volumes of water; an increase in capacity is required. (2) Develop a technical guidance project to optimize rainwater drainage systems. (3) Inspection of canal locks on river Pedele (Selija street) to assess its operational state.

5.1 Storm caused rooftop damage. 5.6. Electric distribution network disruptions due to wind gusts.

During storm in 2016, Mierkalna folk house rooftop was displaced, and trees fell in surrounding territories.

Suggestions: (1) Tree removal around power lines to prevent wind-caused disruptions. (2) Exploring alternative energy sources.

7.2 Survey

Participants filled in a survey, indicating (1) what is the likelihood of this happening in Valka and if it happens how severe the impact would and (2) what impact can be made to mitigate those risks at Valka district level, implementing various measures. Table 33 shows survey results and with an indication which risks were also identified during the discussion.

Based on their expertise and experience in particular fields participants determined risk probability in Valka district and possible mitigation or aversion measures applicable at regional level. Scale from 1 to 5 was used to assess the risk probability level, 1 indicating the lowest probability, and 5 – very high probability. This method was used to evaluate all 30 risks. Average rating for risk probability was 2.76 points, and 1.95 points for impact mitigation probability. Above average rating was obtained for 18 risks in risk probability category and 17 risks in

impact mitigation possibility. Out of these, 9 risks were assigned above average rating for both risk probability and mitigation possibility.

Table 35. Survey results summary

		Likelihood and impact	Ability to affect	In-cluded in dis-cussion
	1. Biodiversity and ecosystem service area			
1.1	Water body contamination/eutrophication	3,25	2,25	
1.2	Ecologically plastic species (generalist species) drive out ecologically sensitive (specialist species).	2,42	1,75	✓
1.3	Entrance of infection diseases uncharacteristic for Latvia	2,08	1,75	
1.4	Entrance and increase of viability of new species	2,75	2,00	
1.5	Increase in pest and pathogen spread and viability	3,25	1,67	
1.6	Flood risk (storm surge at sea coast)	0,58	0,25	
	2. Health and welfare			
2.1	Risk of increase in acute intestinal infection diseases, disease flare	3,25	2,58	
2.2	Chronic diseases flare (CVD, diabetes etc.) and increase in death rate	**3,08**	**2,42**	✓
2.3	Acquired endemic state and/or increase in diseases caused by insect-born infections	**3,17**	**2,33**	✓
2.4	Increase in incidence and mortality from respiratory diseases, especially within particular risk groups	2,92	2,58	
2.5	Increase in heat stroke frequency	2,33	2,58	
2.6	Internal and external migration	2,00	2,25	
	3. Tourism and landscape planning			
3.1	Change in winter tourism season length and characteristics	3,50	1,50	
3.2	Flood risk (water raising in rivers and lakes)	3,33	1,67	✓
3.3	Flooding and erosion of the Baltic Sea and Rīgas Bay coastal areas	0,75	0,33	
3.4	Change in summer tourism season length and characteristics	3,42	1,92	
	4. Agriculture and forestry			
4.1	Spread of tree diseases and insect pest populations	3,25	1,83	
4.2	Damage caused by spring frosts	3,42	1,42	
4.3	Storm risk	3,58	1,50	
	5. Construction and landscape planning			

5.1	Increased storm-caused rooftop damage	**3,67**	**2,50**	✓
5.2	Building damage risk due to rainfall caused flooding	3,00	2,17	
5.3	Snow caused overload increase on rooftops	2,75	2,58	
5.4	An increase in indoor overheating	2,25	2,67	
5.5	Road damage risk due to rainfall caused flooding	**3,17**	**2,50**	✓
5.6	Electrical transmission network damage due to wind gusts	**3,58**	**2,92**	✓
5.7	Increased demand for electricity during summer	2,50	2,25	
	6. Civil protection and emergency assistance			
6.1	Flood and ice drift	2,58	1,83	
6.2	Flood risk caused by heavy rainfalls	**3,33**	**2,00**	✓
6.3	Storm and storm surge risk	0,25	0,17	
6.4	Forest and peat fire risk	3,33	2,42	

7.3 Prioritization of risks

Main risks were determined based on discussion and survey results. These risks and mitigation and prevention measures were further analysed. 3 factors were taken into account when selecting the risks:

