

# **NATIONAL RISK ASSESSMENT FOR ICELAND**

## **EXECUTIVE SUMMARY**



**DEPARTMENT OF CIVIL PROTECTION AND EMERGENCY MANAGEMENT**

**THE NATIONAL COMMISSIONER OF THE ICELANDIC POLICE**

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# NATIONAL RISK ASSESSMENT IN ICELAND

## EXECUTIVE SUMMARY FROM THE ICELANDIC VERSION OF ÁHÆTTUSKOÐUN ALMANNAVARNA (2011)

### Geography and the Environment

Iceland is 103.000 km<sup>2</sup>. Vegetation covers 23.805 km<sup>2</sup>, lakes 2.757 km<sup>2</sup> glaciers 11.922 km<sup>2</sup> and wasteland 64.538km<sup>2</sup> therefore only 27% of the country is vegetated and natural forest only covers about 1% of the total area. Population per square km 3, 2 and the coastline is 4.970 km. In 2011 the population in Iceland was 318.452. There are 74 municipalities in Iceland and most people live in the municipality of Reykjavík 118.898. Around 63% of the population lives in municipalities around Reykjavík area (202.341) and the rest in small rural municipalities around Iceland.

**Climate:** A branch of the Gulf Stream flows along the southern and the western coast of Iceland, greatly moderating the climate. The climate in Iceland is much milder than its name and location adjacent to the Arctic Circle would imply. However, this brings mild Atlantic air in contact with colder Arctic air resulting in a climate that is marked by frequent changes in weather and storms Furthermore this leads to more rainfall in the southern and western part than in the northern part of the island.

### The Civil Protection in Iceland

The aim of the Civil Protection in Iceland is to prepare, organize and implement measures aimed at preventing and, to the extent possible, limiting physical injury or damage to the health of the public and damage to the environment and property, whether this results from natural catastrophes or from human actions, epidemics, military action or other causes, and to provide emergency relief and assistance due to any injury or damage that may occur or has occurred (Act 82/2008). The legislation promotes risk assessment and resilience.

# THE STRUCTURE OF THE CIVIL PROTECTION



The state is responsible for civil protection in Iceland on land, in the air and at sea and local authorities are responsible for civil protection at the local level in conjunction with the central government.

## **The Civil Protection and Security Council**

Government policy on civil protection and security is drawn up by the Civil Protection and Security Council for periods of three years at a time. The Government's policy on civil protection and security gives an account of the current situation and prospects in civil protection and security in Iceland, discuss points of importance in the structure of civil protection and security matters, preventive action, necessary coordination of the contents of response plans and the functions of public bodies in that context, stock levels necessary to ensure the survival of the nation in times of peril, reconstruction following catastrophes and other measures the council considers necessary to achieve the aim of The Civil Protection Act. In the council, government ministers, their secretaries, local authorities, heads of critical infrastructure sectors, Civil Protection organizations and stakeholders meet to set the civil protection policy for three years at a time.

The administration of the Civil Protection and Security Council, and the preparation of its meetings, is in the hands of the Minister of Interior and the Prime Minister chairs the committee.

## **Civil Protection and Emergency Management in Iceland**

The Minister of the Interior is the supreme authority in the field of civil protection in Iceland. On behalf of the Minister civil protection issues are in the hands of the National

Commissioner of the Icelandic Police that operates a Department of Civil Protection and Emergency Management.

The National Commissioner of the Icelandic Police (NCIP) takes decisions regarding civil protection alert levels at any given time, in consultation with the relevant regional police commissioner, if possible, and informs the Minister of Interior of these decisions. A state of emergency may be declared if an emergency is likely to occur, is imminent, or has occurred, or if similar circumstances apply. The NCIP operates a National Crisis Coordination Centre in Reykjavik.

The NCIP guarantees that measures are taken in accordance with the Government's civil protection and security policy.

The NCIP coordinates the structure of civil protection measures at the national level and civil protection measures taken by the local authorities. He coordinates the preparation of risk assessments in consultation with the civil protection committees.

## Civil Protection Committees

In each local government area there is a civil protection committee appointed by the local authority; the local authority determine the number of committee members. The civil protection committee consist of the district commissioner of the Civil Protection district in which the local government area lies, representatives of the local authority and those representatives of the local authorities who, in the course of their work, take care of emergency service (The Red Cross, Police, ambulance services, and fire and rescue services). Civil protection committees formulate their policy and organize their civil protection activities at the local level in accordance with the Civil Protection Act. Civil protection committees work on the preparation of risk assessments and response plans in their respective administrative areas in collaboration with the NCIP. In 2011 there were 22 civil protection committee in the 15 Civil Protection districts. In 2015 the Civil Protection district were changed to 9.

