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# Sustainable cities and communities — Indicators for resilient cities

*Villes et communautés territoriales durables — Indicateurs de performance pour les villes résilientes*

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# Contents

Page

# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 268, *Sustainable development of communities*.

# Introduction

Cities need indicators to establish their baseline, and measure and evaluate their performance. However, existing indicators are often not standardized, consistent, or comparable over time or across cities. To address these challenges, a new series of International Standards is being developed to provide standardized indicators that enable a uniform approach to what is measured, and how that measurement is to be undertaken.

The first standard in this series – ISO 37120 *Sustainable Development in Communities—Indicators for city services and quality of life* – has quickly become the international reference point for sustainable city indicators. While ISO 37120 contains a number of indicators of relevance to a city's resilience planning and assessment, ISO/TC268/WG2 experts and city representatives have identified the need for additional indicators for resilient cities, reflected here in ISO 37123 as well as the need for additional indicators for Smart Cities developed in ISO 37122.

A resilient city is able to prepare for, recover from and adapt to shocks and stresses.

Cities are increasingly confronted by shocks which include extreme natural or human made events which result in loss of life and injury, material, economic, and/or environmental losses and impacts. These shocks can include floods, earthquakes, hurricanes, wildfires, pandemics, chemical spills and explosions, terrorism, power outages, financial crises, cyber-attacks, conflicts. A resilient city is also able to manage and mitigate ongoing human and natural stresses in a city relating to environmental degradation (e.g. poor air and water quality), social inequality (e.g. chronic poverty and housing shortages) and economic instability (e.g. rapid inflation and persistent unemployment) that cause persistent negative impacts in a city.

A city's preparedness can be characterised by developing a detailed understanding of the risks to the city, by taking action to reduce vulnerability and exposure, and by enhancing the awareness and participation of individuals, households and businesses.

A resilient city is able to recover from shocks and stresses in a timely and efficient manner, with a focus on ensuring the continuity or rapid restoration of city services such as electricity, water, telecommunications, waste management, sanitation, food distribution, financial services, and access to emergency services.

A resilient city is also a city that understands the necessity to adapt its systems and processes to ensure that they are as robust as possible in the face of shocks and stresses, building back better following extreme events, while focussing on the goal of restoring and ensuring long term prosperity.

Resilience is both a core component and an essential enabler of sustainable development. This Standard is focused on resilience measurement as a major contribution to the long-term sustainability of a city. The structure of the 'Family of City Indicators Standards for Sustainable Development of Communities' in this ISO series reflects this relationship between sustainable development, resilient development and smart development (see Figure 1).

Progress toward sustainable development through maintaining and improving city services and quality of life in the face of shocks and stresses is a core component of a Resilient City. ISO 37123 Indicators for Resilient Cities shall therefore be implemented in conjunction with ISO 37120 *Sustainable cities and communities —Indicators for city services and quality of life*.


**Figure 1 — Sustainable Development of Communities – Relationships within the Family of City Indicators Standards**

The indicators in this Draft International Standard have been selected to make reporting as simple and inexpensive as possible, and therefore reflect an initial platform for reporting. The indicators have been developed to help cities:

a) prepare for, recover from and adapt to shocks and stresses

b) learn from one another by allowing comparison across a wide range of performance measures, and by sharing good practices.

The indicators in this Draft International Standard can be used to track and monitor progress towards a Resilient City, through the development of a city resilience strategy or when applying a city management system such as ISO 37101. While the indicators are structured around ISO themes that correspond to different sectors and services provided by cities, it is noted that the indicators can also be organized according to the Risk Management process (Annex B) and/or the Disaster Management process (Annex C).

The following considerations were also considered in the development of this Draft International Standard:

— *Support the local implementation of the Sustainable Development Goals (SDGs).* The SDGs were an outcome of the Rio+20 Conference of 2012, where member states agreed to launch a process to develop a set of global goals. The SDGs were designed to build upon the Millennium Development Goals (MDGs) and to converge with the post-2015 development agenda. In January 2016, the 17 SDGs of the 2030 Sustainable Development Agenda – adopted by world leaders in September 2015 at an historic UN Summit – officially came into force. The alignment between the indicators in this Standard and the SDGs is presented in an informative Annex (Annex D).

— *Support the local implementation of the Sendai Framework.* The Sendai Framework was adopted by UN Member States on 18 March 2015 at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan. The Sendai Framework is a 15-year, voluntary, non-binding agreement which recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government. It aims for the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. The alignment between the indicators and the Sendai Framework is presented in Annex D.

— *Alignment with established city resilience frameworks.* Indicators were also selected to maximize the alignment with existing international city resilience measurement frameworks, including the City Resilience Index and the UNISDR Disaster Resilience Scorecard for Cities.

— *Alignment with climate adaptation.* Adaptation to climate change is a major consideration for many cities evaluating their resilience now and in the future. ISO 37123 is complementary to ISO Standards on climate adaptation including ISO 14090: *Adaptation to climate change – Principles, requirement and guidelines* and ISO 14091: *Adaptation to climate change – Vulnerability, impacts and risk assessment*.

A city which conforms to this standard does so in regard to measurement of indicators for city resilience in conformity with the definitions and methodologies as set out in this standard, and may only claim compliance to that effect. The Standard does not provide a value judgement, threshold or target numerical value for the indicators and therefore conformance with this standard does not confer a status in this regard.

It is acknowledged that cities may not have direct influence or control over factors governing some of these indicators, but the reporting is important for meaningful comparison and provides a general indication of resilience.

In this document, the following verbal forms are used:

— “shall” indicates a requirement;

— “should” indicates a recommendation;

— “may” indicates a permission;

— “can” indicates a possibility or a capability.

# Sustainable cities and communities — Indicators for resilient cities

## 1 Scope

This International Standard defines and establishes definitions and methodologies for a set of indicators on resilience in cities.

This International Standard is applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size and location. Maintaining, enhancing and accelerating progress towards improved city services and quality of life is fundamental to the definition of a Resilient City, so this standard shall therefore be implemented in conjunction with ISO 37120 *Sustainable cities and communities —Indicators for city services and quality of life*.

This International Standard follows the principles set out and can be used in conjunction with ISO 37101:— *Sustainable development in communities — Management systems — General principles and requirements,* and other strategic frameworks.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 37101, *Sustainable development in communities — Management system for sustainable development — Requirements with guidance for use*

ISO 37120, *Sustainable cities and communities — Indicators for city services and quality of life*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 37120 and ISO 37101, as well as the following apply.

**3.1**
**Critical infrastructure**
physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society

Note 1 to entry: Examples of critical infrastructure can include, but is not limited to, power generation, transmission and distribution, water treatment, distribution and drainage, wastewater and storm water infrastructure, transportation, gas supply and distribution, telecommunications infrastructure, educational facilities, hospitals and other health facilities.

[SOURCE: UNITED NATIONS, Sendai Framework for Disaster Risk Reduction]

**3.2**
**Disaster**
serious disruption to a city or community due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to human, material, economic, and/or environmental losses and impacts

Note 1 to entry: Disasters can be frequent or infrequent, depending on the probability of occurrence and the return period of the relevant hazard. A slow-onset disaster is one that emerges gradually over time, for example through drought, desertification, sea level rise, or epidemic disease. A sudden-onset disaster is one triggered by a hazardous event that emerges quickly or unexpectedly, often associated with earthquakes, volcanic eruptions, flash floods, chemical explosions, critical infrastructure failures, or transport accidents.

[SOURCE: UNITED NATIONS, Sendai Framework for Disaster Risk Reduction]

**3.3**
**Hazard**
phenomenon, human activity or process that may cause loss of life, injury, or other health impacts, property damage, social and economic disruption, or environmental degradation.

Note 1 to entry: Hazards include biological, environmental, geological, hydro-meteorological, and technological processes and phenomena. Biological hazards include pathogenic micro-organisms, toxins and bioactive substances (e.g., bacteria, viruses, parasites, venomous wildlife and insects, poisonous plants, mosquitoes carrying disease-causing agents). Environmental hazards may be chemical, natural, radiological, or biological, and are created by environmental degradation, physical or chemical pollution in the air, water, and soil. However, many of the processes and phenomena that fall into this category may be "drivers" of hazard and risk rather than hazards themselves (e.g., soil degradation, deforestation, biodiversity loss, sea level rise). With respect to drinking water, 'hazard' may be understood as a microbiological, chemical, physical or radiological agent that causes harm to human health. Geological or geophysical hazards originate from internal earth processes (e.g., earthquakes, volcanic activity, landslides, rockslides, mud flows). Hydro-meteorological hazards are of atmospheric, hydrological, or oceanographic origin (e.g., cyclones/ typhoons/hurricanes, floods, drought, heatwaves, cold spells, coastal storm surges). Hydro-meteorological conditions may also be a factor in other hazards such as landslides, wildland fires, and epidemics. Technological hazards originate from industrial or technological conditions, dangerous procedures, infrastructure failures, or specific human activities (e.g., industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, chemical spills).

[SOURCE: UNITED NATIONS, Sendai Framework for Disaster Risk Reduction]

**3.4**
**Hazard Map**
developed to illuminate areas that are affected or vulnerable to a particular hazard (e.g. earthquakes, landslides, rockslides)

**3.5**
**Natural buffers**
ecological assets that reduce physical vulnerability to shocks and stresses

Note 1 to entry: Ecosystems, such as wetlands, forests, and coastal systems, can provide cost- effective natural buffers against many **shocks and stresses**. Examples of natural buffers include reefs, floodplains, parklands, forests, and wetlands.

[SOURCE: IUCN]

**3.6**
**Potable water**
water that is safe for human consumption, either in its original state or after treatment, and that is intended for drinking, cooking, food preparation or other domestic purposes

**3.7**
**Resilient city**
A resilient city is able to prepare for, recover from and adapt to shocks and stresses.

Note 1 to entry: A resilient can resist, absorb, accommodate, adapt to, transform, and recover from the effects of disasters and shocks in a timely and efficient manner, including through the preservation and restoration of essential basic structures and services in a sustainable way, and through risk management practices. It involves stakeholders and especially citizens in disaster risk reduction through co-creation processes; reduces vulnerability and exposure to natural and human-made disasters; and increases its capacity to respond to disasters, shocks, and other unforeseen chronic stresses, through enhanced preparedness.

Note 2 to entry: A resilient city is still able to thrive regardless of the hazards, shocks and stresses it faces. It has a focus on lesson learning, continuous improvement and building back better after disasters.

Note 3 to entry: Resilience is the adaptive capacity (2.2.15) of an organization (2.2.9) in a complex and changing environment. Resilience is also the ability of an organization to manage disruptive related risk (2.1.5). [SOURCE: ISO Guide 73; ISO 22300 Societal Security]

**3.8**
**Shocks**
natural or human-made events that cause a disaster such as, floods, earthquakes, hurricanes, wildfires, pandemics, chemical spills and explosions, terrorism, power outages, financial crises, cyber-attacks, and conflicts

**3.9**
**Stresses**
underlying human and natural pressures or tensions that cause persistent negative impacts in a city relating to environmental degradation (e.g. poor air and water quality), social inequality (e.g. chronic poverty and housing shortages) and economic instability (e.g. rapid inflation and persistent unemployment).

**3.10**
**Vulnerability**
susceptibility of individuals, households, businesses, assets, or systems in a city to the impacts of hazards, as determined by physical, social, economic, and environmental factors, processes, and conditions

[SOURCE: UNITED NATIONS, Sendai Framework for Disaster Risk Reduction]

## 4 City Indicators

This International Standard contains indicators designed to assist cities in preparing for, recovering from and adapting to shocks and stresses.

To reduce vulnerability to shocks and stresses, these indicators will support cities in engaging all sectors, stakeholders, and populations; apply collaborative leadership models and methods; work across disciplines and city systems; and use data information and appropriate technologies. The indicators can improve resilience in cities by promoting and enabling inclusive and collaborative approaches to governance at all levels (neighborhood, district, city, metropolitan area, region, state/province, country). This involves long-term risk management of critical networks and their interactions and potential failures.

This International Standard shall be implemented in conjunction with ISO 37120. The indicators are classified into themes according to the different sectors and services provided by a city, in alignment with ISO 37120. The classification structure is used solely to denote the services and area of application of each type of indicator when reported on by a city. This classification has no hierarchical significance and is organized alphabetically according to themes. All indicators shall be compiled and reported on an annual basis.

In some cases, it is difficult to define simple, quantitative metrics to measure the performance of systems and processes that are in place for managing resilience at the city level. However, it has been

agreed that these systems and processes are core components of city resilience, and thus warrant inclusion in the standard. Some indicators are thus defined so as to reflect the minimum characteristics or performance requirements for these systems and processes, which can then be objectively verified.

It is important to review the results of multiple types of indicators across themes; to focus on a single indicator can lead to a distorted or incomplete conclusion. Elements of aspiration must also be taken into consideration in the analysis. Furthermore, it is also important to acknowledge potential antagonistic effects of the outcome of particular indicators, either positive or negative, when analysing results.

For data interpretation purposes, cities shall take into consideration contextual analysis when interpreting results. The local institutional environment may affect the capacity to apply indicators. Furthermore, it is important also to note that each city will face a unique set of shocks and stresses, as well as having a unique set of assets and resources to manage and address these shocks and stresses. In this context, it is important that caution is taken in applying these indicators to make comparison between cities to ensure a full understanding of these relevant contextual factors. Some aspects of resilience may also be the responsibility of the private sector, other levels of government or individuals themselves.

# 5 Economy

## 5.1 Historical disaster losses as a percentage of city product

### 5.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Historical losses reflect direct economic losses (in monetary terms) of disasters.

NOTE 2 This indicator reflects the “Economy and sustainable production and consumption “issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 5.1.2 Indicator requirements

Historical disaster losses as a percentage of city product shall be calculated as the direct economic losses from disaster(s) within the city summed over a period of five years (numerator) divided by the total city product summed over the same time period (denominator). The result shall be multiplied by 100 and expressed as historical disaster losses as a percentage of city product.

Direct economic losses shall refer to losses (in monetary terms) that result from disasters. Such losses are associated with damage or destruction to physical, social and critical infrastructure within the city’s administrative boundary (even if not under the city’s jurisdiction). Physical infrastructure refers to the built structures, systems, and assets required for a city’s economy to function, to include transportation networks, telecommunication services, energy grids, sewerage and waste disposal systems, water supplies, city buildings and facilities, and housing. Social infrastructure is an important subset of physical infrastructure and includes structures that accommodate social services, such as schools, universities, hospitals, and prisons. Critical infrastructure refers to systems, services or assets (physical or virtual) that are vital for the welfare of society (refer to definition in 3.1).

### 5.1.3 Data sources

The data for this indicator could be sourced from damage and economic loss assessments prepared after disasters. Data may also be available from insurance industry sources.

## 5.2 Average annual disaster loss as a percentage of city product

### 5.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Historical loss data does not provide a full picture of the potential economic losses that a city faces from disasters. Potential economic losses can only be appropriately assessed through modelling of potential future events (catastrophe modelling), which considers major hazards and their likelihood of occurrence, the vulnerability of the city to damage from the hazard, and the economic consequence of this damage. Average annual loss is calculated from a large number of modelled scenarios considering these factors. Average annual loss is a widely used parameter in quantitative risk assessment and management, and allows estimation of the benefits of investing in risk reduction.

NOTE 2 This indicator reflects the "Economy and sustainable production and consumption "issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 5.2.2 Indicator requirements

Average annual disaster loss as a percentage of city product shall be calculated as the average direct economic losses from disaster(s) estimated from city-wide catastrophe modelling scenarios (numerator) divided by the total city product (denominator). The result shall be multiplied by 100 and expressed as average annual disaster loss as a percentage of city product.

Direct economic losses shall refer to losses (in monetary terms) that result from disasters. Such losses are associated with damage or destruction to physical, social and critical infrastructure within the city's administrative boundary (even if not under the city's jurisdiction). Physical infrastructure refers to the built structures, systems, and assets required for a city's economy to function, to include transportation networks, telecommunication services, energy grids, sewerage and waste disposal systems, water supplies, city buildings and facilities, and housing. Social infrastructure is an important subset of physical infrastructure and includes structures that accommodate social services, such as schools, universities, hospitals, and prisons. Critical infrastructure refers to systems, services or assets (physical or virtual) that are vital for the welfare of society (refer to definition in 3.1).

### 5.2.3 Data sources

Catastrophe modelling is a complex modelling activity typically undertaken by specialist risk consulting and advisory firms.

### 5.2.4 Data interpretation

Over time, average annual loss data can be used to quantify the expected benefits of investing in disaster risk reduction measures.