- Was the risk considered a priority during the discussion;

- Does the risk probability rating exceed average rating determined by the survey;

- Does the ability to affect/mitigate risk at Valka district level exceed average rating determined by the survey;

Table 36. Risks identified as main priority

2.2	Chronic diseases flare (CVD, diabetes etc.) and increase in death rate
2.3	Acquired endemic state and/or increase in diseases caused by insect-born infections
5.1	Increase storm-caused rooftop damage
5.5	Road damage risk due to rainfall caused flooding
5.6	Electrical transmission network damage due to wind gusts
6.2	Flood risk caused by heavy rainfalls

During the meeting it was established that risks no.5.5 and 6.2 are often grouped together as flood risk, with road damage as a main concern. In national expert studies above mentioned risks were determined from two separate areas - Construction and landscape planning and Civil protection and emergency assistance. Therefore, this is the same risk considered from two different perspectives. In context of Valka district, road damage was assessed to have the main impact.

As a result, following risks were prioritized:

1. Chronic diseases flare (CVD, diabetes etc.) and increase in death rate
2. Acquired endemic state and/or increase in diseases caused by insect-born infections
3. Increase storm-caused rooftop damage
4. Electrical transmission network damage due to wind gusts
5. Road damage risk due to rainfall caused flooding

8 Summary

Climate change is an important topic not only on the global agenda, but also on the Latvian agenda and even more locally – agenda of Valkas Municipality. The Ministry of Environmental Protection and Regional Development has been assigned to take lead in addressing the climate change related matters.

Latvia as a relatively small country in Northern Europe and Valka municipality is located in the Northern part of Latvia. Valka municipality consists of Valka City (slightly more than 5000 inhabitants) and rural territories (approximately 4000 inhabitants). The average density of people is 10 people per square kilometer. Unfortunately, there are no meteorological stations in the municipality; therefore, possibility of localized monitoring of climate change in Valka municipality specifically is limited. Taken this into account, and the fact that climate in Valka municipality has relatively small deviation from the overall climate in Latvia, the climate-change specific materials mostly relate to the research done on the national level. The identified risks are then assessed against the local situation to determine their relevance.

At the moment there are several studies conducted in Latvia that research closely related topics to the one reviewed in this document – identifying the main risks of climate change, assessing their impact, determining how this could and should be monitored and devising the strategies to mitigate the impacts when needed. In 2016 several important research studies have been finalized and the final reports have been used as an input for this research. Additional two reports will be published shortly, and once information is available, the findings will be used to update climate change impact analysis in this document.

Each research focuses on different sectors:

- Biodiversity and ecosystem services,
- Health and prosperity,
- Landscape planning and tourism,
- Agriculture and forestry,
- Construction and infrastructure planning,
- Civil protection and emergency assistance planning.

Top four research studies of the above mentioned sectors are completed, and the main findings are summarized in this document. Each of the reports includes a different methodology, but they all identify a list of main risks and vulnerabilities that are further categorized based on their impact likelihood. These identified risks and vulnerabilities were then further evaluated in context of their relevance to Valka municipality.

After analysing and assessing the lists of risks in each sector with local experts the following risks were determined as main priority of Valka municipality:

- Chronic diseases flare (CVD, diabetes etc.) and increase in death rate
- Acquired endemic state and/or increase in diseases caused by insect-born infections
- Increase storm-caused rooftop damage
- Electrical transmission network damage due to wind gusts
- Road damage risk due to rainfall caused flooding

References

1 Komisijas Zaļā grāmata Padomei, Eiropes Parlamentam, Eiropas Komisijas un sociālo lietu komitejai un Reģionu komitejai, Adaptācija klimata pārmaiņām Eiropā. ES rīcības variant, SEC(2007) 849

2 Analīze un priekšlikumu sagatavošana informatīvā ziņojuma par piemērošanos klimata pārmaiņām izstrādei Vides politikas pamatnostādņu 2009.-2015.gadam īstenošanas ziņojuma ietvaros, PhD cand Ieva Bruņeniece, Baltijas vides foruma projekts 'BaltClim', 2012)