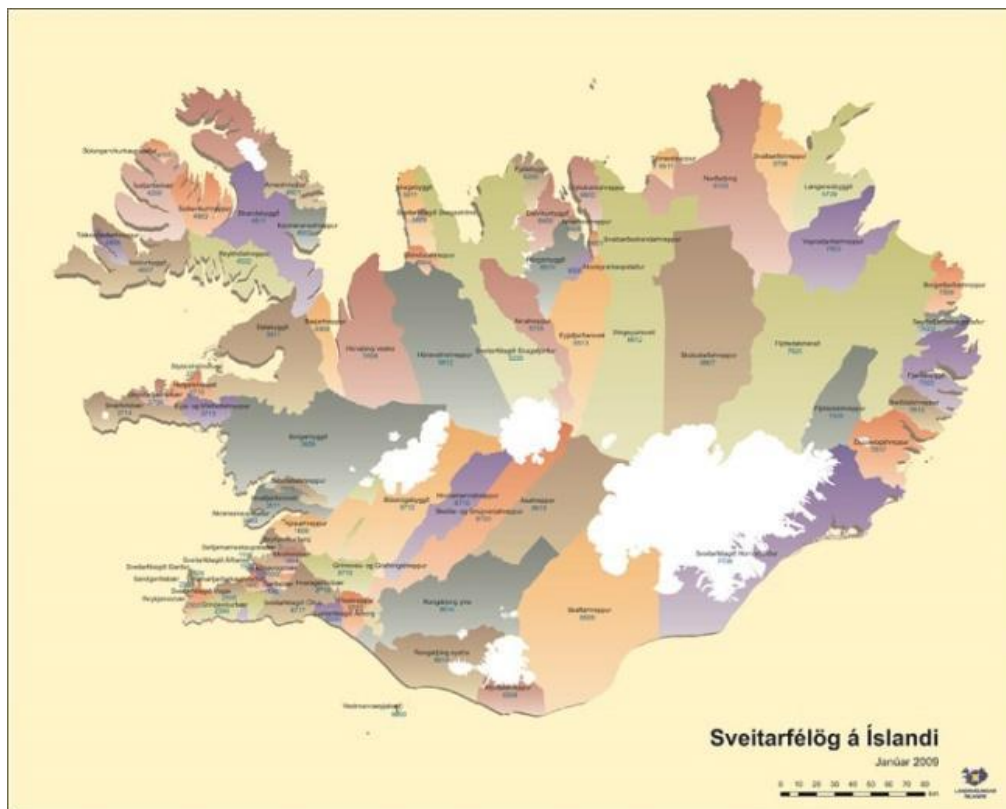


Figure 2 74 Municipalities in Iceland (2011)

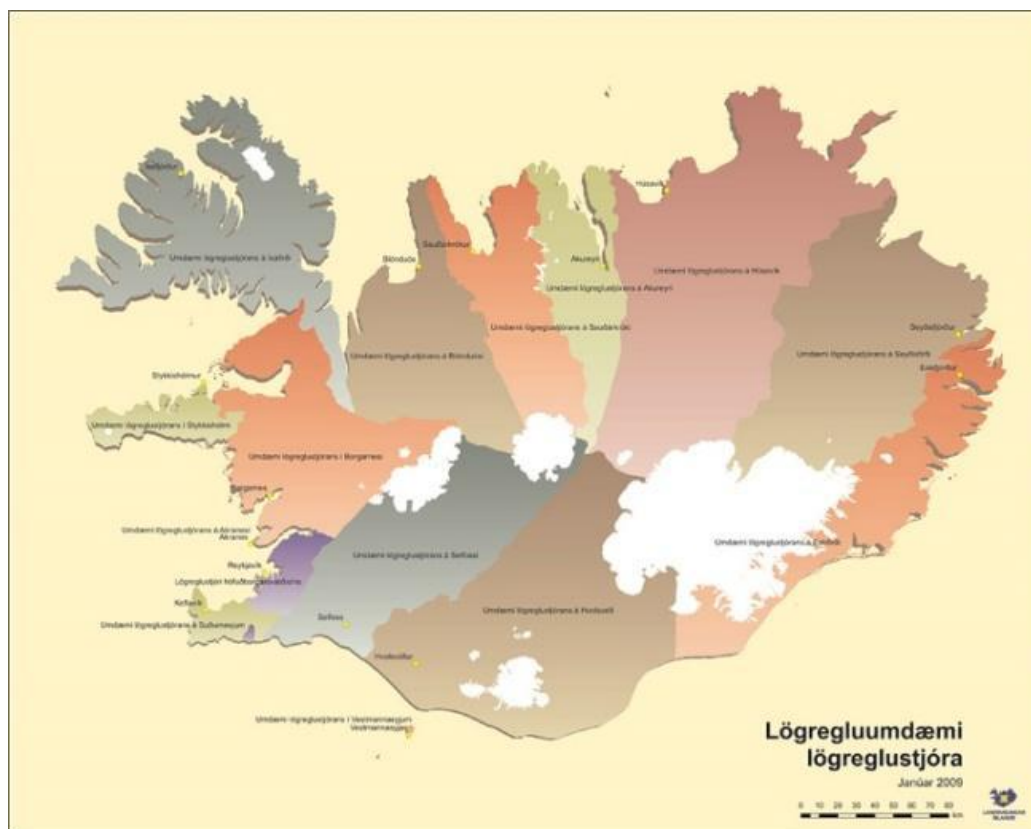


Figure 3 Civil Protection Districts (2011)



Figure 4 Civil Protection Districts 2015

Civil protection committees review their risk assessments and carry out exercises of their response plans in collaboration with the NCIP

## The National Risk Assessment

The first National Risk Assessment in Iceland was performed in 2008 – 2011. All the 15 Civil Protection Districts with 74 municipalities in Iceland were engaged in the assessment that was led by the Department of Civil Protection and Emergency Management at the Office of the National Commissioner of the Icelandic Police and in collaboration with the local Civil Protection Authorities. A legislation from 82/2008 on Civil Protection in Iceland stipulates

that Civil Protection Committees in the municipalities in Iceland should investigate the resilience in their districts and make contingency plans according to their risk assessment.