## 5.3 Percentage of essential service providers that have a documented business continuity plan

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Business continuity plans can enhance a city's preparedness for stresses and shocks, and enable rapid recovery. It is important to note that many private-sector entities provide essential or important goods and services relied upon by citizens. Cities therefore need to be proactive in encouraging private-sector entities to undertake business continuity plans, based on a shared view of the risks likely to arise.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 5.3.1 Indicator requirements

The percentage of essential service providers that have a documented business continuity plan shall be calculated as the total number of essential service providers that have a documented business continuity plan (numerator) divided by the total number of essential service providers (denominator). The result shall be multiplied by 100 and expressed as the percentage of essential service providers that have a documented business continuity plan.

Essential service providers shall refer to entities outside of government that provide services that are vital to the functioning of the city. This includes private sector providers of infrastructure services, including electricity, gas, water, sanitation and wastewater treatment, and waste management. It also should include major food distributors and providers of retail banking services.

A business continuity plan shall refer to a documented strategy that identifies the threats and risks faced by a company or organization, and that helps to protect its assets and personnel from the negative effects of a stress or shock, thereby ensuring operational continuity. Business continuity planning involves identification of potential risks, determining how those risks will affect operations, implementing safeguards and procedures to mitigate those risks, and regularly reviewing risks to ensure their relevance and accuracy. Business continuity plans should be regularly updated.

NOTE ISO 22301: 2012 is the internationally recognised benchmark for business continuity. It specifies requirements to plan, establish, implement, operate, monitor, review, maintain and continually improve a documented management system to protect against, reduce the likelihood of occurrence, prepare for, respond to, and recover from disruptive incidents when they arise.

### 5.3.2 Data sources

Information on business continuity planning should be obtained from identified from essential service providers for the city.

### 5.3.3 Data interpretation

The presence of a business continuity plan does not in itself ensure that identified continuity measures have been implemented or guarantee that business continuity will be ensured in the case of a stress or shock.

## 5.4 Percentage of properties with insurance coverage for high risk hazards

### 5.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Widespread insurance coverage within cities represents a crucial component of resilience due to the critical role that insurance plays in a city to rapidly recover from shocks and stresses. Insurance improves economic and fiscal outcomes through several channels. Before a disaster strikes, the pricing of insurance gives policyholders incentives to reduce their exposures through risk mitigation measures. In the aftermath of disaster, insurance transfers the fiscal burden away from taxpayers onto the private sector and into capital markets. It also limits financial contagion by restoring supply chains and stalled business operations faster, while providing needed liquidity and certainty in business and financial planning.

NOTE 2 This indicator reflects the “living & working environment” as defined in ISO 37101. It can allow an evaluation of the contribution to the “well being” and “resilience” purpose of the city as defined in ISO 37101.

### 5.4.2 Indicator requirements

Percentage of properties with insurance coverage for high-risk hazards shall be calculated as the total number of properties (residential and non-residential) within the city with insurance coverage for high-risk hazards affecting the city (numerator) divided by the total number of properties (households

 

and businesses) in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of properties with insurance coverage for high risk hazards.

Residential properties shall refer to dwellings (or structures) classified for residential use. Examples of residential properties should include, but are not limited to, single-family dwellings, mobile dwellings, semi-detached dwellings, row houses, condominiums and apartment buildings.

Non-residential properties shall refer to structures classified for non-residential use. Examples of non-residential properties should include, but are not limited to, office buildings/private business buildings, hotels, restaurants, government buildings, institutional buildings (e.g., educational and health facilities), factories and other special exempt properties (e.g., non-commercial recreational spaces, places of worship, funeral homes, cemeteries, etc.).

Where possible, insurance coverage data for each sector (i.e. residential and non-residential and the hazards being insured against should be reported and listed in tables.

For the purposes of this indicator, high risk hazards affecting the city are hazards for which there is a likelihood of extreme event(s) that could significantly affect many properties in the city and/or have a major impact on the city.

NOTE This indicator covers property insurance and excludes personal or life coverage. Insurance may come from multiple public or private providers.

Data sources

Aggregate insurance data can be sourced from public insurance agencies or insurance industry associations.

### 5.4.3 Data interpretation

It should be noted that not all residential and non-residential properties in a city may require insurance for all high-risk hazards, e.g., if they are located outside a flood zone (given that proper mapping and identification of flood zones exists). The affordability of insurance will also be a major influence on uptake of insurance within the city for residential and non-residential properties. Two key elements when considering insurance coverage for resilience is the amount of damage sustained and the speed of recovery.

## 5.5 Percentage of total insured value to total value at risk within the city

### 5.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 An aggregate assessment of insurance levels relative to the value at risk from high risk hazards helps to reveal potential instances of underinsurance. It also helps to educate the community, incentivise action to mitigate risks and prepare for disasters, and enhance city risk analysis and management processes.

NOTE 2 This indicator reflects the “Economy and sustainable production and consumption” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 5.5.2 Indicator requirements

Percentage of total insured value to total value at risk within the city shall be calculated as the total insured value of all residential and non-residential properties within the city (numerator) divided by the total value of all residential and non-residential properties in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of total insured value to total value at risk within the city.

Residential properties shall refer to dwellings (or structures) classified for residential use. Examples of residential properties should include, but are not limited to, single-family dwellings, mobile dwellings, semi-detached dwellings, row houses, condominiums and apartment buildings.

Non-residential properties shall refer to structures classified for non-residential use. Examples of non-residential properties should include, but are not limited to, office buildings/private business buildings, hotels, restaurants, government buildings, institutional buildings (e.g., educational and health facilities), factories and other special exempt properties (e.g., non-commercial recreational spaces, places of worship, funeral homes, cemeteries, etc.).Where possible, insurance coverage data for each sector (i.e. residential and non-residential and the hazards being insured against should be reported and listed in tables.

### 5.5.3 Data sources

Aggregate insurance data can be sourced from public insurance agencies or insurance industry associations.

### 5.5.4 Data interpretation

It should be noted that not all properties in a city may require insurance for all hazards (e.g. if they are located outside a flood zone). The affordability of insurance will also be a major influence on the uptake and level of insurance within the city.

## 5.6 Employment Concentration

### 5.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE A diverse local economy is a key component of city resilience. Some communities can be dependent on a small number of industries for providing employment and/or local taxation revenue, rendering these communities vulnerable to chronic stresses associated with economic downturns and structural, industrial and technological changes.

NOTE 2 This indicator reflects the “Economy and sustainable production and consumption” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 5.6.2 Indicator requirements

Employment concentration shall be calculated as the number of people in the city employed in the three largest sectors of the local economy (as measured by total employment) (numerator) divided by the city’s total labour force (denominator). The result shall be multiplied by 100 and expressed as a percentage.

Labour force shall refer to the sum of the total persons employed and unemployed who are legally eligible to work and who are primary residents of the city. This typically includes all working-age adults between the ages of 15 and 64, but the specific age will vary by country.

The sectors used for the calculation of this Indicator should be defined as per the International Standard Industrial Classification of All Economic Activities, Rev.4 (SOURCE: United Nations Statistical Division) or an equivalent classification.

### 5.6.3 Data sources

The data for this indicator can be sourced from national or local workforce or employment surveys, as well as reports from public human resources/employment organizations.

### 5.6.4 Data interpretation

This indicator should be considered in the broader context of the economic wealth and prosperity of the city.

## 5.7 Percentage of the workforce in informal employment

### 5.7.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Informal employment often comes with lower benefits and poorer working conditions, and poverty and informality are often found to be strongly correlated. Therefore, it is important that cities monitor informal employment to formulate effective development policies that help people transition from informal to formal employment (UNDP).

### 5.7.2 Indicator requirements

Percentage of the workforce in informal employment shall be calculated as the number of people working in informal employment (numerator) divided by the city's total workforce (denominator). This result shall then be multiplied by 100 and expressed as the percentage of the workforce in informal employment.

Informal employment shall refer to employment where the employment relationship is, in law or in practice, not subject to national labour legislation, income taxation, social protection or entitlement to certain employment benefits (advance notice of dismissal, severance pay, paid annual or sick leave etc.). The reasons may be the following: non-declaration of the jobs or the employees; casual jobs or jobs of a limited short duration; jobs with hours of work or wages below a specified threshold (e.g. for social security contributions); employment by unincorporated enterprises or by persons in households; jobs where the employee's place of work is outside the premises of the employer's enterprise (e.g. outworkers without employment contract); or jobs, for which labour regulations are not applied, not enforced, or not complied with for any other reason. The operational criteria for defining informal jobs of employees are to be determined in accordance with national circumstances and data availability (ILO).

Informal employment should include own-account workers employed in their own informal sector enterprises, employers employed in their own informal sector enterprises, contributing family workers, irrespective of whether they work in formal or informal sector enterprises, members of informal producers' cooperatives, employees holding informal jobs in formal sector enterprises, informal sector enterprises, or as paid domestic workers employed by households; and own-account workers engaged in the production of goods exclusively for own final use by their household (ILO).

Workforce shall refer to the sum of the total persons employed and unemployed who are legally eligible to work.

### 5.7.3 Data sources

Data on employment should be obtained through labour force surveys or city employment assessments administered by local, regional or national authorities/statistical bodies, or Ministry or Department of Labour Employment.

### 5.7.4 Data Interpretation

Care must be used in evaluating this indicator, as a low or high percentage of the workforce in informal employment may not necessarily be indicative of a more resilient city.

# 6 Education

## 6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction

### 6.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Teaching emergency preparedness and risk reduction in schools increases the coping capacity of society. It helps school administrators, instructors, students, and staff to prepare for emergencies and reduce risks by protecting themselves, their property, and their assets from the effects of a disaster.

NOTE 2 This indicator reflects the "Education and capacity building" and "Safety and security" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 6.1.2 Indicator requirements

The percentage of schools that teach emergency preparedness and disaster risk reduction shall be calculated as the number of schools within the city that teach emergency preparedness and disaster risk reduction (numerator) divided by the total number of schools in the city (denominator). The result shall be multiplied by 100 and expressed as a percentage of schools that teach emergency preparedness and disaster risk reduction.

Schools shall refer to primary and secondary educational institutions.

Emergency preparedness and disaster risk reduction activities shall refer to training drills, and awareness programs, for example, but not limited to evacuation simulations, practicing/rehearsing emergency protocols, testing the carrying capacity of potential evacuation routes, and evaluating the response times for emergency services.

### 6.1.3 Data sources

The data from this indicator can be obtained from educational authorities, individual schools and educational institutions.

## 6.2 Percentage of population trained in emergency preparedness and disaster risk reduction

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Training in emergency preparedness and disaster risk reduction enhances the response capacity of city populations. Regular and repeated training drills help to assimilate disaster awareness and responsiveness into the city population and to refresh and update emergency training and disaster protocols.

NOTE 2 This indicator reflects the "Education and capacity building" and" Safety and security" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 6.2.1 Indicator requirements

Percentage of population trained in emergency preparedness and disaster risk reduction shall be calculated as the total number of people within the city trained by responsible authorities in emergency preparedness and disaster risk reduction activities in the previous 12 months (numerator) divided by the city's total population (denominator). The result shall be multiplied by 100 and expressed as a percentage of population trained in emergency preparedness and disaster risk reduction.

Emergency preparedness and disaster risk reduction activities shall refer to training drills, capacity-building classes and courses, and awareness programs. Specific emergency drills may be supplemented by use of rallies, parades, sporting events, and other local activities, and also simulations of the disaster event to practice/rehearse aspects of emergency response (e.g., crowd management, mass evacuation plans), test carrying capacity of potential evacuation routes, evaluate response and access times, etc. Emergency drilling is a method of practice to help populations respond to disasters and shocks. Emergency drills may involve evacuation plans designed to move people away from a disaster, or shelter-in-place plans that give people a place of refuge.

### 6.2.2 Data sources

The data for this indicator can be sourced from emergency management authorities.

## 6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities

### 6.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Community engagement with emergency preparedness and disaster risk reduction helps vulnerable populations to understand, prepare for, mitigate, and withstand disasters and shocks. Information is disseminated through publicly available and regularly updated platforms that enable the public to access and exchange risk-related data.

NOTE 2 This indicator reflects the “Education and capacity building”,” Safety and security” and “Living together, interdependence and mutuality” issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” and “social cohesion” purposes of the city as defined in ISO 37101.

### 6.3.2 Indicator requirements

Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities shall be calculated as the number of vulnerable people within the city that have been engaged with emergency preparedness and disaster risk reduction activities by responsible authorities (numerator) divided by the total vulnerable population (denominator). The result shall be multiplied by 100 and expressed as the percentage of vulnerable population that has been engaged with emergency preparedness and disaster risk reduction.

Vulnerable people shall refer to individuals who have limited capacity to anticipate, cope with, resist, and recover from the effects of a disaster. The following segments of the population are especially vulnerable to disasters:

— the elderly;

— persons with physical or mental impairments;

— children;

— pregnant women;

— ill or undernourished people;

— the homeless;

— people located in slums and informal housing;

— refugees and internally displaced people; and

— transient or nomadic communities.

Other population segments in the city that may be vulnerable to hazards due to location or context-specific factors may also be included in the total vulnerable person count.

Where possible, percentage data for each relevant vulnerable population should be included and listed as additional information.

Emergency preparedness and disaster risk reduction activities shall refer to training drills, capacity-building classes and courses, and awareness programs.

Responsible authorities shall refer to professionals or trained volunteers in departments of the city or national government (e.g., planning, disaster management, health, environment, utility provision, emergency services, civil protection), or other actors in the disaster risk reduction and resilience sectors (NGOs, civil society organisations, academic and research institutions, UN organisations, donor organisations, the private sector), that are working in direct collaboration with the city authority on such emergency preparedness and disaster risk reduction activities

### 6.3.3 Data sources

The data for this indicator can be sourced from emergency management authorities and other responsible authorities.

## 6.4 Percentage of emergency preparedness publications provided in alternative languages

### 6.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Multilingual education and training activities in emergency preparedness and risk mitigation help to ensure that learning opportunities are available to all citizens, regardless of linguistic differences.

NOTE 2 This indicator reflects the" Safety and security" and "Living together, interdependence and mutuality" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "social cohesion" purposes of the city as defined in ISO 37101.

### 6.4.2 Indicator requirements

The percentage of emergency preparedness publications provided in alternative languages shall be calculated as the number of emergency preparedness publications provided in alternative languages within the city (numerator) divided by the total number of emergency preparedness publications published by the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of emergency preparedness publications information provided in alternative languages.

Alternative languages shall refer to other languages spoken in the city, including those not having official or legal status with the local government.

Publications shall refer to official printed materials and digital materials produced by the city government for emergency preparedness.

### 6.4.3 Data sources

The data for this indicator can be sourced from emergency management authorities.

## 6.5 Educational disruption

### 6.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE It is important that educational institutions minimize disruption and ensure continuity of education for all children. Monitoring educational disruption as the number of lost teaching days due to extreme events can help to assess the effectiveness of minimizing disruption in educational institutions (IFC).

### 6.5.2 Indicator requirements

Educational disruption shall be calculated as the number of teaching days lost annually due to shocks or stresses.

Teaching days lost shall refer to days when educational institutions are not operational during regular hours of teaching. Partial lost teaching days shall be included in the calculation of this indicator (e.g., a half-day of lost teaching due to an extreme event).

Any closure of an education facility in the city shall be counted as one teaching day lost. Multiple educational facilities closed on the same calendar date shall be counted as one teaching day lost.

### 6.5.3 Data sources

Data on the number of teaching days lost due to shocks or stresses can be sourced from local or regional school boards, or a ministry/department of education.

# 7 Energy

## 7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity

### 7.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A diverse electricity supply mix helps ensure that alternative electricity provisions are available to the city in the event of a system failure, resulting in no or reduced power delivery or supply capacity. A diverse electricity supply system or infrastructure protects cities from generation and capacity disruption resulting from fuel or energy source disruption, and thus helps cities to mitigate and prepare for disasters and shocks. It is however noted that other system elements, such as the design and state of repair of transmission and distribution systems, will also influence the reliability of electricity supply and are not directly covered by this indicator.

NOTE 2 This indicator reflects the “Community infrastructures” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 7.1.2 Indicator requirements

Number of different electricity supply sources providing at least 5 percent of total energy supply capacity shall refer to the number of different, or separate, electricity supply sources to the city each providing at least 5 percent of total energy supply capacity.

NOTE The 5 percent threshold is used by international organizations such as the World Bank to ease calculations and to capture the major supply sources.

When the number of different electricity supply sources exceed two, the percentage of electricity supply capacity of each supply source should be reported.

A different (or separate) electricity supply source shall refer to electricity supplies that are not disrupted or directly influenced by other sources. This includes electricity supplies that are sourced from fossil fuels (coal, natural gas, petroleum), mineral fuels (uranium, thorium), and renewables (wind, solar, hydro, geothermal, tidal, biomass). These sources are converted to electricity at thermal and hydroelectric power stations, PV power plants, wind farms and wave farms, tidal power stations, and solar power towers.