3 Priekšlikumu izstrāde Nacionālajai klimata pārmaiņu pielāgošanās stratēģijai, identificējot zinātniskos datus un pasākumus pielāgošanās klimata pārmaiņām nodrošināšanai, kā arī veicot ietekmju un izmaksu novērtējumu:
http://www.varam.gov.lv/lat/fondi/grants/EEZ_2009_2014/nacionala_klimata_politika/?doc=18209

4 Pilsētas mēru pakts enerģētiks un klimata jomā:
http://www.pilsetumerupakts.eu/about/covenant-of-mayors_lv.html

5 Analīze un priekšlikumu sagatavošana informatīvā ziņojuma par piemērošanos klimata pārmaiņām izstrādei Vides politikas pamatnostādņu 2009.-2015.gadam īstenošanas ziņojuma ietvaros, I. Bruņeniece (2012)

6 IPCC definīcija http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch2s2-2-4.html
kas modificēta atbilstoši EEA materiālos izmantotajai pieejai
http://www.eea.europa.eu/publications/climate-impacts-andvulnerability-2012/at_download/file)

7 Risku un ievainojamības novērtējums un pielāgošanās pasākumu identificēšana bioloģiskās daudzveidības un ekosistēmu pakalpojumu jomā (2016), Estonian, Latvian, and Lithuanian Environment

8 Risku un ievainojamības novērtējums un pielāgošanās pasākumu identificēšana veselības un labklājības jomā (2016), Estonian, Latvian, and Lithuanian Environment

9 Risku un ievainojamības novērtējums un pielāgošanās pasākumu identificēšna ainavu planošanas un tūrisma jomā (2016), SIA Baltokonsults

10 Risku un ievainojamības novērtējums un pielāgošanās pasākumu identificēšana lauksaimniecības un mežsaimniecības jomā, (2016), Dr.silv. Āris Jansons, Dr.oec. Sandija Zēverte-Rivža, Dr.sc.ing. Laima Bērziņa, Dr.agr. Kaspars Kampuss un Dr.oec. Dina Popluga

12 Valkas novada teritorijas Pānojums 2016.-2017. Gadam (2015), Valkas Dome

13 Vidzemes Reģions veselības profils (2015), Slimību profilakses un kontroles centrs

14 Akadēmisko Terminu Datubāze AkadTerm: http://termini.lza.lv/

15 Klimata pārmaiņas un gaisa kvalitāte. Eiropas Vides Agentura (Raksts Publicēts 10.06.2013 Pēdējās izmaiņas 03.06.2016) http://www.eea.europa.eu/lv/signali/signali-2013/raksti/klimata-parmainas-un-gaisa-kvalitate

16 Klimats un ilgtspējīga attīstība, Kļaviņš Māris, Zaļoksnis Jānis Latvijas Universitāte, 2016 https://issuu.com/janisbrizga/docs/klimats-gr__mata

17 Latvijas vides, ģeoloģijas un meteoroloģijas centrs
https://www.meteo.lv/en/jaunumi/weather/climate-change-in-latvia?id=1217&cid=103
https://www.meteo.lv/en/jaunumi/weather/climate-change-in-latvia?id=1217&cid=103

18 Latvijas Vides aizsardzības un reģionālās attīstības ministrija (VARAM)
http://www.varam.gov.lv/lat/darbibas_veidi/Klimata_parmainas

19 NatCatSERVICE datu bāze. [Online] [Cited: 5 July 2017.] https://www.munichre.com/natcatservice.

20. Apsīte, E., Bakute, A., Elferts, D., Kurpniece, L., Pallo, I. Climate change impacts on river runoff in Latvia. s.l. : Climate research, 2011. 48(1), 57-71.

21 The BACC II, AuthorTeam. Second Assessment of Climate Change for the Baltic Sea Basin. Regional Climate Studies. [Online] 2015. http://dx.doi.org/10.1007/978-3-319-16006-1.

22 Meža ugunsbīstamības indekss. Jansons, et al. 62, 2015, Vol. 29.

23 Climate change impact and risks of concrete infrastructure deterioration. . M.G. Stewart, X. Wang, M.N. Nguyen,. 33, 2011, Vol. 4. 1326-1337.

24 Secretariat, UNISDR. Global Assessment Report on Disaster Risk Reduction 2011 - Revealing Risk, Redefining Development. Geneva, Switzeland : United Nations International Strategy for Disaster Reduction (UNISDR), 2011.