By involving experts from different sectors and disciplines the Civil Protection committees in the Civil Protection Districts were able to assess risks in their immediate environment and share common understanding of the challenges they faced and decide which measures in prevention and preparedness to use to address the risk in order to treat the risk they had identified.

## **The Risk Assessment and methodology**

### **Objective and scope**

The main objective of the risk assessment was to obtain overview of hazards in each of the 15 Civil Protection districts in Iceland and identify, analyze and evaluate risk. Also to increase risk awareness, implement mitigation measures and preparedness with the aim to increase community resilience. The methodology that was used is based on the Joint Australian/New Zealand standard AS/NZS-4360-2004 Risk Management that the ISO 31000 risk management guidelines and framework 2009 was later based on. This guide provides a generic framework for managing risk. Also used to assess level of risk associated with various threats was the Scandinavian (RVA) risk and vulnerability model (ROS-model).

It was decided to include all Civil Protection Committee (22) in the districts to participate in the analysis and group of known threats were predefined in an all hazard approach and the participants were urged to include and identify other threats they considered important. Vulnerabilities were also assessed and the existing capacities to prevent, prepare, mitigate respond to and recover from. Looking a risk as a likelihood of the incident and possible consequences vulnerability were taken into the risk assessment. Vulnerability in a system can significantly affect capacity to respond during emergencies



The analysis had an all hazard approach focusing on registering risk with diverse origin in each Civil Protection District Iceland based assessment at a local and national level

- Risk from **natural hazards** (geo – climate and hydrological)  
volcanic eruptions, earthquakes, floods, storm surges, tsunamis, avalanches, landslides, drift ice and risk from geothermal events, climate change
- Risk to public **health and the environment**  
mass casualty accidents at sea, air, land, tunnel and traffic disruption, fire (forest fires and other fires), pandemics, animal diseases, pollution, CBRN accidents, , food security, pandemic influenza and health emergencies
- **Technical risk and infrastructure**  
Utility and infrastructure breakdown, power, water, sewage, communication, transportation, dam or structure failure, food supply
- **Safety and political risk** – disruption and unrest civil and political, sabotage and terrorism. Public safety and improved safety in tourism

To evaluate the risk the different hazards were evaluated according to consequences and likelihood

- **Consequences** of threat to life and health, the environment, property and society (1 - 5) depending on the severity of the event

Value	Lives and health of the population	The environment	Great economic values	Great social values – function of society	Consequences
5	Many fatalities and seriously injury Catastrophic direct/ extremely large indirect effects on Health and lives	Catastrophic damage to the environment – long-term and permanent	Catastrophic damage to property -	Solid mistrust towards social institutions and general instability, extreme disruptions in societal functionality,	<b>Extreme</b>
4	Extremely large direct or significant indirect effects on health,	Extremely serious damage to environment long-term effect	Extremely serious damage property	Extremely serious disruptions to societal functionality, continued distrust towards several social institutions and changed behavior	<b>Critical</b>
3	Significant direct or moderate serious effects on health	Serious short time damage to the environment -	Serious damage to property	Disruptions in societal functionality, continued mistrust towards several social institutions or changed behavior ,	<b>Major</b>
2	Moderate direct effects on health and lives,	Limited damage to the environment – little effect	Limited damage to property	Limited disruptions to societal functionality, transient mistrust towards several social institutions ,	<b>Minor</b>
1	Small direct effects on health and lives,	Extremely limited damage to environment	Extremely limited damage to property	Extremely limited disruptions to societal functionality	<b>Insignificant</b>

**Figure 6 Consequences**

- *Likelihood* (1 – 5) depending on the likelihood of the event

Value	Likelihood	References
5	Very high probability (almost certain)	More than 10 times a year
4	High probability (likely)	1 - 10 times a year
3	Medium probability (moderate)	1 time every 10 -50 years
2	Low probability (unlikely)	1 time every 50 -1000 years
1	Very unlikely (rare)	1 time every > 1000 years

Figure 7 Likelihood

- Risk is estimated from likelihood and consequences
- Risk is estimated with references to vulnerability and capability.
- Impact is estimated according the probability and number of deaths
- Each risk was given a risk number according to likelihood, consequences, (impact and number of deaths) and injuries capability to deal with the risk (contingency and response plans, mitigation etc.)
- A 'risk matrix' was used in risk evaluations to estimate levels of risk.

<u>Almost Certain</u> 5	5	10	15	20	25
<u>Likely</u> 4	4	8	12	16	20
<u>Moderate</u> 3	3	6	9	12	15
<u>Unlikely</u> 2	2	4	6	8	10
<u>Rare</u> 1	1	2	3	4	5
likelihood/consequences	<u>Insignificant</u> (1)	Minor (2)	Major (3)	<u>Critical</u> (4)	<u>Extreme</u> (5)