#### 7.1.3 Data sources

The data for this indicator could be sourced from energy system regulators or management authorities, individual energy providers, electric utilities, and electricity supply or service providers.

#### 7.1.4 Data Interpretation

While multiple, different, electricity sources contribute to city resilience in the event of a system failure, this is not necessarily indicative of city resilience in all cases.

### 7.2 Electricity supply capacity as a percentage of peak electricity demand

#### 7.2.1 General

Those implementing this International Standard shall report on this indicator in accordance with the following requirements.

NOTE 1 Having sufficient capacity in electricity supply allows cities to cope with predicted future growth in demand and shorter-term (temporary) demand surges stemming from shocks and stresses. Managing the supply and demand of electricity is thus critical in the continuity of essential utility services, to ensure that built systems are not overloaded and that they can maintain sufficient redundancy to absorb surges in demand. It is important that cities monitor peak electricity demand relative to available supply capacity (i.e., the reserve margin), to assess the vulnerability and robustness of its electrical supply system.

NOTE 2 This indicator reflects the “Community infrastructures” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

#### 7.2.2 Indicator requirements

Electricity supply capacity as a percentage of peak electricity demand shall be calculated as the electricity supply capacity available to the city (numerator) divided by the city’s monthly peak electricity demand averaged over the calendar year (denominator). The result shall be multiplied by 100 and expressed as the electricity supply capacity as a percentage of peak electricity demand.

Electricity supply capacity shall refer to the expected maximum available supply of electricity to meet projected peak demands, including reserve supplies to meet unexpected losses, interruptions, or surges in demand.

Peak electricity demand shall refer to the highest level of electricity needs from consumers, across a specified period. Peak demand fluctuates with human activity cycles, time of the day, the season of the year, weather extremes, and industrial activity.

#### 7.2.3 Data sources

Data should be gathered from electricity distributors, city energy or environment offices, and from international sources such as the International Energy Agency (IEA) and the World Bank.

# 8 Environment and climate change

## 8.1 Magnitude of urban heat island effects (atmospheric)

### 8.1.1 General

Those implementing this document should report on this indicator in accordance with the following requirements.

NOTE 1 At city scale, urban areas are warmer, on average, than their rural surroundings. This applies to the city surface and the urban atmosphere, and it defines a phenomenon known as the "urban heat island" effect. Heat islands are caused by retention of heat in city construction materials, reduction of wind speeds in street "canyons," diminished evaporative cooling over impervious surfaces, and release of combustive heat from fuel use in buildings, industry, and vehicles. In cities with a hot climate, or with a hot season, the heat island effect can convey serious health implications for human morbidity and mortality during prolonged heat wave events or extremely hot days or nights. The heat island effect also increases (decreases) energy demand for building cooling (heating) in hot (cold) cities or seasons. The measured magnitude of the heat island effect fluctuates with time of day, season of the year, geographic location, urban form and function, and prevailing weather conditions.

NOTE 2 City governments have direct control or influence over many planning and policy instruments that can influence or reduce urban heat island effects. These include urban planning policies, building codes, and the designation and maintenance of green spaces.

NOTE 3 This indicator reflects the "Biodiversity and Ecosystem Services" and "Living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of the environment" and "wellbeing" purposes of the city as defined in ISO 37101.

### 8.1.2 Indicator requirements

The urban heat island effect shall be calculated as the difference between mean daily air temperatures recorded simultaneously in one urban and one non-urban area, averaged over a 12-month period.

Urban area shall refer to a central part of the city on the order of several hectares, with close-set buildings, paved roads, heavy traffic flow, and high population density.

Non-urban area shall refer to a peripheral part of the city on the order of several hectares, with few buildings and roads, abundant natural land cover, and low population density.

Cities should describe the two locations of the temperature sensors (or climate stations) used to measure the heat island magnitude (e.g., park, airport, city centre, agricultural area). This is necessary to convey the local representativeness of the measured values, and the physical, demographic and human activities representative of the area surrounding the two instruments (or stations) and their influence on the recorded temperatures. References to "urban climate zones" (UCZ) (World Meteorological Organization [WMO], 2006, pg. 11) are helpful in this regard. WMO guidelines for temperature observations in urban and non-urban should be followed (see WMO/TD No. 1250, "Initial Guidance to Obtain Representative Meteorological Observations at Urban Sites"; https://library.wmo.int/pmb_ged/wmo-td_1250.pdf).

### 8.1.3 Data sources

The data shall be sourced from government agencies or research institutions that operate and maintain meteorological observatories, climate stations, or environmental monitoring sites in cities and their surrounding rural areas.

### 8.1.4 Data Interpretation

Care should be taken when interpreting data relating to the urban heat island effect, as the magnitude is sensitive to measurement height, measurement location, measurement interval, instrument type, and instrument placement. Location is especially important because the heat island effect at city scale is comprised of many smaller local and micro-scale climates (e.g., hot and cool spots associated with

small parks, water bodies, heat-emitting factories) throughout the city that may not be representative of the broader climate.

## 8.2 Percentage of natural areas within the city that have undergone ecological evaluation for their protective services

### 8.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Ecological assets such as forests, mangroves and floodplains give protection to human settlements from hazards such as floods, heatwaves, and tropical storms. Protective services are direct benefits provided by ecological assets to prevent or reduce the negative impacts of hazards on cities and their citizens. Examples of protective services include the reduction of peak stormwater runoff by natural ground cover in river catchments and the attenuation of storm surges by coastal mangroves. To help a city identify and enhance the protective value of its ecological assets, the city's natural areas can be formally evaluated for the protective services they provide.

NOTE 3 This indicator reflects the "Biodiversity and Ecosystem Services" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of environment" purposes of the city as defined in ISO 37101.

### 8.2.2 Indicator requirements

Percentage of natural areas within the city that have undergone ecological evaluation for their protective services shall be calculated as the total area of publicly owned natural areas within the city that have undergone ecological evaluation for their protective services (numerator) divided by the total area of all publicly owned natural areas in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of natural areas within the city that have undergone ecological evaluation for their protective services.

Natural areas shall refer to geographic spaces or zones whose distinguishing characteristics have arisen naturally, or whose predominant land cover and landscape features are otherwise natural (soil, sand, water, or vegetation) rather than built (impermeable construction materials).

Protective services are direct benefits provided by ecological assets to prevent or reduce the negative impacts of hazards on cities and their citizens. Ecological evaluation shall refer to a formal assessment or classification of the protective services provided by the ecological assets and systems in the defined area.

NOTE While outside the scope for this indicator, assessments should ideally also be undertaken to evaluate ecosystems that lie beyond the city boundary but that provide important ecological services to the city (e.g. upstream watersheds). This may require transboundary collaboration with other city governments, regulatory authorities and other stakeholders. Also, outside scope are ecological evaluations by private landowners using own resources. Although privately owned ecological assets provide the same protective service as public lands, they may be difficult to evaluate.

### 8.2.3 Data sources

Ecological evaluations are available from city environmental departments, external environment agencies, or a combination of these and similar agencies.

## 8.3 Territory undergoing ecosystem restoration as a percentage of total city area

### 8.3.1 General

Those implementing this document should report on this indicator in accordance with the following requirements.

NOTE 1 Ecosystem restoration is an effective way to strengthen ecological resilience and to mitigate the impacts of natural hazards. It has multiple benefits such as improved stormwater management, water pollution control, and reduced flooding and soil erosion.

NOTE 2 This indicator reflects the "Biodiversity and Ecosystem Services" and" Living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of the environment" purpose of the city as defined in ISO 37101.

### 8.3.2 Indicator requirements

The territory undergoing ecosystem restoration as a percentage of total city area shall be calculated as the territory (in square kilometres) undergoing ecosystem restoration within the city boundary (numerator) divided by the total city area in square kilometres (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Ecosystem restoration shall refer to the process of recovering natural and semi-natural landscape elements (i.e., related to soil, water bodies and vegetation) that have been degraded, damaged or destroyed. Vegetation elements for restoration vary in spatial scale from individual rows of trees to entire valley systems; water elements vary from single ponds to entire watercourses. Examples of ecosystem restoration work include reconditioning of embankments or brownfields to parks or other recreational uses.

### 8.3.3 Data sources

Data on ecosystem restoration can be sourced from the city's capital and public works budget. Other sources include city parks and environmental departments.

## 8.4 Annual frequency of extreme rainfall events

### 8.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Extreme rainfall events can cause flooding of low-lying areas (including residences, infrastructure and roads); overwhelm water sanitation systems; and damage urban lands dedicated to agriculture and forests within the city. Monitoring extreme rainfall events enables cities to anticipate probable changes in extreme weather, and to make sound investment and budgetary decisions regarding infrastructure and service provision responsibilities. This monitoring of these extreme rainfall events can lead to better planning, preparation for and response to these events.

### 8.4.2 Indicator requirements

Annual frequency of extreme rainfall events shall be calculated as the number of extreme rainfall events in a given year.

Extreme rainfall events shall refer to precipitation events in which 50 mm or more of rain has fallen within the city over a 24-hour period.

### 8.4.3 Data sources

Data on extreme rainfall events can be sourced from local or regional meteorological organizations or departments monitoring the environment and climate change.

## 8.5 Annual frequency of extreme heat events

### 8.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE During extreme heat waves, mortality and morbidity increase among the general population, especially among vulnerable groups. This monitoring of these extreme heat events can lead to better planning, preparation for and response to these events.

### 8.5.2 Indicator requirements

Annual frequency of extreme heat events shall be calculated as the number of extreme heat events in a given year.

Extreme heat events shall refer to an extended period of time (at least 72 hours) with unusually hot weather conditions that put human health and wellbeing at risk. Country-specific, air temperature thresholds for defining extreme heat events vary. For example, in Canada an extreme heat event may be defined as 72 hours or more with air temperatures above 30 °C/86 °F (or a specific community-based threshold), while in the USA it may be defined as temperatures above 32 °C/90 °F (or a specific community-based threshold).

Those reporting on this indicator shall use their country-specific method and temperature threshold.

NOTE Cities should consider the location of the air temperature measurements to convey the local representativeness of the reported values (e.g., airport, city centre).

### 8.5.3 Data sources

Data on extreme heat events can be sourced from local or regional meteorological organizations or departments monitoring the environment and climate change.

## 8.6 Annual frequency of extreme cold events

### 8.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE During extreme cold events, mortality and morbidity increase among the general population, especially among vulnerable groups. This monitoring of these extreme cold events can lead to better planning, preparation for and response to these events

### 8.6.2 Indicator requirements

The annual frequency of cold events shall be calculated as the number of extreme cold events in a given year.

Extreme cold events shall refer to an extended period of time (at least 72 hours) with unusually hot weather conditions that put human health and wellbeing at risk. Country specific, air temperature thresholds for defining extreme cold events vary. For example, in Canada an extreme cold event may be defined as air temperatures or wind chills below -30 °C/-22 °F (or a specific community-based

 

threshold) for at least 72 hours, while in the USA it may be defined as temperatures or wind chills below -29 °C/- 20 °F (or a specific community-based threshold).

Those reporting on this indicator shall use their country specific method and temperature threshold.

NOTE Cities should consider the location of the air temperature measurements to convey the local representativeness of the reported values (e.g., airport, city centre).

### 8.6.3 Data sources

Data on extreme cold events can be sourced from local or regional meteorological organizations or departments monitoring the environment and climate change.

## 8.7 Annual frequency of flood events

### 8.7.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Floods are the most common natural disaster and the leading cause of natural disaster fatalities worldwide. With increasing frequency of climatic extremes, the occurrence and severity of urban flood events is intensifying. Cities can use annual flood frequency data to improve flood warning systems, and to monitor and forecast flood disasters and water resources. This monitoring of these flood events can lead to better planning, preparation for and response to these events.

### 8.7.2 Indicator requirements

The annual frequency of flood events shall be calculated as the number of flood events in the city in a given year.

A flood event shall refer to an overflow of water onto normally dry land, and may include the inundation of a normally dry area caused by a significant rise in the water level of a stream, lake, reservoir or coastal region. A flood event may also include pooling of water at or near the point of rainfall. Flooding is a longer-term event than flash flooding, lasting at least 72 hours (USA National Weather Service).

### 8.7.3 Data sources

Data on flood events can be sourced from local or regional meteorological organizations or departments monitoring the environment and climate change.

## 8.8 Percentage of city land area covered by tree canopy

### 8.8.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE A city's tree canopy coverage can have numerous benefits, including reduction of daytime air temperatures in hot seasons, improving air quality, and strengthening social ties among neighbours. These factors can strengthen resilience while also helping to attract businesses and residents (U.S. Climate Resilience Toolkit)

### 8.8.2 Indicator requirements

The percentage of city area covered by tree canopy shall be calculated as the city land area covered by tree canopy (numerator) divided by city's total land area (denominator). The result shall then be multiplied by 100 and expressed as the percentage of city land area covered by tree canopy.

Tree canopy shall refer to the layered biomass of tree leaves, branches, and stems that obscures the underlying ground surface when viewed from above.

#### 8.8.3 Data sources

Data on tree canopy coverage can be sourced from local or regional conservation organizations, or a Ministry/Department of Environment, Land Use or Urban Planning. As well, data can be sourced using GIS tools and methods.

## 9 Finance

### 9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget

#### 9.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Upgrading and maintenance of city services helps to ensure a more resilient city. If the assets to provide these services are not maintained and/or upgraded, the level of service over time is likely to decline and to be more vulnerable to disruption during shocks and stresses. Cities should proactively maintain and upgrade basic services to ensure public safety, and to ensure adequacy for the future.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" and "Community infrastructures" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

#### 9.1.2 Indicator requirements

Annual expenditure on maintenance and upgrades of city service assets as a percentage of total city budget shall be calculated as the annual total of all funds spent on maintenance and upgrades of assets for the provision of city services (numerator) divided by the total annual budget of the city (denominator). The result shall be multiplied by 100 and expressed as the expenditure on maintenance and upgrades of city service assets as a percentage of total city budget.

Where possible, expenditure data by service type (e.g., water, waste, transport) should be included as percentage values and included separately as a table.

City services will vary in each city, but usually include sanitation, water supply, waste collection, public transport, electricity and gas supply, street lighting, and road maintenance.

#### 9.1.3 Data sources

Information on expenditures can be sourced from capital and maintenance budget documents which are approved annually.

### 9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget

#### 9.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Protective storm water infrastructure is critical to mitigate hazards and potential impacts of extreme precipitation events. It should be maintained, upgraded, and managed proactively to ensure public safety, and to ensure adequacy for the future.

NOTE 2 This indicator reflects the "Community infrastructures" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 9.2.2 Indicator requirements

Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget shall be calculated as the annual total of all funds spent on upgrades and maintenance of storm water physical and management infrastructure (numerator) divided by the total annual budget of the city (denominator). The result shall be multiplied by 100 and expressed as the expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget.

Storm water infrastructure shall refer to facilities, technical and organizational structures that are designed, installed, and/or maintained to mitigate the effects of rainwater and snowmelt hazards in urban areas. Examples of stormwater infrastructure include levees and flood barriers; flood basins; sea walls; storm drains and storm-water holding tanks; storm water ditches, culverts, and catchment basins.

### 9.2.3 Data sources

Information on expenditures can be sourced from capital and maintenance budget documents which are approved annually.

## 9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget

### 9.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Ecosystem restoration is an effective way to strengthen ecological resilience and to mitigate hazards. It has multiple benefits such as improved storm water management, water pollution control, and reduced flooding and soil erosion.

NOTE 2 This indicator reflects the "Biodiversity and Ecosystem Services" and "Living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of environment" purpose of the city as defined in ISO 37101.

NOTE 3 Ecosystem Restoration is the "process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed" (Society for Ecosystem Restoration).

### 9.3.2 Indicator requirements

Annual expenditure on ecosystem restoration as a percentage of total city budget shall be calculated as the total of all funds spent annually on ecosystem restoration assets for the specific purpose of enhancing the protective and other ecosystem services that enhance the resilience of the city (numerator) divided by the total city budget (denominator). The result shall be multiplied by 100 and expressed as the expenditure on ecosystem restoration as a percentage of total city capital budget.

### 9.3.3 Data sources

Data on ecosystem restoration may be included in the city's capital and public works budget. Some elements of expenditure may also be included in the city's parks and conservation budgets. The total city budget used in this calculation should to be taken directly from the city's audited financial statements without amendment or variation.

### 9.3.4 Data interpretation

This indicator measures specific city-expenditure to support and enhance the ecosystems services.

## 9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Embedding green and blue infrastructure into the urban fabric is an effective way to strengthen ecological resilience and to mitigate the impacts of many hazards. These infrastructures have multiple benefits such as improved storm water management, water pollution control, and reduced flooding and soil erosion.