25 F. Nemry, H. Demirel. Impacts of Climate Change on Transport: A Focus on Road and Rail Transport : A Focus on Road and Rail Transport Infrastructures. Luxembourg : JRC Scientific and Policy Reports, European Commission, Joint Research Centre, and Institute for Prospective Technological Studies, 2012.

26 Climate-change feedback on economic growth: explorations with a dynamic general equilibrium model. F. Eboli, R. Parrado, R. Roson. 15, s.l. : Environment and Development Economics, 2010, Vol. 5. 515-533.

27 Lietusgāžu un sniega kušanas ūdeņu patreizējā un potenciālā ietekme uz Rīgas pilsētas teritorijas applūšanu. s.l. : SIA „Procesu analīzes un izpētes centrs" , 2011.

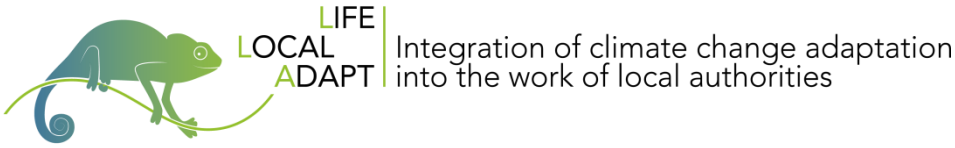
28 Alzubaidi, H. Operation and maintenance of gravel roads. VTI Meddelande 852A : Swedish National road and Transport Research Institute, 1999.

Annex 1 List of experts

This is a list of experts who participated in the analysis and evaluations or risks to prioritize them and to discuss the preventive measures.

Jana, varētu šeit lūdzu dzlībnieku saraktu ar amatiem pievienot?

Annex 2 Summary discussion experts panel



Eiropas Kopienas vides un klimata pasākumu programmas LIFE 2015 projekta
LIFE LOCAL ADAPT

Pielāgošanās klimata pārmaiņām integrēšana vietējo pašvaldību darbībā / Integration of climate change adaption into the work of local authorities
Nr. LIFE15 CCA/DE/000133

SANĀKSME / DISKUSIJA PAR PIELĀGOŠANOS KLIMATA PĀRMAIŅĀM VALKAS NOVADĀ

Agenda

Time: Friday 8 Septembet 2017 10.00-13.00

Location: Valkas novada dome, Beverīnas iela 3 (large meeting room)

10.00 - 10.30 – Introduction, background and information about the project (Jana Putniņa un Elīna Svikliņa)

10.30 – 11.00 – Climate changes globally and locally (Elīna Svikliņa)

11.00 – 11.30 – Adaptation to climate change – approach and methodology (Indra Liniņa)

11.30 – 12.30 – Discussion: Valka situation and main risks (Elīna Svikliņa vada diskusiju)

Aim of the discussion is to share information about climate change effects in diffrerent sectors and what activities should be implementated to mitigate these risks. What is needed and what can be do done on the local (Valka) level.

12.30 – 12.50 – Survey: determining/prioritizing the main climat change risks in Valka (Indra Liniņa un Elīna Svikliņa)

Outcome of the survey will be used as input for detemining final list of priority risks

12.50 – 13.00 – Wrap up and next steps (Jana Putniņa)

LIFE LOCAL ADAPT | Integration of climate change adaptation into the work of local authorities

Eiropas Kopienas vides un klimata pasākumu programmas LIFE 2015 projekta
LIFE LOCAL ADAPT

Pielāgošanās klimata pārmaiņām integrēšana vietējo pašvaldību darbībā / Integration of climate change adaption into the work of local authorities
Nr. LIFE15 CCA/DE/000133

SANĀKSME / DISKUSIJA PAR PIELĀGOŠANOS KLIMATA PĀRMAIŅĀM VALKAS NOVADĀ

Summary

The following risks were discussed in detail:

1.2. Generalist species replacing specialist species.

Experts pointed out a hogweed invasion as one of the main concerns. Mapped spread of hogweed in Valka district in attached to the report.

Suggestions: Herd grazing in hogweed spread territories, mowing, chemical control (herbicides)

2.2. Chronic diseases flare (CVD, diabetes etc.) and increase in mortality rate.

Including acute viral infection outbreaks in organized groups.