Figure 8 The Matrix

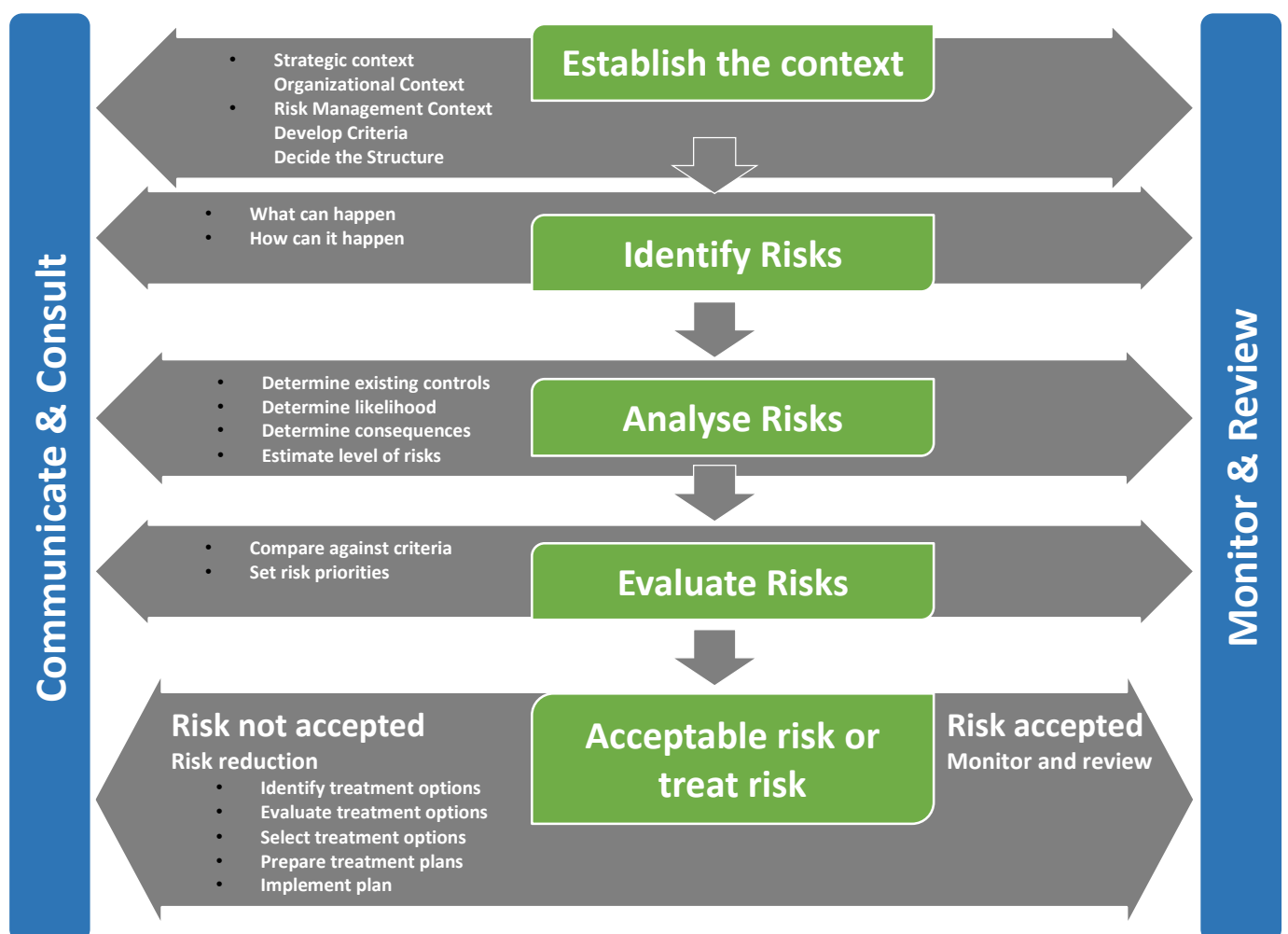


Figure 9 Risk Management Process ISO 31000

For each risk evaluated there was a *scenario analysis* that looked at the possible event, previous events, the likelihood, the impact and consequences, responsible *monitoring agency*, mitigation and preparedness measures, emergency response measures, recovery measures and lessons learnt.

## Natural hazard and risk in Iceland

With its relatively isolated location in the middle of the North Atlantic Ocean Iceland is at risk from variety of hazards. Extreme weather related hazards with snowstorms and cold, storm surges, earthquakes, volcanic activity and glacial outburst floods, snow avalanches and landslides, floods, hazards from geothermal activity and drift ice. The following natural hazard and risk were identified in the assessment.

## Volcanic eruptions

There are 30 active volcanic systems in Iceland and in the last 50 years over 20 eruptions have occurred. The risk from volcanic eruption is assessed high on people's health and lives, the environment, infrastructure and vulnerable systems. The associated risk are lava flow, ash, lightning, and toxic gas and both the national and the global community have suffered from ash dispersal, especially in 2010 when Eyjafjallajökull erupted. Most recent eruptions in Iceland: Bárðarbunga 2014 – 15, Grímsvötn 2011, Eyjafjallajökull 2010, Fimmvörðuháls 2010, Grímsvötn 2004, Hekla 2000.