NOTE 2 This indicator reflects the "Biodiversity and Ecosystem Services" and "Living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of environment" purpose of the city as defined in ISO 37101.

### 9.4.1 Indicator requirements

Annual expenditure on green and blue infrastructure as a percentage of total budget shall be calculated as the total of all funds spent on creating or enhancing green and blue infrastructure assets for the specific purpose of providing infrastructure-related services for the city (numerator) divided by the total city budget (denominator). The result shall be multiplied by 100 and expressed as the expenditure on green and blue infrastructure as a percentage of total city budget.

Green and blue infrastructure shall refer to all natural and semi-natural landscape elements that can be broadly defined as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of infrastructure and ecosystem services and protect biodiversity (SOURCE: European Commission, *Building a Green Infrastructure for Europe*). Green elements are related to vegetation and vary in spatial scale from individual rows of trees to entire valley systems; blue elements are related to water and vary from single ponds to entire watercourses. Ways to embed this infrastructure into the urban fabric include greening of street squares and roadsides; greening roofs and facades; developing urban agriculture; creating urban green corridors; replacing impermeable surfaces with pervious materials; natural water filtration; and daylighting urban rivers and restoring existing water courses.

### 9.4.2 Data sources

Data on green and blue infrastructure can be sourced from the city's capital and public works budget. Some elements of expenditure can also be included in the city's budget for parks and legally protected areas. The total city budget used in this calculation should to be taken directly from the city's audited financial statements without amendment or variation.

## 9.5 Annual expenditure on emergency management planning as a percentage of total city budget

### 9.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Budgeting for emergency management planning helps cities to create a detailed plan of action so that the city can adequately respond to shocks and stresses.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" and "Safety and security" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "responsible resource use" purposes of the city as defined in ISO 37101.

### 9.5.2 Indicator requirements

Annual expenditure on emergency management planning as a percentage of total city budget shall be calculated as the total annual expenditure on emergency management planning (numerator) divided by

the total annual city budget (denominator). The result shall be multiplied by 100 and expressed as the annual expenditure on emergency management planning as a percentage of total city budget.

Emergency management planning shall refer to the process of assessing a city's goals for disaster risk reduction and emergency preparedness, and creating a detailed plan of action to meet those goals so that the city can respond to shocks and stresses. Elements of emergency management planning include determining potential emergency situations and consequences of those situations (i.e., through risk assessments, hazard mapping, vulnerability analysis), and identifying the necessary and appropriate responses and procedures for each emergency situation (e.g., warning systems, evacuation routes, service conduits). Emergency management planning shall exclude ongoing operational emergency service budgets for police, fire, or ambulance services.

### 9.5.3 Data sources

Information on expenditures can be sourced from capital and maintenance budget documents which are approved annually.

## 9.6 Annual Expenditure on social and community services as a percentage of total city budget

### 9.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Social and community services are widely recognised as contributing to the development of social cohesion, which is widely recognised as being fundamental to resilience.

### 9.6.2 Indicator requirements

Annual expenditure on social and community services as a percentage of total city budget shall be calculated as the total annual expenditure on social and community services by the city (numerator) divided by the total annual budget of the city (denominator). The result shall be multiplied by 100 and expressed as the expenditure on social and community services as a percentage of total city budget.

Social and community services shall be defined as services directly provided or supported by the city with the goal of promoting or supporting individual and community resilience and wellbeing. This may include, but is not limited to, programs and funding for community groups and associations, public health awareness, libraries, emergency shelters, homeless shelters, drop-in centres, community centres, civic events, community outreach, food programs, health and human services, seniors programs and services, and outreach, and support and assistance for disadvantaged and vulnerable groups.

### 9.6.3 Data sources

Information on expenditures on social and community services can be sourced from the annual city budget.

### 9.6.4 Data interpretation

The provision of social and community services may also be the responsibility of other levels of governments (e.g. local, regional, national) and other stakeholders such as charities and not-for-profit groups. The expenditure by the city government on these services should be interpreted in this broader context.

## 9.7 Total allocation of disaster reserve funds as a percentage of total city budget

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A disaster reserve fund is managed by the city government specifically to meet the unanticipated expenses of emergency response, recovery, and reconstruction from a disaster event. The disaster reserve fund elevates a city's preparedness for disasters. The additional benefit of disaster reserve funds held by the city allows for the dispersal of funds to support rapid resumption of services.

NOTE 2 This indicator reflects the "safety and security" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 9.7.1 Indicator requirements

The total allocation of disaster reserve funds as a percentage of total city budget shall be calculated as the total allocation of disaster reserve funds (numerator) divided by the total city budget (denominator). The result shall be multiplied by 100 and expressed as the total allocation of disaster reserve funds as a percentage of total city budget.

Disaster reserve fund shall refer to budgets managed by the city government and allocated specifically for meeting the unanticipated expenses of emergency response, recovery, and reconstruction from a disaster event.

### 9.7.2 Data sources

Information on disaster reserve funds can be sourced through the city budget.

### 9.7.3 Data interpretation

Different jurisdictions will have different models for covering the costs of dealing with disasters, which will need to be taken into account when interpreting this indicator.

# 10 Governance

## 10.1 Annual number of multi-stakeholder risk assessments

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Multi-stakeholder risk assessments provide information on the exposure and vulnerability of cities (and their expanding areas) to risks. Risk assessments are an effective way to integrate consideration of the potential impact of hazards into long-term city plans for urbanizing areas and are therefore essential to risk mitigation. For purposes of emergency planning, risk assessments must be accurate, accessible, current, and appropriate to the city's risk profile. Risk assessments should be conducted regularly and include the input of key city stakeholders.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 10.1.1 Indicator requirements

The frequency with which multi-stakeholder risk assessments take place shall refer to the number of multi-stakeholder risk assessments that have occurred in the previous 5 years.

Multi-stakeholder risk assessment shall refer to the systematic process of evaluating potential risks to individuals, groups, and organizations that have common interests in the safety and wellbeing of a city and its residents. Stakeholders may include city emergency services; other city services and departments (e.g., public works, transportation); the local health sector; utility providers (including

telecommunications); local businesses; NGOs; civil society organisations (including minority group representation); the environmental sector; the wider city population in all neighbourhoods (formal and informal); community groups; local universities; scientific institutions; other tiers of government or neighbouring cities (where necessary for the city's resilience); and industry associations.

The results of a risk assessment can be conveyed through maps, whether these are hazard, vulnerability, exposure, evacuation, or risk. Also included in risk assessments are reviews of protective infrastructure and critical assets.

### 10.1.2 Data sources

The data for this indicator could be sourced from city department(s) and regulatory authorities with responsibility for ensuring management of major risks facing the city.

## 10.2 Frequency with which disaster management plans are updated

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Cities must regularly test and update the long-term adequacy of disaster management plans to reflect relevant hazards and risks facing the community (based on current data or modelled hazard and demographic projections), and to effectively mitigate those risks. Disaster management plans, will change with urbanization and land use, shifting weather and climate patterns, and improved knowledge and technology.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 10.2.1 Indicator requirements

The frequency with which disaster management plans are updated shall refer to the total number of city-wide disaster management plan updates that occurred in the previous 5 years (numerator) divided by five (denominator).

Disaster management shall refer to the long-term organization, planning, and application of measures to prepare for, respond to, and recover from disaster events. Disaster management plans should be integrated with wider regional or national responses and should stipulate which agency assumes leadership in different emergency scenarios, the response roles of different agencies, and the human and non-human resources available. Key components of a disaster management plan are command and control; evacuations (including hospitals, jails, etc.); communication systems; critical asset management (including likely "failure chains"); integration of private sector utilities covering energy, water/sanitation, trash collection, communications, etc.; medical response; law and order response; fire and rescue response; public information; and triage policies.

### 10.2.2 Data sources

The data for this indicator should be available from the relevant emergency management authority(s) with responsibility for emergency planning.

## 10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Inter-agency engagement and co-ordination is essential for pre-event preparedness and post-event response activities. This engagement should play out at multiple levels of government, including city departments.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 10.3.1 Indicator requirements

Percentage of city departments that are engaged in preparing for and responding to potential risks shall be calculated as the number of city departments that are actively engaged in preparing for and responding to potential risks (numerator) divided by the total number of city departments within the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of city departments that are engaged in preparing for and responding to potential risks.

Consideration should be given to inclusion of third parties including businesses where these entities provide key services on behalf of city departments.

### 10.3.2 Data sources

The data for this indicator should be sourced from city departments.

## 10.4 Percentage of essential city services covered by a documented continuity plan

### 10.4.1 General

Those implementing this document should report on this indicator in accordance with the following requirements.

NOTE 1 Continuity plans can enhance a city's preparedness for, and recovery from, shocks. The benefits of a continuity plan include continued delivery of essential services, reduced disruption to city operations, and timely and rapid recovery from disruptions due to shocks. Cities therefore need to be proactive in developing and adopting continuity plans, based on relevant risks and the issues likely to arise.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 10.4.2 Indicator requirements

The percentage of essential city services covered by a documented continuity plan shall be calculated as the total number of essential services that are covered by a documented continuity plan (numerator) divided by the total number of essential services provided in the city by government entities (denominator). The result shall be multiplied by 100 and expressed as the percentage of essential city services covered by a documented continuity plan.

Essential city services shall refer to services that are deemed vital to the wellbeing and functioning of the community. These can include but are not limited to: transportation, electricity, gas, water, sanitation and wastewater treatment, waste management, food, health, police, fire and emergency services, and ambulance.

A continuity plan shall refer to a documented strategy that identifies the threats and risks facing the city operations, and that helps to protect its assets and personnel from the negative effects of shocks. Continuity planning involves defining potential risks, determining how those risks will affect operations, implementing safeguards and procedures to mitigate those risks, and regularly reviewing risks to ensure their relevancy and currency. Continuity plans should be regularly updated.

NOTE ISO 22301: 2012 is the internationally recognised benchmark for organizational continuity. It specifies requirements to plan, establish, implement, operate, monitor, review, maintain and continually improve a documented management system to protect against, reduce the likelihood of occurrence, prepare for, respond to, and recover from disruptive incidents when they arise.

### 10.4.3 Data sources

The data for this indicator will be sourced from the continuity plans of entities providing essential city services

## 10.5 Percentage of city electronic data with secure and remote back-up storage

### 10.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Safe and efficient back-up, access, recovery, and storage of data is critical to the functioning of city governments and their disaster mitigation and recovery strategies. Important data held by governments should be backed up at secure, offsite data centres to protect against disruptions and/or damage to primary storage. Plans and mechanisms for the safe, long-term storage of city data should reflect the city's vulnerabilities to hazards and should be updated and tested regularly.

NOTE 2 This indicator reflects the “Governance, empowerment and engagement” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 10.5.2 Indicator requirements

Percentage of city electronic data with secure and remote back-up storage shall be calculated as the volume of city electronic data with secure and remote back-up storage (numerator) divided by the total volume of electronic city data (denominator). The result shall be multiplied by 100 and expressed as the percentage of city data with secure and remote back up storage.

Back-up remote storage shall refer to the storage of data (held on servers, workstations, and laptops) at a secure secondary (i.e., offsite) location.

### 10.5.3 Data sources

Data for this indicator can be sourced from the city’s IT department.

## 10.6 Percentage of public meetings dedicated to resilience in the city

### 10.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Public meetings in cities help to promote and enable inclusive and collaborative approaches to resilience planning. These help to enhance citizen engagement and citizen-driven strategies in creating a more resilient city.

### 10.6.2 Indicator requirements

The percentage of public meetings dedicated to resilience in the city shall be calculated as the number of public meetings dedicated to resilience in the city (numerator) divided by the total number of public meetings in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of public meetings dedicated to resilience in the city.

### 10.6.3 Data sources

Data on public meetings can be sourced from a city’s public meeting registry.

### 10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements

#### 10.7.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Intergovernmental agreements are a common and useful instrument serving a variety of purposes. With regards to resilience, intergovernmental agreements help to foster relationships across and between levels of government (e.g. city, state/province and national governments) and promote and entrench long-term collaborative planning for managing shocks.

#### 10.7.2 Indicator requirements

The number of intergovernmental agreements dedicated to planning for shocks as a percentage of total intergovernmental agreements shall be calculated as the number of intergovernmental agreements involving the city that are dedicated to planning for shocks (numerator) divided by the total number of intergovernmental agreements (denominator). The result shall be multiplied by 100 and expressed as the number of intergovernmental agreements dedicated to planning for shocks as a percentage of total intergovernmental agreements.

An intergovernmental agreement shall refer to an agreement that is entered into by the city with at least one other level of government (e.g. state/provincial and national levels of government).

#### 10.7.3 Data sources

Data on intergovernmental agreements can be sourced from city departments and ministries responsible for intergovernmental relations.

## 11 Health

### 11.1 Average waiting time in hospital emergency rooms

#### 11.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Average waiting time in hospital emergency rooms is a key indicator of the capacity of local health services and can be used to assess their ability to respond to shocks and stresses. Data on waiting times can also be analysed to determine patient flow through hospital emergency rooms, identifying blockages and ensuring staffing levels match patient needs.

#### 11.1.2 Indicator requirements

Average waiting times in hospital emergency rooms shall be calculated as the number of minutes that all registered patients in all emergency rooms across the city have waited to be admitted for treatment in a twelve-month period (numerator) divided by the total number of patients admitted for treatment in all emergency rooms in the same twelve-month period (denominator). The result shall be expressed as the average waiting time in hospital emergency rooms in minutes.

Waiting time begins when patients register in the emergency room queue. It ends when patients are admitted for treatment.

### 11.1.3 Data sources

Data on average waiting times in hospital emergency rooms can be sourced from local hospitals, or a local or regional ministry/department of health services.

### 11.1.4 Data Interpretation

Data on waiting times can be analysed to determine patient flow through hospital emergency rooms, identifying blockages and ensuring staffing levels match patient needs and helps to plan, prepare and adapt to provide emergency medical services in the case of shocks and stresses.

## 11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs

### 11.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Health care facilities must have services, supplies, and capabilities to treat the critical medical needs of people who are made sick, injured, or displaced by a disaster event. This helps to reduce the population's vulnerability to hazards, while also mitigating their likely effects.

NOTE 2 This indicator reflects the "Health and care in the community" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 11.2.2 Indicator requirements

The percentage of health care facilities equipped with capabilities and medical supplies for acute needs shall be calculated as the total number of health care facilities equipped with capabilities and medical supplies for acute needs within the city (numerator) divided by the total number of health care facilities within the city (denominator). The result shall be multiplied by 100 and expressed as a percentage of health care facilities equipped with adequate capabilities and medical supplies for acute needs.

For the purposes of this indicator, health care facilities shall refer to hospitals and clinics. Capabilities and medical supplies for acute needs shall refer to the clinical health care functions (e.g., emergency medicine, trauma care, pre-hospital emergency care, critical care surgery, urgent care, and short-term inpatient stabilization) that are able to deal with at least 90 percent of major injuries within 6 hours.

### 11.2.3 Data sources

Data on the capability and equipment levels of health facilities can be sourced from health authorities.

## 11.3 Percentage of hospitals equipped with back-up electricity supply

### 11.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE During shocks and stresses, hospitals play a critical role in providing emergency care. These facilities need to care for existing patients, while they also take on the role of treating disaster-related casualties and injuries. Health care facilities rely on electricity to maintain their essential functions and therefore require a reliable back-up electricity supply to maintain these functions in the case of power outages.

### 11.3.2 Indicator requirements

The percentage of hospitals equipped with back-up electricity supply shall be calculated as the number of hospitals equipped with back-up electricity supply (numerator) divided by the total number of

hospitals in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of health care facilities equipped with equipped with back-up electricity supply.

Back up electricity supply will include electrical energy sources (including generators and battery storage) protected from likely hazards and with sufficient energy or fuel supplies to provide sufficient power to run the essential functions of the hospital for a 72-hour period.

### 11.3.3 Data sources

Data on the number of hospitals equipped with emergency energy supplies and generators should be sourced from health authorities.

## 11.4 Percentage of population with basic health insurance

### 11.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 The provision of basic health insurance supports people in maintaining good health and allows access to appropriate medical care when sick, injured or disabled. Health insurance can reduce the financial burden that persons and their family face when requiring essential medical services. Health insurance also plays a role in enabling communities to be less vulnerable to shocks and stresses.

NOTE 2 This indicator reflects the "Health and care in the community" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "social cohesion" purpose of the city as defined in ISO 37101.

### 11.4.2 Indicator requirements

The percentage of population with basic health insurance shall be calculated as the total number of residents within the city with basic health insurance coverage (numerator) divided by the city's total population (denominator). The result shall be multiplied by 100 and expressed as a percentage of population with basic health insurance.

Basic health insurance shall refer to a form of risk protection from incurred medical expenses, either through free or low-cost access to medical services or through payments of benefits as a result of sickness or injury to recover costs. Health insurance may be publicly or privately provided.