Suggestions: Informative seminars, raising awareness of and educating medical personnel and social workers.

2.3 Increased incidence of diseases and/or endemic occurrence of insect-born infections.

Particular emphasis was placed on the increased tick distribution area and prevalence of tick-borne diseases. Based on data from The Centre for Disease Prevention and Control, Valka district is not an endemic region for Tick-borne encephalitis, therefore children under 18 years cannot avail of publicly-funded vaccination scheme.

Suggestions: Informative seminars, raising awareness of and educating medical personnel and social workers. Increase public awareness of non-specific preventive measures and their significance.

3.2 Flood risk (rising water levels in rivers and lakes), 5.5 Road damage caused by rainfalls and 6.2 Flood risk caused by heavy rainfalls

Flood affected areas were identified; risk area map was added to the report.

Suggestions: (1) Improve pumping station operation. The problem of capacity has been identified, as in the case of heavy rainfall, it's not sufficient to pump large volumes of water; an increase in capacity is required. (2) Develop a technical guidance project to optimize rainwater drainage systems. (3) Inspection of canal locks on river Pedele (Selija street) to assess its operational state.

5.1 Storm caused rooftop damage. 5.6. Electric distribution network disruptions due to wind gusts.

During storm in 2016, Mierkalna folk house rooftop was displaced, and trees fell in surrounding territories.

Suggestions: (1) Tree removal around power lines to prevent wind-caused disruptions. (2) Exploring alternative energy sources.

Annex 3 Survey results

what is the likelihood of this happening and impact in Valka district (=Probability)

what impact can be made to mitigate those risks at Valka district level (=Impact)

		Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	Probablity	Impact	
		1		2		3		4		5		6		7		8		9		10		11		12		KOPA		VIDEJAIS		
1. Biodiversity and ecosystem service area																														
1.1	Water body contamination/eutrophication	4	3	3	2	3	1	3	1	2	4	4	2	3	4	3	3	5	1	2	2	4	1	3	3	39	27	**3,25**	**2,25**	✓
1.2	Ecologically plastic species (generalist species) drive out ecologically sensitive (specialist species).	4	3	1	1	3	2	1	1	2	1	4	2	3	2	2	1	2	2	2	2	3	2	2	2	29	21	2,42	1,75	
1.3	Entrance of infection diseases uncharacteristic for Latvia			2	2	4	3	1	1	2	2	3	2	3	3			3	3	2	2	3	2	2	1	25	21	2,08	1,75	
1.4	Entrance and increase of viability of new species	3	1	2	2	4	3	2	1	2	1	3	2	3	3	3	2	2	2	2	2	4	4	3	1	33	24	2,75	**2,00**	
1.5	Increase in pest and pathogen spread and viability	4	1	4	1	5	3	2	1	2	1	3	2	3	2	4	1	3	1	2	2	4	4	3	1	39	20	**3,25**	1,67	

1.6	Flood risk (storm surge at sea coast)			1	1	5	1											1	1							7	3	0,58	0,25	
2. Health and welfare																															
2.1	Risk of increase in acute intestinal infection diseases, disease flare	4	3	3	2	5	3	4	3	2	2	3	2	3	4	3	1	4	1	2	2	3	4	3	4	39	31	**3,25**	**2,58**	✓
2.2	Chronic diseases flare (CVD, diabetes etc.) and increase in death rate	3	3	4	2	5	3	4	4	2	1	3	2	4	4	2	1	2	1	2	2	3	3	3	3	37	29	**3,08**	**2,42**	✓
2.3	Acquired endemic state and/or increase in diseases caused by insect-born infections	4	2	3	2	5	3	4	5	2	1	3	2	4	4	2	1	3	1	2	2	3	3	3	2	38	28	**3,17**	**2,33**	✓
2.4	Increase in incidence and mortality from respiratory diseases, especially within particular risk groups	3	3	2	1	3	3	4	5	2	2	3	2	4	4	1	1	4	1	3	2	3	4	3	3	35	31	**2,92**	**2,58**	✓
2.5	Increase in heat stroke frequency	2	4	2	1	4	3	3	4	2	3	3	2	3	3	1	1	2	1	2	3	3	4	1	2	28	31	2,33	**2,58**	
2.6	Internal and external migration	1	1	2	2	1	1	4	5	3	4	1	1	2	2	1	1	2	1	2	2	2	4	3	3	24	27	2,00	**2,25**	
3. Tourism and landscape planning																															
3.1	Change in winter tourism season length and	2	2	4	1	5	1	3	1	2	1	4	1	3	3	4	1	5	2	4	2	3	1	3	2	42	18	**3,50**	1,50	