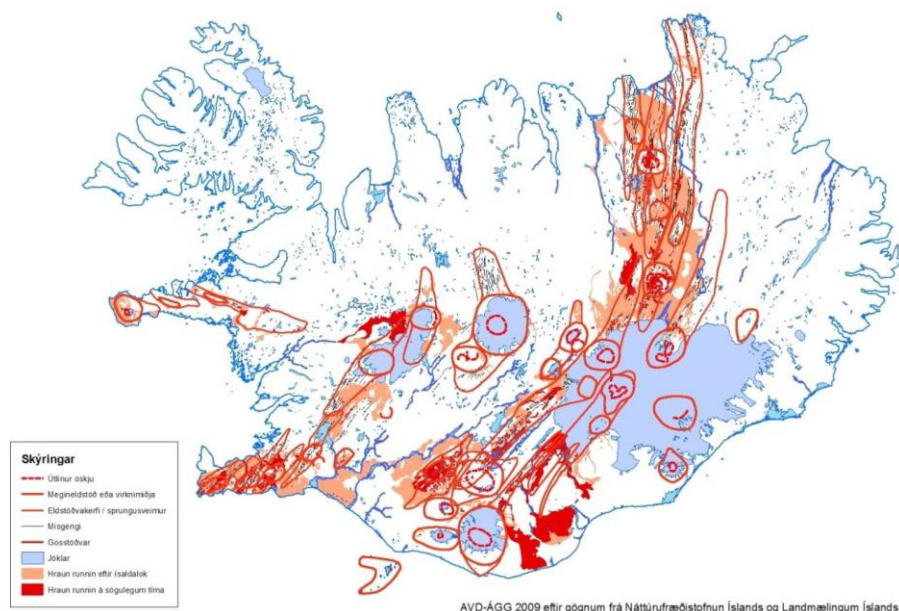


Figure 10 Volcanic Systems in Iceland (Agust Gunnar Gylfason 2009)

## Earthquakes.

Earthquakes are quite common in Iceland. Situated on the Mid-Atlantic ridge Iceland is prone to earthquakes. Both in the south and north Iceland seismic zones, there have been earthquakes > M7 with damaging results and the risk is assessed high. Most recent damaging earthquakes were in 2000 (two earthquakes M6.5 with three days apart) and 2008 M6.3. In the north of Iceland the main activity is in three parallel zones.

Earthquakes > M5.0 are common and often coincide with volcanic activity.

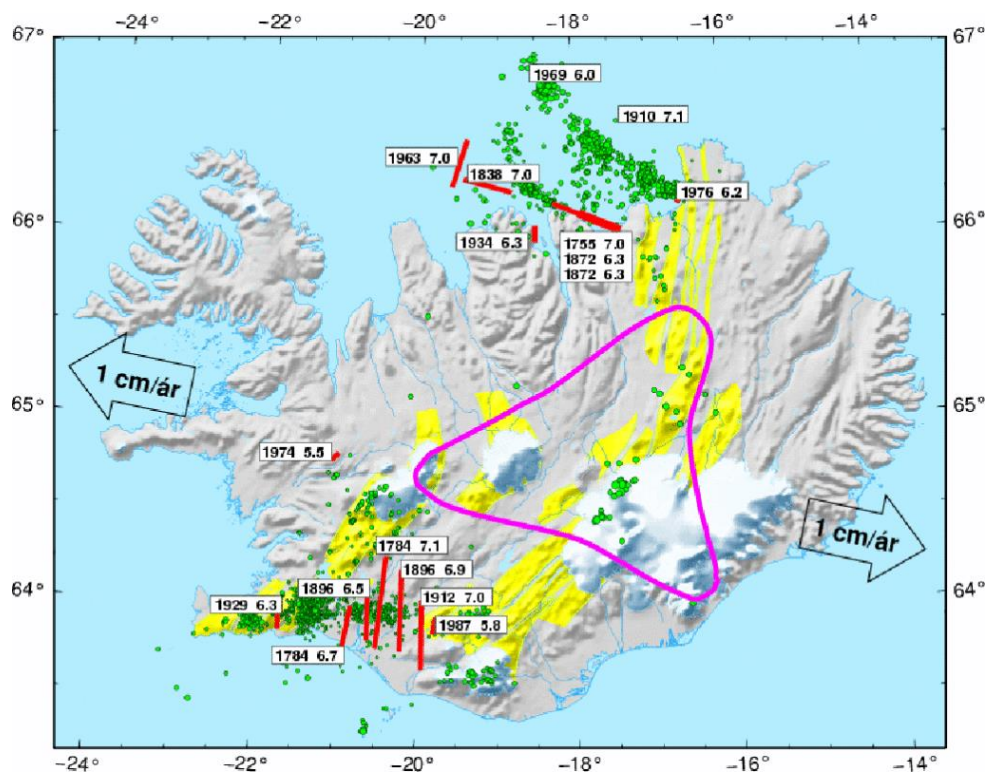


Figure 11 Earthquakes >5.5 from 1700-2000 (Gunnar B. Guðmundsson 2005)

## Extreme weather.

All district had experienced extreme weather related events and risk to lives and their health of population, loss to property and the environment. In many cases there were disruption to critical infrastructure like power and transport

## Tsunami

The risk of tsunami is localized in Iceland in narrow fjords and coastal areas and tsunamis have accompanied earthquakes, glacial outburst floods, landslides and snow avalanches with local impact.

## Glacial outburst floods

Glacial outburst floods (Jökulhlaup) are connected to volcanic activity from underneath glaciers both directly with volcanic eruptions and indirectly with geothermal activity. Glacial

outburst floods pose a great risk to people's lives and health, the environment and the economy in local communities close to Eyjafjallajökull, Mýrdalsjökull and Vatnajökull.