### 11.4.3 Data sources

Data on residents with unified health histories can be sourced through local, regional, or provincial health care providers or insurers.

## 11.5 Percentage of children that are fully immunized

### 11.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Immunization is one of the most cost-effective public health interventions to date, averting an estimated 2 to 3 million deaths every year. Immunization programmes have been very successful in protecting children against specific infections, hence why it is important children receive all basic vaccinations.

### 11.5.2 Indicator requirements

The percentage of children that are fully immunized shall be calculated as the number of children aged 0 to 14 that have been fully immunized in the city (numerator) divided by the total number of children

aged 0 to 14 in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of children that are fully immunized.

According to the World Health Organization, a child that is fully immunized shall refer to a child that has received all basic vaccinations before reaching one year of age. More specifically, a child is fully immunized with all basic vaccinations if the child has received Bacillus Calmette-Guerin (BCG) vaccine against tuberculosis at birth; three doses each of polio and pentavalent (diphtheria-tetanus-pertussis-hepatitis B (Hep), Haemophilus influenza type B (Hib)) vaccines at 6, 10 and 14 weeks of age; and a vaccination against measles at 9 months of age.

### 11.5.3 Data sources

Data on children immunizations should be sourced from a relevant local or regional ministry, department, or organization that is responsible for providing immunization health services.

## 11.6 Number of infectious disease outbreaks per year

### 11.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE An infectious disease outbreak is a major potential shock for a city. The ability of a city to prepare for, recover from and adapt to an infectious disease outbreak is indicative of resilience.

### 11.6.2 Indicator requirements

The number of infectious disease outbreaks per year shall be calculated as the count of infectious disease outbreaks in a given year in the city.

An infectious disease shall refer to a disease caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another.

As defined by the World Health Organization, an outbreak shall refer to an occurrence of cases of disease in excess of what would normally be expected in a defined community, geographical area or season. An outbreak may occur in a restricted geographical area or may extend over several countries. It may last for a few days or weeks, or for several years.

### 11.6.3 Data sources

Data on the number of infectious diseases can be sourced from relevant local or regional ministries, departments or organizations responsible for disease surveillance and epidemiology.

### 11.6.4 Data Interpretation

Public health surveillance ensures an ongoing, systematic collection, analysis and interpretation of health-related data essential to the planning, implementation, and evaluation of public health practice. Surveillance is undertaken to inform disease prevention and control measures, especially in the case of disease outbreaks. Furthermore, public health surveillance, such as the tracking of disease outbreaks, is an essential communication point in forecasting and responding to disease outbreaks and incidents of regional, national and international significance.

# 12 Housing

## 12.1 Capacity of designated emergency shelters per 100 000 population

### 12.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Emergency shelters are places of rest, reprieve, and recuperation for people displaced by shocks and stresses. They are essential to a city's capacity for disaster preparedness and response, and therefore resilience.

NOTE 2 This indicator reflects the "Health and care in the community" and " Living together, interdependence and mutuality" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 12.1.2 Indicator requirements

Capacity of designated emergency shelters per 100 000 population shall be calculated as the total capacity of all designated emergency shelters in the city (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the capacity of designated emergency shelters per 100 000 population.

Capacity shall refer to the maximum, pre-determined number of people that can be accommodated in an emergency shelter

Emergency shelter shall refer to an existing structure that has been officially designated to be used for temporary housing for people whose previous housing is unsafe or unavailable during or after a disaster, or who are fleeing the effects of a disaster. Emergency shelters should be able to resist a disaster by virtue of their construction and/or location.

### 12.1.3 Data sources

Information on designated emergency shelters can be sourced from emergency management authorities.

## 12.2 Percentage of buildings structurally vulnerable to high-risk hazards

### 12.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 The vulnerability of a city's building stock to severe damage or collapse during a disaster is vital to overall resilience. Assessment and review of building vulnerability can help cities to identify structures in need of repair, retrofit, or rebuilding so as to meet current codes and standards that are relevant to the current hazard-risk profile. This is especially true in cities prone to earthquakes, hurricanes, cyclones, floods, tsunamis, and landslides.

NOTE 2 This indicator reflects the "living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 12.2.2 Indicator requirements

The percentage of buildings structurally vulnerable to high-risk hazards shall be calculated as the total number of buildings in the city that are vulnerable to high-risk hazards (numerator) divided by the total number of buildings in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of buildings structurally vulnerable to high-risk hazards.

Buildings shall refer to all residential and non-residential structures that are designed for human occupancy (i.e. with roofs and walls) and that stand in permanent or semi-permanent locations. This includes public and private buildings used for residential, commercial, industrial, institutional, recreational, and other purposes. Buildings that are structurally vulnerable to high risk hazards (such as earthquakes, cyclones and floods) are at high risk of suffering collapse or significant damage due to the effects of hazards that can cause death or injury to the building's occupants.

### 12.2.3 Data sources

Data for this indicator can be obtained from city departments or local authorities responsible for ensuring compliance with building codes, standards, and safety regulations.

## 12.3 Percentage of residential buildings not in conformity with building codes and standards

### 12.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 National and/or local building codes stipulate safety and performance standards for the design and construction of residential buildings. These codes and standards must be legally and actively enforced to ensure that buildings withstand the high-risk hazards that a community faces, and thereby reduce risk of building damage or collapse during a disaster.

NOTE 2 This indicator reflects the "living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 12.3.2 Indicator requirements

The percentage of residential buildings not in conformity with building codes and standards shall be calculated as the total number of residential buildings in the city not in conformity with building codes and standards (numerator) divided by the total number of residential buildings in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of residential buildings not in conformity with building codes and standards.

This indicator relates to all building codes and standards, including (and especially) those that regulate the structural integrity of residential buildings and their resistance to severe damage or collapse during a disaster (e.g., earthquakes, floods, cyclones, landslides).

Residential buildings shall refer to all structures designed for long-term human occupancy (i.e., with roofs and walls) and that stand in permanent or semi-permanent locations.

Building codes shall refer to the ordinances, regulations, and associated standards intended to regulate aspects of design, construction, material use, alteration, and occupancy of built structures.

### 12.3.3 Data sources

Data for this indicator can be obtained from city departments or local authorities responsible for enforcing building codes, standards, and safety regulations, and for licensing of new residential buildings.

## 12.4 Percentage of damaged infrastructure that was "built back better" after a disaster

### 12.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Post-disaster learning is an essential process in the reconstruction of stronger and enhanced communities. The process of "building back better" helps cities to mitigate existing risks and prepare for future disasters. Lessons learned from real disaster events can be integrated into a city's risk-management framework.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement", "Innovation, creativity and research" and " Living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 12.4.2 Indicator requirements

Percentage of damaged infrastructure that was built back better after a disaster shall be calculated as the total number and length of infrastructures within the city that were "built back better" after a disaster or extreme event (numerator) divided by the total number and length of infrastructures within the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of damaged infrastructure that was built back better after a disaster.

This indicator can only be assessed in instances where a disaster or extreme event has impacted the city resulting in damage to buildings and structures.

Infrastructure shall refer to point and linear assets (physical, built) that provide essential functions at single, identifiable sites or positions within the city, or along conduits, corridors, routes, or lines within the city, and that stand in permanent or semi-permanent locations. Point infrastructures shall include major buildings used for education (e.g., schools, universities, colleges) and health care (e.g., hospitals, health clinics), as well as stations, facilities, plants, installations, or other point-source works used for solid waste disposal and treatment; water and wastewater treatment; and power generation, transmission, and distribution. Linear infrastructure shall include major pipelines used for delivery of water and gas, or removal of wastewater; transmission lines for delivery of electricity; and major transportation routes and corridors for movement of people and goods over land and water (e.g., highways, roadways, railways, causeways, bridges).

In the context of this indicator, "Built back better" shall refer to the recovery, rehabilitation, and reconstruction of cities' physical infrastructure after disaster events to increase its resilience. Examples of "Built back better" are:

— Introducing disaster risk reduction measures (including building codes and regulations) to increase the resilience of physical assets being reconstructed, such as earthquake-resistant;

— Building designs or raised-floor elevation in flood-prone areas;

— Introducing and enforcing appropriate land-use planning regulations, which curtail reconstruction in high-risk areas.

— Reconstructing improved hazard-control infrastructure, such as flood embankments

— Replacing damaged assets with context sensitive, technologically updated alternatives. For example, modernizing damaged telecommunications equipment to keep up with technological advances.

— Using recovery as an opportunity to right size infrastructure to better meet community needs. For example, reconstructing hospitals with an adequate number of beds.

[SOURCE: Global Facility for Disaster Reduction And Recovery (GFDRR) Building Back Better in Post-Disaster Recovery]

### 12.4.3 Data sources

Data for this indicator could be sourced from the Planning and Engineering Departments of the city along with other public and private entities involved in the planning and construction of city infrastructure.

## 12.5 Annual number of deaths in residential fires per 100 000 population

### 12.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Domestic fire safety is fundamental to the livelihood of residents. It is important that cities monitor the number of residential (i.e., house) fires to understand residents' awareness of domestic fire safety. In addition, cities can utilize house fire data to better inform residents about fire safety equipment and evacuation planning, and about measures to mitigate occurrence of house fires.

### 12.5.2 Indicator requirements

The annual number of deaths in residential fires per 100 000 population shall be calculated as the annual number of deaths in residential fires (numerator) divided by one 100,000$^{th}$ of the city's total population. The result shall be expressed as the annual number of deaths in residential fires per 100 000 population.

Residential fires shall include all fires that have occurred in residential properties, which should include, for example, single family detached homes, semi-detached residences, condominiums, duplexes, mobile homes, etc. The city shall list all residential property types included in the calculation when reporting on this indicator, if available.

### 12.5.3 Data sources

Data on the annual number of deaths in residential fires should be sourced from local or national government departments and agencies responsible for public safety.

## 12.6 Annual number of residential properties flooded as a percentage of total residential properties in the city

### 12.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE With the increasing frequency of severe weather events, it is essential that homeowners take steps to protect their homes from flooding. Cities also play a critical role in mitigating residential flooding, for example, through planning controls and construction and maintenance of storm water infrastructure. Sources of flooding can include, but are not limited to, rainfall, storm surge, overflowing river banks, surface water run-off, groundwater rise, sewage back-up.

### 12.6.2 Indicator requirements

The annual number of residential properties flooded as a percentage of total residential properties in the city shall be calculated as the annual number of residential properties that have flooded in the city (numerator) divided by the total number of residential properties in the city (denominator). The result shall then be multiplied by 100 and expressed as the annual number of residential properties flooded as a percentage of total residential properties in the city.

Residential properties shall refer to dwellings (or structures) classified for residential use. Examples of residential properties should include, but are not limited to, single-family dwellings, mobile dwellings, semi-detached dwellings, row houses, condominiums and apartment buildings.

### 12.6.3 Data sources

Data on the number of residential properties flooded can be sourced from local or regional ministries/ departments responsible for public safety, water and/or environment services.

## 12.7 Percentage of residential properties located in high-risk zones

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Properties located in high-risk zones are especially vulnerable to damage or destruction during disaster events. Controlling the type and location of property development is a key strategy for cities to avoid and reduce risks from natural hazards.

NOTE 2 This indicator reflects the "safety and security" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "attractiveness" purposes of the city as defined in ISO 37101.

### 12.7.1 Indicator requirements

Percentage of residential properties located in high-risk zones shall be calculated as the number of residential properties located in high-risk zones within the city (numerator) divided by the total number of residential properties in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of residential properties located in high-risk zones.

Residential properties shall refer to dwellings (or structures) classified for residential use. Examples of residential properties should include, but are not limited to, single-family dwellings, mobile dwellings, semi-detached dwellings, row houses, condominiums and apartment buildings.

High-risk zones shall refer to those areas of the city that are particularly vulnerable to natural hazards, such as flood plains, and hillsides prone to mudslides, and low-lying coastal areas. Hazard maps should be used to identify such areas and indicate the probability of occurrence of a relevant hazard.

### 12.7.2 Data sources

Mapping/delineation of hazards within the city is often a key responsibility of city governments. Information on hazard maps and the location of risk zones can be obtained from several departments and stakeholders, including GIS departments, emergency planners, and research institutions.

# 13 Population and social conditions

## 13.1 Vulnerable population as a percentage of city population

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Vulnerable members of a community are often the people most at risk from shocks and stresses. For emergency planning purposes, ensuring the safety of vulnerable people often requires a disproportionately large quantity of time and resources of emergency services during shocks. Knowing the magnitude of a city's vulnerable population can help a city prepare for shocks and stresses.

NOTE 2 This indicator reflects the "Living together, interdependence and mutuality" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "social cohesion" purposes of the city as defined in ISO 37101.

### 13.1.1 Indicator requirements

The vulnerable population as a percentage of total city population shall be calculated as the total number of vulnerable people within the city (numerator) divided by the city's total population (denominator). The result shall be multiplied by 100 and expressed as the vulnerable population as a percentage of total city population.

Vulnerable people shall refer to individuals who have limited capacity to anticipate, cope with, resist, and recover from the effects of a disaster, and can include the following segments of the population:

— the elderly;

— persons with physical or mental impairments;

— children;

— pregnant women;

— ill or undernourished people;

— the homeless;

— people located in slums and informal housing;

— refugees and internally displaced people; and

— transient or nomadic communities.

Other population segments in the city that may be vulnerable to hazards due to location or context specific factors may also be included in the total vulnerable person count.

### 13.1.2 Data sources

Population and demographic data can be typically obtained from census and household survey data. Measuring some categories of vulnerable persons however may require additional or alternative data collection methods such as additional specific surveys (e.g. for homeless people).

## 13.2 Percentage of population with access to social assistance programs

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Providing social and financial assistance to disadvantaged and low-income persons helps ensure access to essential needs and maintenance of basic living standards. Social assistance also can help to reduce the vulnerability of recipient populations to shocks and shocks.

NOTE 2 This indicator reflects the "Health and care in the community" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "social cohesion" purposes of the city as defined in ISO 37101.

### 13.2.1 Indicator requirements

Percentage of population with access to social assistance programs shall be calculated as the number of people within the city with access to social assistance programs (numerator) divided by the total population of the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of population with access to social assistance programs.

Social assistance shall refer to government-funded financial aid that provides support to families and individuals who cannot meet their basic living costs due to illness, disability, low income, or unemployment. For some recipients, the need for assistance is temporary, while for others it is long term.

NOTE Social assistance is also known as welfare, income assistance, or social security.

### 13.2.2 Data sources

Data on access to social assistance programs should be available from the government agencies (at all tiers of government) responsible for providing these programs.

## 13.3 Percentage of population at high risk from natural hazards

### 13.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Knowing the proportion of a city's population that is exposed to hazards can help to educate the community, incentivise actions to mitigate risk, identify instances of underinsurance, and enhance city risk analysis and management processes.

NOTE 2 This indicator reflects the "Health and care in the community", "Living together, interdependence and mutuality" and "Living & working environment" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience", "well being" and "attractiveness" purposes of the city as defined in ISO 37101.

### 13.3.2 Indicator requirements

Percentage of population at high risk from natural hazards shall be calculated as the number of people in the city at high-risk of exposure to natural hazards (numerator) divided by the total city population (denominator). The result shall be multiplied by 100 and expressed as the percentage of population at high risk from natural hazards.

NOTE Delineating high-risk exposure, requires detailed local risk assessment (LRA) and up-to-date hazard and vulnerability maps. Assessments and maps should be publicly available and inclusive of entire urban areas. Up-to-date information is particularly important for hazards such as floods because changes in urban development can affect the area of a community at risk.

Where possible, the percentage data for each relevant hazard type should be included and listed in a table.

### 13.3.3 Data sources

Mapping/delineation of hazards, vulnerabilities, risks, and exposures in the city is often a key responsibility of city governments. Information on these maps can be obtained from several departments and stakeholders, including GIS departments, emergency planners, and research institutions.

## 13.4 Spatial segregation as measured by the Index of Dissimilarity based on income grouping

### 13.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Spatial segregation has pervasive effects on the income, education and employment perspectives of poor, segregated groups. It further engenders social divides and lack of trust, which may potentially exacerbate the impacts of hazards and disasters (OECD, 2018).

### 13.4.2 Indicator requirements

Spatial segregation as measured by the Index of Dissimilarity based on income grouping shall be calculated using the following formula:

$$\text{Index of Dissimilarity} = 1 - \sum_{g} \left( \frac{pop_g^c}{pop^c} \right)^2$$

where $pop_g^c$ is the number of people in income group $g$ in city C and $pop^c$ is the total population of city C. Higher levels of the Index of Dissimilarity reflect more even populations across the different income groups.