	characteristics																													
3.2	Flood risk (water raising in rivers and lakes)	4	1	3	1	3	1	2	1	3	2	3	1	4	4	4	1	4	1	3	2	4	3	3	2	40	20	**3,33**	1,67	
3.3	Flooding and erosion of the Baltic Sea and Rīgas Bay coastal areas			1	1	4	1	3	1									1	1							9	4	0,75	0,33	
3.4	Change in summer tourism season length and characteristics	3	3	3	1	4	1	4	2	3	2	3	1	4	4	5	1	4	1	3	2	2	2	3	3	41	23	**3,42**	1,92	
4. Agriculture and forestry																														
4.1	Spread of tree diseases and insect pest populations	4	2	2	2	5	2	4	3	3	2	2	1	2	2	4	1	3	1	3	3	4	2	3	1	39	22	**3,25**	1,83	
4.2	Damage caused by spring frosts	4	1	2	1	4	1	4	1	3	2	3	1	3	3	4	1	4	1	3	2	4	1	3	2	41	17	**3,42**	1,42	
4.3	Storm risk	3	3	3	1	4	1	5	1	3	1	4	2	4	4	4	1	3	1	3	1	4	1	3	1	43	18	**3,58**	1,50	
5. Construction and landscape planning																														
5.1	Increased storm-caused rooftop damage	3	3	3	2	4	3	4	3	4	2	4	2	4	4	4	1	4	1	3	3	4	3	3	3	44	30	**3,67**	**2,50**	✓
5.2	Building damage risk due to rainfall caused flooding	2	2	2	2	3	2	4	2	4	2	2	2	4	4	4	1	4	1	2	3	2	2	3	3	36	26	**3,00**	**2,17**	✓
5.3	Snow caused overload increase on rooftops	3	2	2	2	1	1	3	4	3	3	1	2	3	4	4	2	4	1	3	3	3	4	3	3	33	31	2,75	**2,58**	

5.4	An increase in indoor overheating	1	1	1	3	2	3	3	5	2	3	2	2	3	3	3	3	3	1	2	3	4	4	1	1	27	32	2,25	**2,67**	
5.5	Road damage risk due to rainfall caused flooding	3	3	2	2	3	3	3	2	3	3	3	2	4	4	3	2	4	1	3	3	4	3	3	2	38	30	**3,17**	**2,50**	✓
5.6	Electrical transmission network damage due to wind gusts	4	2	2	1	4	4	5	4	3	3	4	4	4	4	3	2	4	1	3	3	4	4	3	3	43	35	**3,58**	**2,92**	✓
5.7	Increased demand for electricity during summer	2	1	1	2	4	2	5	5	3	3	2	2	1	1	2	2	4	1	2	2	2	4	2	2	30	27	2,50	**2,25**	
6. Civil protection and emergency assistance																														
6.1	Flood and ice drift	1	1	1	1	3	1	3	2	2	2	3	2	3	4	4	1	2	2	3	2	3	3	3	1	31	22	2,58	1,83	
6.2	Flood risk caused by heavy rainfalls	3	2	3	2	3	1	4	3	3	2	3	2	4	4	4	1	4	1	3	2	3	3	3	1	40	24	**3,33**	**2,00**	✓
6.3	Storm and storm surge risk			2	1													1	1							3	2	0,25	0,17	
6.4	Forest and peat fire risk	4	2	3	2	4	2	4	4	3	2	2	2	3	3	4	2	3	1	3	3	4	4	3	2	40	29	**3,33**	**2,42**	✓

Annex 4 Mapped spread of hogweed in Valka district

Jana – Ingars solīja to karti – tu varētu lūdzu pievienot?

Annex 5 Flood affected areas

Jana – Ingars solīja to karti – tu varētu lūdzu pievienot?