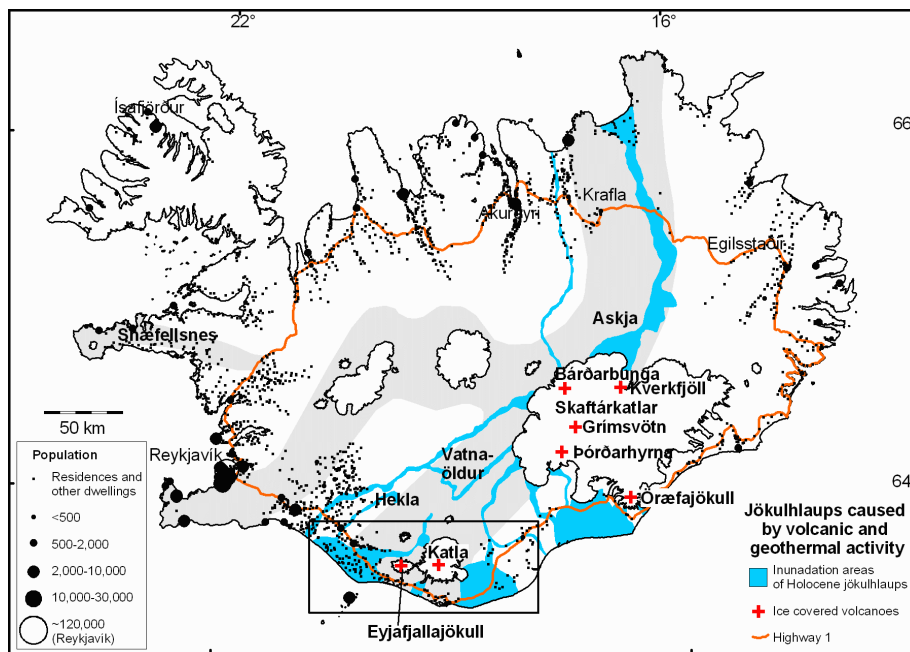


Figure 12 Glacial outburst floods from 3 glaciers: Eyjafjallajökull, Mýrdalsjökull and Vatnajökull

## Floods

Flooding in rivers is common following high precipitation and melting of snow in the highland. The risk is assessed high and can affect infrastructure such as transport, agricultural areas and villages. Mitigation measures such as land use planning, warning and hazard awareness, maps and hazard assessment needs to be implemented.

## Coastal floods and severe storm surges.

In the 20<sup>th</sup> century over 50 coastal floods caused damage in villages in Iceland especially in the south. Mitigation measures have focused on structural measures but more non-structural mitigation measures need to be made such as evacuation and contingency evacuation plans and risk awareness in villages in coastal areas.

## Snow Avalanches

Snow avalanches have caused many deaths and economic loss in Iceland. Many towns and villages are situated beneath steep mountains and in 1995 a snow avalanche killed 34 people



in two villages in the Western fjords. Mitigation measures such as land use changes, snow monitoring, assessments and structural protection measures have been increased since the accident in 1995. The risk is high and contingency plans need to be prepared for 23 populated areas that have their hazard assessments in place.

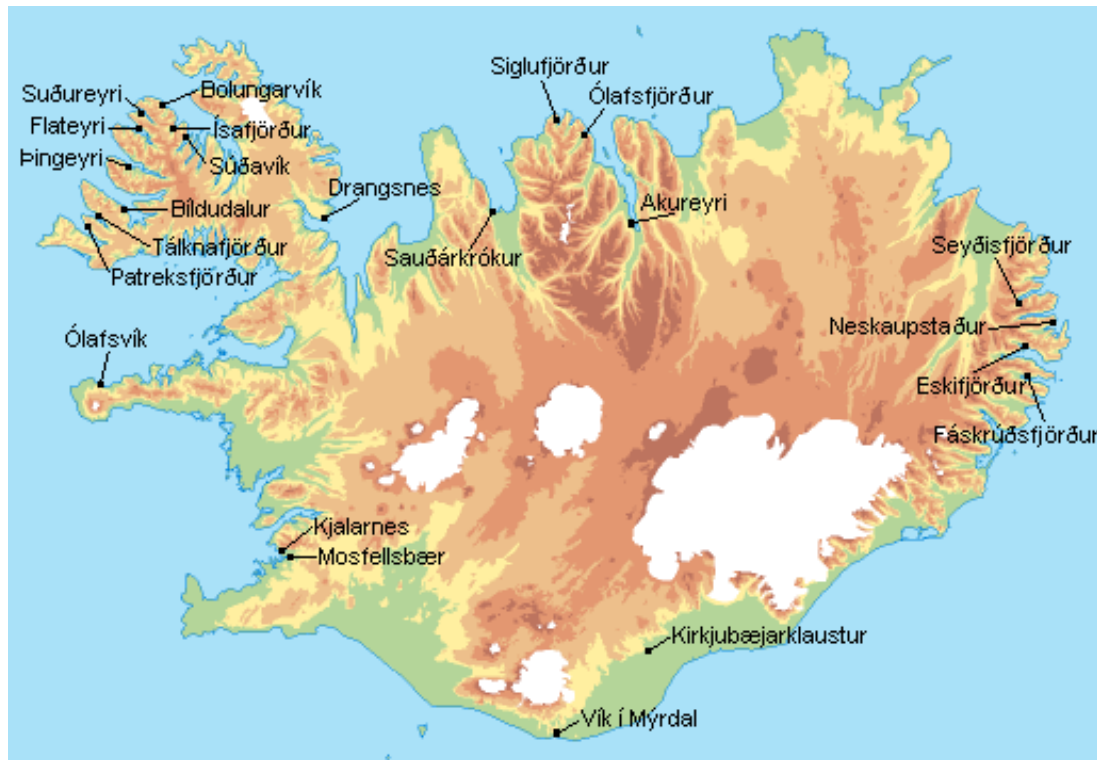


Figure 13 Identified snow avalanches areas in urban settlements with hazard assessment

## Landslides

Landslides are triggered either by earthquakes or intense and prolonged rainfall. In mountainous areas especially in north, east and western fjords in Iceland landslides are common. Rock- debris- and mud slides have caused fatalities, economic and environmental damage in Iceland.