The Index of Dissimilarity shall be calculated based on the following sixteen (16) income groupings:

| **INCOME GROUP** |
|---|
| Under $5,000 |
| $5,000 to $9,999 |
| $10,000 to $14,999 |
| $15,000 to $19,999 |
| $20,000 to $24,999 |
| $25,000 to $29,999 |
| $30,000 to $34,999 |
| $35,000 to $39,999 |
| $40,000 to $44,999 |
| $45,000 to $49,999 |
| $50,000 to $59,999 |
| $60,000 to $69,999 |
| $70,000 to $79,999 |
| $80,000 to $89,999 |
| $90,000 to $99,999 |
| $100,000 and over |

### 13.4.3 Data sources

Data on the number of people belonging to specific income groups can be sourced from the national census or a regional or local ministry, department, or organization responsible for monitoring income statistics.

## 13.5 Percentage of neighbourhoods with regular and open neighbourhood association meetings

### 13.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Neighbourhood groups increase sense of place and mobilisation levels at the very local scale, while building social capital and local interpersonal ties.

### 13.5.2 Indicator requirements

The percentage of neighbourhoods with regular and open neighbourhood association meetings shall be calculated as the number of neighbourhoods in the city with regular and open neighbourhood association meetings (numerator) divided by the total number of neighbourhoods in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of neighbourhoods with regular, open neighbourhood association meetings.

A neighbourhood shall refer to an administratively defined geographic area within the city.

Regular and open neighbourhood association meetings shall refer to neighbourhood association meetings that occur at least annually and there are no exclusions in regard to who is able to attend the meetings. A neighbourhood association shall refer to an association representing the residents of a specific neighbourhood.

### 13.5.3 Data sources

Data on the number of neighbourhoods with association meetings should be sourced from the relevant local or regional registration authority that collects information and data on the registration of official neighbourhood associations.

## 13.6 Annual percentage of the city population directly affected by natural hazards

### 13.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 The number of people directly affected (i.e., evacuated, relocated, injured, or sickened) by natural hazards is a measure of a city's vulnerability. In some cases, it is a more relevant measure of disaster impact than the number of deaths.

NOTE 2 This indicator reflects the "safety and security" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "wellbeing" and "resilience" purposes of the city as defined in ISO 37101.

### 13.6.2 Indicator requirements

The annual percentage of the city population directly affected by natural hazards shall be calculated as the annual number of people evacuated, relocated, injured, or sickened due to natural hazards (numerator) divided by the total city population (denominator). The result shall be multiplied by 100 and expressed as the annual percentage of the city population directly affected by natural hazards.as

Where possible, the data for each relevant hazard type should be included and listed as a table.

NOTE: An indicator that measures annual disaster-related deaths is included in ISO 37120.

### 13.6.3 Data sources

The data for this indicator can be sourced from emergency management authorities and other agencies engaged in emergency response.

# 14 Recreation

## 14.1 Percentage of city population living within 0.5 km of public outdoor recreation space

### 14.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Access to outdoor recreation space plays an important role in promoting the physical, mental and emotional wellbeing of individuals and communities. Recreation facilities and spaces also support the development of community identity and cohesion. City governments can ensure that all citizens have close and convenient access to public recreation space.

### 14.1.2 Indicator requirements

Percentage of city population living within 0.5 km of public outdoor recreation space shall be calculated as the number of people living within 0.5 km of public outdoor recreation space (numerator) divided by the total city population (denominator). The result shall be multiplied by 100 and expressed as the percentage of city population living within 0.5 km of public outdoor recreation space.

Public recreation space shall refer to land and open space available to the public for relaxation, amusement or leisure pursuits. Recreation space shall include only space that primarily serves a recreation purpose.

Outdoor recreation space can include city-owned or maintained land. Other recreation spaces within the city not owned or operated by the city, can also be considered outdoor recreation space provided they are open to the public which can include, but is not limited to, state or provincially owned lands, school and college grounds, as well as non-profit organizations. If cities report only city-owned recreation space, this shall be noted.

For multi-use facilities, only the portion of the land devoted to recreation shall be counted (the play areas at a school or college, for example, not the entire school site). Double counting shall be avoided—for example, do not include indoor facilities on parkland.

The area of the entire outdoor recreation space shall be included (for example, wooded areas of parks, and building maintenance and utility areas), but shall exclude parking areas.

### 14.1.3 Data sources

Data can be sourced from a city planning department and/or departments responsible for recreation. Outdoor recreation spaces may be delineated using aerial photography and/or land use maps. Geographic Information Systems (GIS) can be used to map places of residence in proximity to outdoor recreation spaces. The georeferenced population census can be obtained by a relational database-join process that relates inhabitants with their address in the georeferenced municipal street guide. The result will be a point layer in which each point represents one person's place of residence. Once both layers—i.e., recreation space and georeferenced population—are included in the GIS, proximity buffers of the recreation spaces can be created. Populations that live near to the recreation space are those that are contained in the buffer layer, obtained by spatial selection.

NOTE ISO 37120 includes an indicator on measuring the area of outdoor recreation space

# 15 Safety

## 15.1 Percentage of city population covered by multi-hazard early warning system

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 This indicator refers to the specific warning of an imminent threat. Early warnings of that threat are essential to reduce human and economic losses from disasters. Warning systems prevent loss of life and mitigate the economic and material impacts of disasters. It is the responsibility of city governments to ensure that its citizens are effectively covered by some form of early warning system, enabling better preparedness for (and response to) shocks. Warnings should be reliable and specific to hazard type and should allow ample time for preparation and response (as far as technology permits).

NOTE 2 The use of social media may enhance learning opportunities around a resilience culture; increase interactions with citizens; grow social capital (a strong relationship) among citizens; collect good practices of resilience building activities that consequently are disseminated through social media; and build a higher level of trust among different partners (city stakeholders and external partners) for further knowledge sharing. On the other hand, the use of social media in crisis situations should be monitored and filtered as it may result in false information sharing and incite panic.

NOTE 3 This indicator reflects the “safety and security” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 15.1.1 Indicator requirements

Percentage of city population covered by multi-hazard early warning systems shall be calculated as the total number of people within the city covered by multi-hazard early warning systems (numerator) divided by the city’s total population (denominator). The result shall be multiplied by 100 and expressed as a percentage of population covered by multi-hazard early warning systems.

Early warning systems shall refer to an integrated and coordinated arrangement of hazard monitoring, forecasting and prediction, disaster risk assessment, and communication and preparedness activities that enable cities and residents to take action to reduce risks in advance of hazardous events.

Multi-hazard early warning systems cover a range of hazards and impacts, and are ideally designed to be used in multi-hazard contexts where hazardous events may occur as a singular event, simultaneously, in succession, or cumulatively over time. Warnings should be delivered over the maximum possible notice period via multiple media, including, but not limited to, phone, TV, radio, web, and sirens.

NOTE The technology of disaster warnings is rapidly evolving, both in the long-term assessment of risk (e.g., seasonal weather forecast) and the notification period and update frequency for a specific event (e.g., landslide risk, tornado warnings, movement of flood crest). However, meaningful earthquake warning systems do not currently exist for practical purposes.

### 15.1.2 Data sources

The data for this indicator can be sourced from emergency management authorities.

## 15.2 Percentage of emergency responders that have received disaster response training

### 15.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Emergency responders are among the first people to arrive at the scene of an emergency related to a disaster event. Response training is therefore a critical element of disaster preparedness.

NOTE 2 This indicator reflects the "safety and security" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 15.2.2 Indicator requirements

Percentage of emergency responders that have received disaster response training shall be calculated as the total number of emergency responders that have received disaster response training in the city (numerator) divided by the total number of emergency responders in the city (denominator). The result shall be multiplied by 100 and expressed as a percentage of emergency responders that have received disaster response training.

Emergency responders shall refer to police officers, firefighters, paramedics, and rescuers. They are among the first people to arrive at the scene of an emergency related to a disaster, and are trained to deal with an array of medical, security, and safety issues that can arise immediately before, during, or after a disaster.

Disaster training should ideally cover worst-case scenarios.

### 15.2.3 Data sources

The data for this indicator can be sourced from emergency management authorities.

## 15.3 Percentage of local hazard warnings issued by national agencies annually that are received in a timely fashion by the city

### 15.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Early warning mechanisms or arrangements between hazard monitoring agencies (e.g., weather offices) and local emergency responders are an essential component of disaster preparation. Warnings and forecasts from national offices must be disseminated in accurate and a timely fashion to emergency planning authorities, via well-understood information systems and management plans that correspond to the estimated return period (i.e., likelihood and severity) of a disaster event. Warnings should be reliable and specific to the city, and should allow ample time for preparation and response (as far as technology permits).

NOTE 2 The use of social media may enhance learning opportunities around a resilience culture; increase interactions with citizens; grow social capital (a strong relationship) among citizens; collect good practices of resilience building activities that consequently are disseminated through social media; and build a higher level of trust among different partners (city stakeholders and external partners) for further knowledge sharing. On the other hand, the use of social media in crisis situations should be monitored and filtered as it may result in false information sharing and panic creation.

NOTE 3 This indicator reflects the "safety and security" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 15.3.2 Indicator requirements

Percentage of local hazard warnings issued by national agencies annually that are received in a timely fashion by the city shall be calculated as the number of local hazard warnings issued annually by national agencies that are received in a timely fashion by the city (numerator) divided by the annual total number of local hazard warnings issued by national agencies to the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of local hazard warnings issued by national agencies that are received in a timely fashion by the city.

Hazard warning or forecast shall refer to a specific call, notice, projection, alert, or alarm of a potential disaster event. Warnings should be delivered over the maximum possible notice period via multiple media, including phone, TV, radio, and web.

Timely fashion shall refer to hazard warnings or forecasts received by city emergency responders with sufficient time to activate information systems and implement emergency plans (e.g., evacuation routes) to warn citizens. This allows time for responders to ask questions and obtain further information about the warning or forecast from representatives of the issuing authority.

Emergency responders shall refer to police officers, firefighters, paramedics, and rescuers. They are among the first people to arrive at the scene of an emergency related to a disaster, and are trained to deal with an array of medical, security, and safety issues that can arise immediately before, during, or after a disaster.

NOTE The technology of disaster warnings is rapidly evolving, both in the long-term assessment of risk (e.g., seasonal weather forecast) and the notification period and update frequency for a specific event (e.g., landslide risk, tornado warnings, movement of flood crest). However, meaningful earthquake warning systems do not currently exist for practical purposes.

### 15.3.3 Data sources

The data for this indicator can be sourced from emergency management authorities.

## 15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population

### 15.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Damage or destruction to critical infrastructure assets such as hospitals and schools have major negative consequences for cities and can seriously hamper disaster recovery efforts.

NOTE 2 This indicator reflects the “Education and capacity building” and ” Health and care in the community” issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 15.4.2 Indicator requirements

The number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population shall be calculated as the total number of health and education facilities destroyed or damaged by natural hazards within the city (numerator) divided by one 100 000$^{th}$ of the city’s population (denominator). The result shall be expressed as the number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population.

Where possible, data for both the health and educational sectors should be included and listed separately in tables.

This indicator is only applicable in the instance when a disaster or extreme event has occurred in the last 12 months.

Health facilities for the purposes of this indicator shall include hospitals and clinics. Educational facilities shall refer to schools, colleges, universities, etc., that provide learning spaces for students to receive primary, secondary, or tertiary education.

### 15.4.3 Data sources

The data for this indicator can be sourced from emergency management authorities as well as health and educational authorities.

# 16 Solid Waste

## 16.1 Number of active waste disposal sites available for debris and rubble per square kilometre

### 16.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Debris removal and processing can be critical to helping a city recover from a disaster. It is essential to dispose of debris that is blocking rescue and emergency response activities. Safe and well managed disposal sites are key to debris removal if they are established in suitable locations, follow national safety rules, and meet capacity requirements.

### 16.1.2 Indicator requirements

The number of active waste disposal sites available for debris and rubble per square kilometre shall be calculated as the number of active waste disposal sites in the city where debris and rubble can be disposed of (numerator) divided by the total land area of the city (square kilometre) (denominator). The result shall then be expressed as the number of active waste disposal sites available for debris and rubble per square kilometre.

A waste disposal site shall refer to a site used for the accumulation of waste with the purpose of disposing or treatment of such waste. A waste disposal site may include vacuum pyrolysis plants, incinerators, compost plants, transfer stations, storage facilities and recycling plants. These facilities are seen as disposal sites because they allow for "continuous" storage of waste on their premises before the disposal, removal or handling thereof. An active waste disposal shall include any site that is currently in use and is fully functioning to dispose of waste in the city.

Debris and rubble should include building and construction materials (e.g., wall coverings, plaster, drywall, plumbing fixtures, roofing shingles and other roof coverings) and other loose solid waste such as desks, chairs, sheet metals, PVC pipes, and papers.

### 16.1.3 Data sources

Data on active disposal sites for debris and rubble can be sourced from local or regional solid waste management departments, ministries or organizations.

# 17 Telecommunication

## 17.1 Percentage of emergency responders in the city equipped with specialised communication technologies able to operate reliably during a disaster event

### 17.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Mobile telecommunications networks (e.g., terrestrial cell antennas) can be damaged or overly congested during a disaster event. Having a privileged-access ‘subscriber identity module’ (SIM) installed in handsets can help emergency responders to avoid such problems and safely connect to their networks during and after a disaster event. Satellite telephones, which connect to orbiting satellites rather than terrestrial cell towers, can avoid such problems when terrestrial cellular services are unavailable. Professional mode radio (PMR) is designed for specific use by organizations such as police forces and fire brigades to allow point-to-multipoint communication across large areas.

NOTE 2 This indicator reflects the "safety and security" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 17.1.2 Indicator requirements

Percentage of emergency responders in the city equipped with specialised communication technologies able to operate reliably during a disaster event shall be calculated as the number of emergency responders within the city having access to professional mode radio, satellite telephony, or privileged-access mobile communications networks (numerator) divided by the total number of emergency responders in the city (denominator). The result shall be multiplied by 100 and expressed as a Percentage of emergency responders in the city equipped with specialised communication technologies able to operate reliably during a disaster event.

Emergency responders shall refer to police officers, firefighters, paramedics, and rescuers. They are among the first people to arrive at the scene of an emergency related to a disaster and are trained to deal with an array of medical, security, and safety issues that can arise immediately before, during, or after a disaster.

Professional mode radio (PMR) shall refer to field radio communication systems that are designed for specific use by organizations such as police forces and fire brigades. These radio systems allow point-to-multipoint communication across large areas.

NOTE Professional mode radio is also known as private mobile radio and land mobile radio.

Satellite telephony shall refer to the technology associated with mobile phones that are connected to orbiting satellites rather than terrestrial cell sites.

Privileged-access mobile communication shall refer to the exchange of information across mobile telephone networks that have prioritized access for persons such as members of emergency services and emergency response teams.

### 17.1.3 Data sources

The data for this indicator can be sourced from emergency management authorities.

## 17.2 Percentage of city population that receives communications about emergency preparedness and disaster risk reduction

### 17.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Educating citizens on the actions they can take to reduce risks from disasters and shocks is an important area for cost-effective disaster preparedness. Regularly updated media platforms and communication programs enable stakeholders and the wider population to access and exchange hazard-related information. Citizen engagement should take place through multiple media channels.

NOTE 2 The use of social media may enhance learning opportunities around a resilience culture; increase interactions with citizens; grow social capital (a strong relationship) among citizens; collect good practices of resilience building activities that consequently are disseminated through social media; and build a higher level of trust among different partners (city stakeholders and external partners) for further knowledge sharing. On the other hand, the use of social media in crisis situations should be monitored and filtered as it may result in false information sharing and panic creation.

NOTE 3 This indicator reflects the "safety and security" and "education and capacity building" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 17.2.2 Indicator requirements

Percentage of city population that receives communications about emergency preparedness and disaster risk reduction shall be calculated as the number of people within the city that are reached by communications about emergency preparedness and disaster risk reduction (numerator) divided by the total city population (denominator). The result shall be multiplied by 100 and expressed as the percentage of city population that receives communications about emergency preparedness and disaster risk reduction.

Communication shall refer to the act of transferring written or spoken information from one place or person to another. This information is delivered, received, and stored through various forms of mass media, including print (newspapers, newsletters), broadcast (radio, television), electronic (email, internet, mobile devices, social platforms), and outdoor (billboards, signs, placards).

### 17.2.3 Data sources

The data for this indicator can be sourced from emergency management authorities.

# 18 Transportation

## 18.1 Percentage of public transportation trips operating on schedule

### 18.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Public transportation services are a critical service for the functioning of cities, playing a fundamental role in the local economy and providing citizens with access to employment, education and recreation opportunities. System reliability and punctuality can be an indication of the likely robustness of the system to resist and recover from shocks.

NOTE 2 This indicator reflects the “mobility” issue as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” and “attractiveness” purposes of the city as defined in ISO 37101.