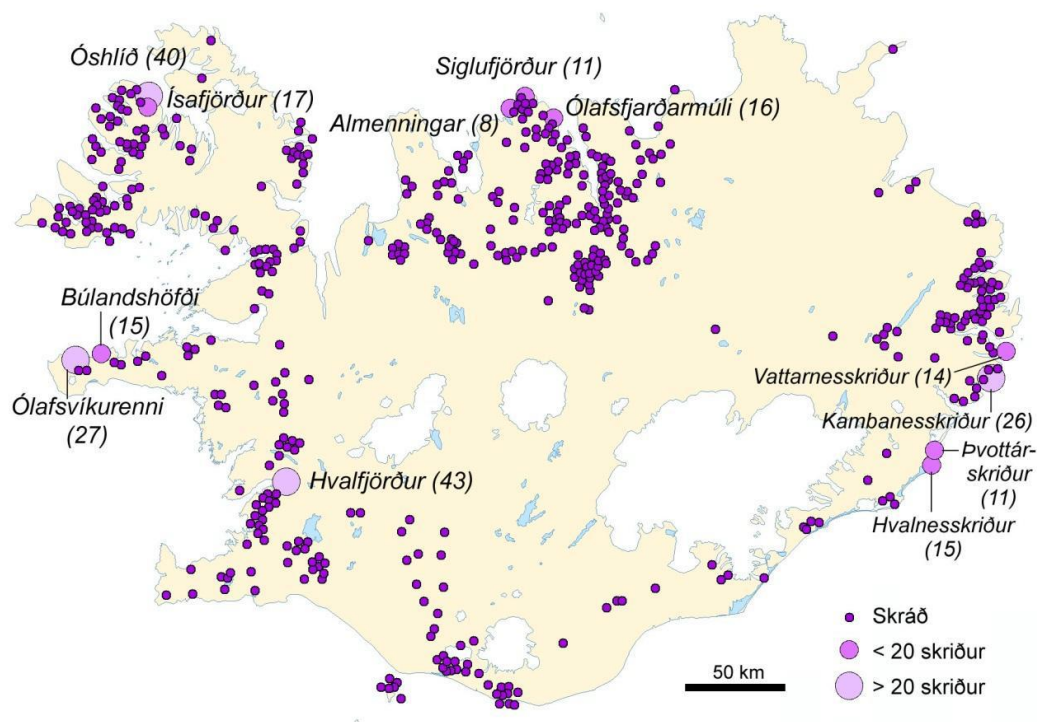


Figure 14 Landslides in Iceland 1900-2000 (Lovísa Ásbjörnsdóttir)

## Geothermal risk

The heat in high temperature areas in Iceland is over 200°C and most of these areas are located in the volcanic zones. These are mud and Sulphur pots and fumaroles. Low geothermal fields are 75-100°C and water holes (hot springs) these are situated all over Iceland. The geothermal heat rises to the surface as running water or steam and the risk is considerable.

## Ice and Drift ice

Drift ice is any sea ice other than fast ice, the latter being attached to the shoreline. Drift ice is carried along by winds and sea currents. The risk is mainly to ships sailing in Icelandic waters. Also, polar bears have occasionally travelled on drift ice to Iceland in the north and pose a threat to the population.

## Climate change

Climate change is an environmental and economic issue and unclear in many ways. The effects of climate change will be felt in Iceland as other countries and according to IPCC, warming intensifies towards northern high latitudes with diminishing snow cover, widespread glacier retreat, sea level rise and flooding. The civil protection system needs to increase monitoring of natural systems in order to be able to adapt better to climate change with mitigation measures and contingency plans accordingly.

## Environment and Health related risk

### Accidents with mass casualties on land, on sea, in air

#### Mass casualties disasters

Risk related to major accidents was *assessed high* when looking at:

**Aviation accidents:** aviation accidents outside of airports. All airports in Iceland with scheduled flights have their contingency plans which are exercised regularly with Civil Protection responders

**Maritime accidents:** whale watch boats, ferries and cruise ship accidents were assessed and the risk was high when looking at fires on board, stranded vessels and food poisoning on board

### Accidents on land

*Coach accidents* – tourists in the highland, schoolchildren on their way to school

**Tunnel accidents** – only one contingency plan in place for tunnels in Iceland – mitigation measures important.

**Icelanders injured/deceased abroad** – terrorist activities, war, natural hazard or other events. The Foreign Service needs to make contingency plans for such events

## **Fires.**

**House and industrial fires.** Fire safety plans have to be approved for every local community belonging to a Fire brigade. All Fire brigades must have certain standards, training and education according to Icelandic laws. CBRN and industrial areas are identified.

**Forest fires/grass and scrubs fires.** Several places identified as risk areas. One contingency plan in place for west-Iceland, Skorradalur, which is a 25 km long valley heavy forested area, both natural and planted. The main risks are steep hills with trees and vacation homes, narrow one way street, which makes evacuation hard and difficult access to water.

## **Health**

**Epidemic:** Large outbreaks of illnesses that can spread among the population

**Pandemic:** Large outbreaks that spread in large geographic area, affect large portion of the population, it could be an influenza or other diseases. Frequent incidents could have social, economic and political tension and disrupt normal way of living.

Infectious diseases and pandemics are risks that are hard to predict, both the likelihood and consequences. When a request came from World Health Organization in 2005 to prepare for an outbreak of pandemic influenza it was decided by the Icelandic government that a national and local pandemic contingency plan should be made.

On behalf of the Icelandic government The Civil Protection, National Commissioner of the Icelandic Police and the Directorate of Health were in charge of making a national and local contingency plan that were issued and exercised in 2008.

## **Animal diseases**

Long isolation of the native livestock has made cows, sheep, and horses in Iceland vulnerable to transmittable diseases in imported animals and there are severe restrictions on import of animals and all potentially disease transmitting things. Screening for potential animal diseases to the country is high.

Foot and mouth diseases and avian influenza (H5N1) and MVV)

## **Infrastructural and technical risks**

Icelandic society relies very heavily on technology and interconnected infrastructure. The loss of infrastructure and the high degree of interconnectedness of infrastructures was of concern in the risk assessment of critical infrastructure. Infrastructure is an integral part in modern life and important in daily life. Critical infrastructure of national significance refers to both physical networks and virtual connections. Transport (sea, air, and land), water, energy (electricity/transmission, heat and sewage system and power plants), telecommunication/IT, food supply and security are vital infrastructures that have direct impact on productivity, security and standard of living.

Critical infrastructure organizations are responsible for delivery and security of their product and the Civil Protection/government must ensure that they are prepared and their contingency plans are up to date.

## **Tourism and safety**

In recent years tourism has increased significantly in Iceland and many local government fear too much pressure on internal infrastructures as they are not ready for such increased tourism. Increased risk is therefore to safety and security due to vulnerable and fragile infrastructures. A new system of cell broadcasting was initiated 2012 in order to alert tourists travelling in Iceland by sending SMS to mobile phones when emergencies were imminent in certain locations

## **Political and Civil unrest**

Icelandic societal security is vulnerable to many of the activities that have been mentioned here in the risk assessment. Risks from nature like earthquakes, floods and volcanic eruption, health and infrastructure breakdown can have disruptive social, economic and political effect on societies. Some municipalities assessed the risk of terrorist activities and civil unrest in their environment and feared they would not be able to deal with the consequences of an attack and relied on backup from the National Police and the Civil Protection and Emergency Management. Manmade disasters were mentioned, some events with low probability and high consequences others like property damage in connection with demonstrations and protest.

Contingency/Response Plans made by the Civil Protection and Emergency Management in collaboration with local authorities in 2016, updated and exercised every 3 – 5 years:

Contingency plans for volcanic eruptions

Eyjafjallajökull

Mýrdalsjökull – Katla

Bárðarbunga – to the north, (plans for the south and west are in progress)

Contingency plans for earthquakes

Earthquakes in North Iceland for two districts (Eyjafjörður and Þingeyjarsýsla)

Contingency plans for health emergencies:

Pandemic influenza,

Epidemiology for the International Airport in Keflavik.

Contingency plan for Forest/scrub fires in West Iceland - Skorradalur

Contingency plans for 16 airports in Iceland – including the international airport in Keflavik, Akureyri and Egilsstaðir

Contingency plans for Mass Casualties Accidents in 7 Civil Protection districts in Iceland

Contingency plan for Tunnel accidents in Hvalfjarðargöng in south-west Iceland

Contingency plans for two dams close to hydroelectric power plants Háslón and Hraunaveita

Contingency plans for ferries, whale watch boats and cruise ships

Ferries in East Iceland Seyðisfjörður

Ferry to the Westman Islands, South Iceland

Ferries and whale watch boats in Husavik North Iceland

Sea accidents and cruise ships docking in harbors in the capital

Figure 15 Recent disasters in Iceland

Year	Recent disasters in Iceland
1990	Storm surge and floods in South Iceland
1995	Two deadly snow avalanche in the western fjords, Súðavík and Flateyri
1996	Volcanic eruption in Gjálp, Vatnajökull, with glacial outburst flood and disruption of roads and power
1998	Volcanic eruption in Grímsvötn, Vatnajökull
2000	Earthquakes in South Iceland M6.5
2000	Volcanic eruption in Hekla volcano South Iceland
2004	Volcanic eruption in Grímsvötn, Vatnajökull
2006	Chemical accident in Eskifjörður, East Iceland
2008	Earthquakes in South Iceland M6.3
2009	Pandemic influenza
2010	Volcanic eruption in Fimmvörðuháls, South Iceland
2010	Volcanic eruption in Eyjafjallajökull, South Iceland
2011	Glacial outburst flood, disruption of transportation, Mýrdalsjökull, South Iceland
2011	Volcanic eruption in Grímsvötn, Vatnajökull
2012	Extreme weather in September, storm and snow blizzards in North Iceland, with power outage and massive livestock deaths
2014 - 2015	Volcanic eruption Bárðarbunga/Holuhraun