### 18.1.2 Indicator requirements

Percentage of public transportation trips operating on schedule shall be calculated as the number of public transportation trips operating on schedule (numerator) divided by the total number of public transportation trips (denominator). The result shall be multiplied by 100 and expressed as the percentage of public transportation trips operating on schedule.

Public transportation shall include shared passenger transit services that operate within the city, and that include travel modes such as buses, trolleybuses, trams (or light rail), passenger trains, rapid transit (e.g., metro/subways), and ferries.

Operating on schedule shall refer to trips making all the scheduled stops and arriving at the destination terminal on-time, early or no more than five minutes late.

### 18.1.3 Data source

The data for this indicator can be sourced from city transportation offices and local/regional transit authorities.

## 18.2 Number of evacuation routes available per 100 000 population

### 18.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Accessible and well-documented evacuation routes and exit strategies are necessary to ensure mass movement of people safely and quickly away from a disaster. Evacuation routes are therefore an important response measure to help cities deal with the immediate effects of a disaster.

NOTE 2 This indicator reflects the "mobility" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "attractiveness" purposes of the city as defined in ISO 37101.

### 18.2.2 Indicator requirements

The number of evacuation routes available per 100 000 population shall be calculated as the total number of evacuation routes (numerator) divided by one 100 000$^{th}$ of the city's total population (denominator). The result shall be expressed as the number of evacuation routes available per 100 000 population.

Evacuation routes shall refer to highways, roadways, waterways, and railways and that are officially designated for urgent removal and temporary relocation of people and their assets away from imminent or ongoing danger associated with a disaster.

### 18.2.3 Data sources

The data for this indicator can be sourced from emergency management authorities.

# 19 Urban/local agriculture and food security

## 19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency

### 19.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Mechanisms should be in place to ensure continuity of essential food supplies during an emergency or due to shocks, when city supply chains are disrupted or stopped. The first three days after a disaster or shock event—and before external help might be available—are critical to the recovery effort. This indicator focuses on availability and supply for building resilience under emergency situations.

NOTE 2 This indicator reflects the "Health and care in the community" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101

### 19.1.2 Indicator requirements

Percentage of city population that can be served by city food reserves for 72 hours in an emergency shall be calculated as the number of people within the city that can be served by city food reserves for 72 hours (numerator) divided by the total city population (denominator). The result shall be multiplied by 100 and expressed as the percentage of population that could be served by intra-city food reserves for 72 hours.

City food reserves shall refer to essential food supplies from city emergency stores, arrangements with local supermarkets, and other contingency plans that secure food stocks for households.

NOTE Cities can refer to the "Sphere Project" and its *Humanitarian Charter and Minimum Standards in Disaster Response.* The project was launched in 1997 by a group of humanitarian NGOs, who established minimum standards to be attained in disaster assistance, in each of five key sectors: water supply and sanitation, nutrition, food aid, shelter, and health services. http://www.sphereproject.org/

#### 19.1.3 Data sources

The data for this indicator will require data to be sourced from the emergency management department in the city.

### 19.2 Percentage of the city's population living more than one kilometre from a grocery store

#### 19.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE The proximity to good quality and affordable food is a challenge for many city residents. Nearby grocery stores can provide access to good quality and affordable food, which improves the health, productivity and general prosperity of city residents, as well as the overall resilience of a city.

#### 19.2.2 Indicator requirements

The percentage of the city's population living more than one kilometre from a grocery store shall be calculated as the number of people in the city that live more than one kilometre from a grocery store (numerator) divided by the city's total population (denominator). The result shall be multiplied by 100 and expressed as the percentage of the city's population living more than one kilometre from a grocery store.

A grocery store shall refer to a retail shop that primarily sells food.

#### 19.2.3 Data sources

Data on the number of people living within one kilometre of a grocery store can be sourced from surveys and by the use of GIS mapping tools.

## 20 Urban Planning

### 20.1 Percentage of city area covered by publicly available hazard maps

#### 20.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A hazard map is a key tool for a city to plan for resilience. The maps should be publicly available, and cover the wholecity. Up-to-date hazard maps are particularly important for hazards like flooding, where changing development patterns can significantly affect the area of the community potentially at risk. Urban plans are informed with, and influenced by, up-to-date risk information. Publicly available information is important for community awareness and may also be important for insurers seeking to improve the accuracy of risk pricing.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 20.1.2 Indicator requirements

Percentage of city area covered by publicly available, hazard maps shall be calculated as the area of city covered by publicly available hazard maps (numerator) divided by the total city area (denominator). The result shall be multiplied by 100 and expressed as the percentage of total city area covered by publicly available hazard maps.

### 20.1.3 Data sources

Information on hazard maps can be sourced from several departments and stakeholders, including GIS departments, emergency planners, and research institutions.

## 20.2 Pervious land area as a percentage of total city land area

### 20.2.1 General

Those implementing this document should report on this indicator in accordance with the following requirements.

NOTE 1 Pervious (or permeable) land areas perform important environmental functions in urban settings, such as improving the urban climate and easing storm runoff from rainfall or snowmelt. Pervious areas are therefore considered natural assets that can reduce physical vulnerability to hazards such as floods, heatwaves, and tropical storms, while strengthening ecological resilience within the city. Cities can directly influence the quantity and distribution of pervious surface through planning policies and other mechanisms.

NOTE 2 This indicator reflects the "Biodiversity and Ecosystem Services" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "preservation and improvement of environment" purposes of the city as defined in ISO 37101.

### 20.2.2 Indicator requirements

Pervious land area as a percentage of total city land area shall be calculated as the area of pervious land within the city (in square kilometres) (numerator) divided by the total city land area (in square kilometres) (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Pervious land area shall refer to all permeable surfaces in the city that enable water absorption and drainage. Permeable surfaces include areas of vegetation (e.g., grasses and forest), bare soils (e.g. gardens, agricultural plots), sand (e.g. beaches, desert), and water (e.g. lakes, rivers). Pervious areas also include green roofs on buildings. Areas that are without permeable cover are assumed to be sealed (i.e. paved or impervious).

### 20.2.3 Data sources

Information on pervious area can be obtained from city recreation and parks departments, planning departments, forestry departments and census data. Pervious areas can be delineated using aerial photography and/or land use/land cover maps.

## 20.3 Percentage of city land area in high risk zones where risk reduction measures have been implemented

### 20.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Property and people located in high-risk zones are vulnerable to the damaging, destructive, and deadly effects of disasters. Risk reduction measures, such as the provision of additional protective infrastructure, are needed to reduce the risk of hazard exposure for populations inside these zones.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 20.3.2 Indicator requirements

Percentage of city land area in high risk zones where risk reduction measures have been implemented shall be calculated as the city land area in high risk hazard zones where risk reduction measures have been implemented (square kilometres) (numerator) divided by the total land area of the city (square kilometres) (denominator). The result shall be multiplied by 100 and expressed as the percentage of city land area in high risk zones where risk reduction measures have been implemented

### 20.3.3 Data sources

Information on risk assessments and hazard maps can be sourced from several departments and stakeholders, including GIS departments, emergency planners, planning departments, and research institutions.

## 20.4 Percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Risk assessments are an integral and regular feature of urban planning and investment. They are an effective way to integrate hazard impacts into long-term city plans for urbanizing areas, and are therefore essential to risk mitigation. Results from risk assessments should be readily available and accessible to city departments and utility services, and should inform the planning and implementation of risk-reduction measures and strategies. These processes should be done in ways that are traceable and transparent.

NOTE 2 This indicator reflects the "Governance, empowerment and engagement" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 20.4.1 Indicator requirements

Percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment shall be calculated as the number of city departments and utility services that integrate the results of risk assessments in their planning and investment (numerator) divided by the total number of city departments and utility services within the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment.

Utility services shall refer to all public and private companies providing basic provisions and facilities related to electricity, natural gas, water, sewage, waste management, and telecommunications.

Risk assessment shall refer to the systematic process of evaluating potential risks of hazards and disasters to individuals, groups, organizations, critical assets, and protective infrastructure within the city. The purpose of a regular risk assessment is (i) to ensure resilience building activities are relevant to the city context; (ii) ensure appropriate and proportionate investment of resources according to risks, hazards, shocks and stresses; (iii) enable the different risk exposures and vulnerabilities of the city to be understood; and (iv) enable common consequences to be identified so that capabilities can be developed that will address the impact of many risks in combination (Annex C; ISO 31000). The results of a risk assessment should be conveyed partly through maps, whether these are hazard, vulnerability, exposure, evacuation, or risk.

Critical assets shall refer to properties and services that are essential for a city to function (e.g., dams, bridges, airports, hospitals, mass transit networks, emergency response centres). Protective infrastructure shall refer to physical structures and natural buffers that minimize the physical, humanitarian, and economic impacts of hazards (e.g., levees and flood barriers; flood basins; sea walls;

storm shelters; storm drains and storm water holding tanks; wetlands and mangroves; and shock absorption capabilities fitted to infrastructure to deal with earthquakes).

#### 20.4.2 Data sources

The data for this indicator should be sourced from city departments and utilities.

## 21 Wastewater

### 21.1 Percentage of the city's wastewater treated through decentralized wastewater treatment

#### 21.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Decentralized wastewater treatment is a cost-effective and economical approach to wastewater treatment because it avoids large capital costs and reduces operation and maintenance costs. A decentralized approach helps cities to avoid the risk of sewer overflows and burst pipes during severe weather. In addition, decentralized systems can be green and sustainable, using energy and land wisely. Decentralized wastewater treatment can thereby help municipalities reduce the environmental impacts associated with large centralized treatment systems and can mitigate contamination and health risks associated with wastewater.

#### 21.1.2 Indicator requirements

Percentage of the city's wastewater treated through decentralized wastewater treatment shall be calculated as the total volume of the city's wastewater that has undergone decentralized treatment (numerator) divided by the total volume of wastewater produced and collected in the city (denominator). This result shall then be multiplied by 100 and expressed as the percentage of the city's wastewater treated via a decentralized wastewater treatment.

Decentralized wastewater treatment shall refer to wastewater treatment carried out in a wastewater treatment facility that is not connected to the centralized wastewater treatment plant. A decentralized wastewater treatment system is an onsite or cluster wastewater system that is used to treat and dispose of relatively small volumes of wastewater, generally originating from individual or groups of dwellings and businesses that are located relatively close together. Onsite and cluster systems are commonly used in combination.

#### 21.1.3 Data sources

Data on decentralized wastewater treatment and wastewater treatment in general can be sourced from municipal authorities or the main water supply and treatment entities.

# 22 Water

## 22.1 Number of different sources providing at least 5 percent of total water supply capacity

### 22.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A diversity of water sources and distribution systems ensures that alternative water supplies are available during system failure or disruption from the effects of disasters and shocks. The main goal should be the provision safe drinking water that will safeguard the health of inhabitants. Therefore, risk management should protect and safeguard public health, in particular from pathogenic and chemical hazards, water pollution and contamination, and industrial accidents. With diverse water sources, cities are able to mitigate the effects of dangers to health and improve response and recovery efforts during and immediately after a disaster event.

NOTE 2 This indicator reflects the "Health and care in the community" and "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" purpose of the city as defined in ISO 37101.

### 22.1.2 Indicator requirements

The number of different sources providing at least 5 percent of total water supply capacity shall refer to the number of different, or separate, water supply sources to the city each providing at least 5 percent of water supply capacity.

NOTE The 5 percent threshold is used by major international organizations such as the World Bank to ease calculations and to capture the major supply sources.

When the number of different water supply sources exceed two, the percentage of water supply capacity of the two most significant sources should be reported in tables.

A different (or separate) water supply source shall refer to water supplies that are not disrupted or directly influenced by other sources. Water supply sources shall include dams, reservoirs, rivers, lakes, aquifers, desalination plants, etc.

### 22.1.3 Data sources

The data for this indicator should be provided by the water system operator and/or appropriate regulatory authorities.

### 22.1.4 Data Interpretation

While multiple, different, water sources contribute to city resilience, this is not necessarily indicative of city resilience in all cases.

## 22.2 Percentage of city population that can be supplied potable water by alternative methods for 72 hours

### 22.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Providing potable water is critically important to the response efforts for a disaster event. City water providers and local governments must ensure effective planning for alternative (i.e., back-up) potable water supply methods during and immediately after a disaster event or system disruption. Contingency plans should identify how potable water will be distributed in the case of such a disruption. Back-up supplies are especially important to serve vulnerable populations.

NOTE 2 This indicator reflects the “Health and care in the community” and ”community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” purpose of the city as defined in ISO 37101.

### 22.2.2 Indicator requirements

Percentage of city population that can be supplied potable water by alternative methods for 72 hours shall be calculated as the number of people in the city that can be supplied potable water by alternative methods for 72 hours (numerator) divided by the total city population (denominator). The result shall be multiplied by 100 and expressed as the percentage of city population that can be supplied potable water by alternative methods for 72 hours.

Alternative methods of water supply shall include emergency water tankers, bottled water, rain water harvesting, etc.

### 22.2.3 Data sources

The data for this indicator can be provided by the emergency management department of the city, water system operator and/or appropriate regulatory authorities.

# 23 Reporting and record maintenance

Reports on city indicators shall compile the data required in the individual test methods used.

# Annex A
(informative)

# Typology of City Hazards

The following table presents a typology of hazards faced by cities. This typology and the associated definitions are informative only. Local typologies and definitions may be established by cities themselves or through local standards or regulations.

This typology is presented to assist cities in identifying the potential hazards that they face, which has relevant to many of the indicators contained in this standard. It is also provided as a guide for helping identify peer cities facing similar hazards.

*[Note: The Global Risk Assessment Advisory Board is developing a comprehensive list of hazards aligned with the 5 hazards categories mentioned in the Sendai Framework: Biological, Environmental, geological/ geophysical, Hydro-meteorological, Technological. This is scheduled for publication in late 2018 and it has been agreed by TC 268 WG 2 that this will be included in the draft Standard once this list of published].*

# Annex B
(informative)

# Mapping ISO 37123 Indicators to the Risk Management Process

A major focus of City Resilience is the management of the risks facing cities. The following table highlights how the indicators in this standard relate to the key stages of the risk management process as defined by ISO 31000:2009 *Risk Management*.

| | |
|---|---|
| **Risk Context** | 11.1 Average wait time in hospital emergency rooms<br>11.4 Percentage of population with basic health insurance<br>11.5 Percentage of children that are fully immunized<br>11.6 Number of infectious disease outbreaks per year<br>13.1 Vulnerable population as a percentage of city population<br>13.2 Percentage of population with access to social assistance programs<br>13.4 Spatial segregation as measured by the Index of Dissimilarity based on income grouping<br>13.5 Percentage of neighbourhoods with regular, open neighbourhood association meetings |
| **Risk Assessment:**<br>— ***Risk Identification***<br>— ***Risk Analysis***<br>— ***Risk Evaluation*** | 5.2 Average annual disaster loss as a percentage of city product<br>7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity<br>8.1 Magnitude of urban heat island effects (atmospheric)<br>10.1 Annual number of multi-stakeholder risk assessments<br>10.2 Frequency with which disaster management plans are updated<br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br>10.6 Percentage of public meetings dedicated to resilience in the city<br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br>12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br>12.5 Annual number of deaths in residential fires per 100 000 population<br>12.6 Annual number of residential properties flooded as a percentage of total residential properties in the city<br>12.7 Percentage of residential properties located in high-risk zones<br>13.3 Percentage of population at high risk from natural hazards<br>18.1 Percentage of public transportation trips operating on schedule<br>20.1 Percentage of city area covered by publicly available hazard maps<br>20.2 Pervious land area as a percentage of total city land area<br>22.1 Number of different sources providing at least 5 percent of total water supply capacity |
| **Risk Treatment:** | |
| ***Avoidance*** | |

| | |
|---|---|
| ***Reduction*** | 5.3 Percentage of essential service providers that have a documented business continuity plan<br>6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction<br>6.2 Percentage of population trained in emergency preparedness and disaster risk reduction<br>6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities<br>6.4 Percentage of emergency preparedness publications provided in alternative languages<br>8.2 Percentage of natural areas within the city that have undergone ecological evaluation for their protective services<br>8.3 Territory undergoing ecosystem restoration as a percentage of total city area<br>9.1 Annual expenditure on maintenance and upgrades of city service assets as a percentage of total city budget<br>9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget<br>9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget<br>10.4 Percentage of essential city services covered by a documented continuity plan<br>10.5 Percentage of city electronic data with secure and remote back-up storage<br>11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs<br>15.1 Percentage of city population covered by multi-hazard early warning system<br>15.2 Percentage of emergency responders that have received disaster response training<br>15.3 Percentage of local hazard warnings by national agencies that are received in a timely fashion by city<br>17.2 Percentage of city population that receives communications about emergency preparedness and disaster risk reduction<br>18.2 Number of evacuation routes available per 100 000 population<br>19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency<br>20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented<br>20.4 Percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment<br>22.2 Percentage of population that can be supplied potable water by alternative methods for 72 hours |
| ***Transfer*** | 5.4 Percentage of properties with insurance coverage for high risk hazards<br>5.5 Percentage of total insured value to total value at risk within the city |

| | |
|---|---|
| ***Acceptance*** | 9.5 Annual expenditure on emergency management planning as a percentage of total city budget<br>9.7 Total allocation of disaster reserve funds as a percentage of total city budget<br>17.1 Percentage of emergency in the city equipped with specialised communication technologies able to operate reliably during a disaster even |
| **Communication & Consultation** | |
| **Monitoring & Review** | 5.1 Historical disaster losses as a percentage of city GDP<br>12.3 Percentage of damaged infrastructure that was "built back better" after a disaster<br>13.6 Annual percentage of the city population directly affected by natural hazards<br>15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population |

# Annex C
(informative)

# Mapping ISO 37123 Indicators to the Disaster Management Process

A resilient city seeks to resist, absorb, accommodate, adapt to, transform, and recover from the effects of hazards and disasters in a timely and efficient manner, including through the preservation and restoration of essential basic structures and services in a sustainable way, and through risk

management practices. The following table maps how the indicators in this standard relate to the key elements of the disaster management process.

| | |
|---|---|
| **Mitigation** | 5.2 Average annual disaster loss as a percentage of city product |
| | 5.4 Percentage of properties with insurance coverage for high risk hazards |
| | 5.5 Percentage of total insured value to total value at risk within the city |
| | 7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity |
| | 8.1 Magnitude of urban heat island effects (atmospheric) |
| | 8.2 Percentage of natural areas within the city that have undergone ecological evaluation for their protective services |
| | 8.3 Territory undergoing ecosystem restoration as a percentage of total city area |
| | 9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget |
| | 9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget |
| | 9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget |
| | 9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget |
| | 9.6 Annual expenditure on social and community services as a percentage of total city budget |
| | 10.1 Annual number of multi-stakeholder risk assessments |
| | 10.6 Percentage of public meetings dedicated to resilience in the city |
| | 10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements |
| | 11.1 Average wait time in hospital emergency rooms |
| | 11.4 Percentage of population with basic health insurance |
| | 12.2 Percentage of buildings structurally vulnerable to high-risk hazards |
| | 12.3 Percentage of residential buildings not in conformity with building codes and standards |
| | 12.7 Percentage of residential properties located in high-risk zones |
| | 13.1 Vulnerable population as a percentage of city population |
| | 13.2 Percentage of population with access to social assistance programs |
| | 13.3 Percentage of population at high risk from natural hazards |
| | 18.1 Percentage of public transportation trips operating on schdedule |
| | 20.1 Percentage of city area covered by publicly available hazard maps |
| | 20.2 Pervious land area as a percentage of total city land area |
| | 20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented |
| | 20.4 Percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment |
| | 22.1 Number of different sources providing at least 5 percent of total water supply capacity |

| | |
|---|---|
| **Preparedness** | 5.3 Percentage of essential service providers that have a documented business continuity plan |
| | 6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction within their curriculum |
| | 6.2 Percentage of population trained in emergency preparedness and disaster risk reduction |
| | 6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities |
| | 6.4 Percentage of emergency preparedness publications provided in alternative languages |
| | 9.5 Annual expenditure on emergency management planning as a percentage of total city budget |
| | 10.2 Frequency with which disaster management plans are updated |
| | 10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks |
| | 10.4 Percentage of essential city services covered by a documented continuity plan |
| | 10.5 Percentage of city electronic data with secure and remote back-up storage |
| | 10.6 Percentage of public meetings dedicated to resilience in the city |
| | 10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements |
| | 11.1 Average wait time in hospital emergency rooms |
| | 11.3 Percentage of hospitals equipped with back-up electricity supply |
| | 11.5 Percentage of children that are fully immunized |
| | 13.5 Percentage of neighbourhoods with regular, open neighbourhood association meetings |

| | |
|---|---|
| | 15.1 Percentage of city population covered by multi-hazard early warning system<br>17.2 Percentage of city population that receives communications about emergency preparedness and disaster risk reduction<br>18.2 Number of evacuation routes available per 100 000 population<br>19.1 Percentage of city population that can served by city food reserves for 72 hours in an emergency<br>22.2 Percentage of population that can be supplied potable water by alternative methods for 72 hours |
| **Response** | 9.7 Allocation of disaster reserve funds as a percentage of total city budget<br>11.2 Percentage of health care facilities equipped with adequate capabilities and medical supplies for acute needs<br>13.6 Annual percentage of the city population directly affected by natural hazards<br>15.2 Percentage of emergency responders that have received disaster response training<br>15.3 Percentage of local hazard warnings by national agencies annually that are received in a timely fashion by city<br>17.1 Percentage of emergency in the city equipped with specialised communication technologies able to operate reliably during a disaster even |
| **Recovery / Reconstruction** | 5.1 Historical disaster losses as a percentage of city product<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br>15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population |

# Annex D
(informative)

# Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction

**Table D.1 — Mapping of** ISO 37123 **indicators to UN SDGs (2015)**

| | |
|---|---|
| Goal 1: end poverty in all its forms everywhere<br>Specifically noting:<br>1.3 Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable<br>1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters:<br>1.5.1 Number of deaths, missing persons and persons affected by disaster per 100,000 people<br>1.5.2 Direct disaster economic loss in relation to global gross domestic product (GDP)<br>1.5.3 Number of countries with national and local disaster risk reduction strategies | 5.1 Historical disaster losses as a percentage of city product<br>5.2 Average annual disaster loss as a percentage of city product<br>5.6 Employment concentration<br>5.7 Percentage of the workforce in informal employment<br>10.1 Annual number of multi-stakeholder risk assessments<br>10.2 Frequency with which disaster management plans are updated<br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br>10.4 Percentage of essential city services covered by a documented continuity plan<br>11.4 Percentage of population with basic health insurance<br>11.5 Percentage of children that are fully immunized<br>11.6 Number of infectious disease outbreaks per year<br>12.7 Percentage of residential properties located in high-risk zones<br>13.1 Vulnerable population as a percentage of city population<br>13.2 Percentage of population with access to social assistance programs<br>13.3 Percentage of population at high risk from natural hazards<br>13.4 Spatial segregation as measured by the Index of Dissimilarity based on income grouping<br>13.6 Annual percentage of city population directly affected by natural hazards<br>15.1 Percentage of city population covered by multi-hazard early warning system<br>15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population<br>17.1 Percentage of city area covered by publicly available, up-to-date hazard maps<br>20.1 Percentage of city area covered by publicly available hazard maps |
| Goal 3: ensure healthy lives and promote well-being for all at all ages<br>Specifically noting:<br>3.8.2 Number of people covered by health insurance or a public health system per 1,000 population | 11.1 Average wait time in hospital emergency rooms<br>11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs<br>11.4 Percentage of population with basic health insurance<br>11.5 Percentage of children that are fully immunized<br>11.6 Number of infectious disease outbreaks per year<br>14.1 Percentage of city population living within 0.5 km of public outdoor recreation space<br>15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population |

**Table D.1** *(continued)*

| | |
|---|---|
| Goal 9: build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation<br>Specifically noting:<br>9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all | 5.3 Percentage of essential service providers that have a documented business continuity plan<br>7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity<br>9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget<br>9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget<br>9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget<br>9.4 Annual expenditure on green and blue infrastructure as a percentage of total<br>city budget<br>9.6 Annual expenditure on social and community services as a percentage of total city budget<br>10.1 Annual number of multi-stakeholder risk assessments<br>10.2 Frequency with which disaster management plans are updated<br>10.4 Percentage of essential city services covered by a documented continuity plan<br>10.5 Percentage of city electronic data with secure and remote back-up storage<br>10.6 Percentage of public meetings dedicated to resilience in the city<br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br>11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs<br>11.3 Percentage of hospitals equipped with back-up electricity supply<br>12.1 Capacity of designated emergency shelters per 100 000 population<br>12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster |

**Table D.1** *(continued)*

| | |
|---|---|
| | 12.5 Annual number of deaths in residential fires per 100 000 population |
| | 12.6 Annual number of residential properties flooded as a percentage of total residential properties in the city |
| | 12.7 Percentage of residential properties located in high-risk zones |
| | 18.1 Percentage of public transportation trips operating on time |
| | 18.2 Number of evacuation routes available per 100 000 population |
| | 19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency |
| | 20.1 Percentage of city area covered by publicly available hazard maps |
| | 20.2 Pervious land area as a percentage of total city land area |
| | 20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented |
| | 22.1 Number of different sources providing at least 5 percent of total water supply capacity |
| | 22.2 Percentage of city population that can be supplied potable water by alternative methods for 72 hours |
| Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable | (see also Table D.2) |
| | 5.1 Historical disaster losses as a percentage of city product |
| 11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons | 5.2 Average annual disaster loss as a percentage of city product |
| | 5.3 Percentage of essential service providers that have a documented business continuity plan |
| | 5.7 Percentage of the workforce in informal employment |
| | 7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity |
| | 9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget |
| 11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations | 9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget |
| | 9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget |
| | 9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget |
| | 9.6 Annual expenditure on social and community services as a percentage of total city budget |
| *11.5.1 Number of deaths, missing persons and persons affected by disaster per 100,000 people* | 10.1 Annual number of multi-stakeholder risk assessments |
| | 10.2 Frequency with which disaster management plans are updated |
| *11.5.2 Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services* | 10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks |
| | 10.4 Percentage of essential city services covered by a documented continuity plan |
| | 10.5 Percentage of city electronic data with secure and remote back-up storage |

**Table D.1** *(continued)*

| | |
|---|---|
| 11.B By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels<br>*11.B.1 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030*<br>*11.B.2 Number of countries with national and local disaster risk reduction strategies* | 10.6 Percentage of public meetings dedicated to resilience in the city<br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br>11.1 Average wait time in hospital emergency rooms<br>11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs<br>11.3 Percentage of hospitals equipped with back-up electricity supply<br>11.4 Percentage of population with basic health insurance<br>11.5 Percentage of children that are fully immunized<br>11.6 Number of infectious disease outbreaks per year<br>12.1 Capacity of designated emergency shelters per 100 000 population<br>12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br>12.5 Annual number of deaths in residential fires per 100 000 population<br>12.6 Annual number of residential properties flooded as a percentage of total residential properties in the city<br>12.7 Percentage of residential properties located in high-risk zones<br>13.1 Vulnerable population as a percentage of city population<br>13.2 Percentage of population with access to social assistance programs<br>13.3 Percentage of population at high risk from natural hazards<br>13.4 Spatial segregation as measured by the Index of Dissimilarity based on income grouping<br>13.5 Percentage of neighbourhoods with regular, open neighbourhood association meetings<br>13.6 Annual percentage of the city population directly affected by natural hazards |
| | 14.1 Percentage of city population living within 0.5 km of public outdoor recreation space<br>15.1 Percentage of city population covered by multi-hazard early warning system<br>15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population<br>18.1 Percentage of public transportation trips operating on schedule<br>18.2 Number of evacuation routes available per 100 000 population<br>19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency<br>20.1 Percentage of city area covered by publicly available hazard maps<br>22.1 Number of different sources providing at least 5 percent of water supply capacity<br>22.2 Percentage of population that can be supplied potable water by alternative methods for 72 hours |

**Table D.1** *(continued)*

| | |
|---|---|
| Goal 13: Take urgent action to combat climate change and its impacts<br><br>13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries<br><br>*13.1.1 Number of countries with national and local disaster risk reduction strategies*<br><br>*13.1.2 Number of deaths, missing persons and persons affected by disaster per 100,000 people*<br><br>13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning<br><br>*13.3.1 Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula*<br><br>*13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions* | 5.1 Historical disaster losses as a percentage of city product<br><br>5.2 Average annual disaster loss as a percentage of city product<br><br>5.3 Percentage of essential service providers that have a documented business continuity plan<br><br>6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction<br><br>6.2 Percentage of population trained in emergency preparedness and disaster risk reduction<br><br>6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities<br><br>6.4 Percentage of emergency preparedness publications provided in alternative languages<br><br>7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity<br><br>9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget<br><br>9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget<br><br>9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget<br><br>9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget<br><br>10.1 Annual number of multi-stakeholder risk assessments<br><br>10.2 Frequency with which disaster management plans are updated<br><br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br><br>10.4 Percentage of essential city services covered by a documented continuity plan<br><br>10.5 Percentage of city electronic data with secure and remote back-up storage<br><br>11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs<br><br>11.4 Percentage of population with basic health insurance<br><br>12.1 Capacity of designated emergency shelters per 100 000 population<br><br>12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br><br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br><br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br><br>12.7 Percentage of residential properties located in high-risk zones |

**Table D.1** *(continued)*

| | |
|---|---|
| | 13.1 Vulnerable population as a percentage of city population<br>13.2 Percentage of population with access to social assistance programs<br>13.3 Percentage of population at high risk from natural hazards<br>13.6 Annual percentage of the city population directly affected by natural hazards<br>15.1 Percentage of city population covered by multi-hazard early warning system<br>15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population<br>18.1 Percentage of public transportation trips operating on schedule<br>18.2 Number of evacuation routes available per 100 000 population<br>19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency<br>20.1 Percentage of city area covered by publicly available hazard maps<br>22.1 Number of different sources providing at least 5 percent of total water supply capacity<br>22.2 Percentage of city population that can be supplied potable water by alternative methods for 72 hours |
| Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss<br>15.9 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts | 8.2 Percentage of natural areas within the city that have undergone ecological evaluation for their protective services<br>8.3 Territory undergoing ecosystem restoration as a percentage of total city area<br>9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget |

**Table D.2 — Mapping of** ISO 37123 **indicators to Sendai Framework for Disaster Risk Reduction**

| **The seven global targets** | |
|---|---|
| (a) Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015. | 5.1 Historical disaster losses as a percentage of city product<br>5.2 Average annual loss as a percentage of city product<br>6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction<br>6.2 Percentage of population trained in emergency preparedness and disaster risk reduction<br>6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities<br>6.4 Percentage of emergency preparedness publications provided in alternative languages<br>11.1 Average wait time in hospital emergency rooms<br>11.5 Percentage of children that are fully immunized<br>11.6 Number of infectious disease outbreaks per year<br>12.5 Annual number of deaths in residential fires per 100 000 population<br>13.1 Vulnerable population as a percentage of city population<br>13.2 Percentage of population with access to social assistance programs<br>13.3 Percentage of population at high risk from natural hazards<br>13.6 Annual percentage of the city population directly affected by natural hazards<br>15.1 Percentage of city population covered by multi-hazard early warning system |
| (b) Substantially reduce the number of affected people globally by 2030, aiming to lower average global figure per 100,000 in the decade 2020 -2030 compared to the period 2005-2015. | 5.1 Historical disaster losses as a percentage of city product<br>5.2 Average annual disaster loss as a percentage of city product<br>6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction<br>6.2 Percentage of population trained in emergency preparedness and disaster risk reduction<br>6.4 Percentage of emergency preparedness publication in alternative languages<br>13.1 Vulnerable population as a percentage of city population<br>13.2 Percentage of population with access to social assistance programs<br>13.3 Percentage of population at high risk from natural hazards<br>13.6 Annual percentage of the city population directly affected by natural hazards<br>15.1 Percentage of city population covered by multi-hazard early warning system |
| (c) Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030. | 5.1 Historical disaster losses as a percentage of city product<br>5.2 Average annual loss as a percentage of city product<br>5.4 Percentage of properties with insurance coverage for high risk hazards<br>5.5 Percentage of total insured value to total value at risk within the city<br>5.7 Percentage of the workforce in informal employment<br>9.5 Annual expenditure on emergency management planning as a percentage of total city budget<br>9.7 Total allocation of disaster reserve funds as a percentage of total city budget |

**Table D.2** *(continued)*

| **The seven global targets** | |
|---|---|
| | 12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br>12.7 Percentage of residential properties located in high-risk zones<br>20.1 Percentage of city area covered by publicly available hazard maps<br>20.2 Pervious land area as a percentage of total city land area<br>20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented |
| (d) Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030. | 5.3 Percentage of essential service providers that have a documented business continuity plan<br>7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity<br>9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget<br>9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget<br>9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget<br>9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget<br>9.6 Annual expenditure on social and community services as a percentage of total city budget<br>10.1 Annual number of multi-stakeholder risk assessments<br>10.2 Frequency with which disaster management plans are updated<br>10.4 Percentage of essential city services covered by a documented continuity plan<br>10.5 Percentage of city electronic data with secure and remote back-up storage<br>10.6 Percentage of public meetings dedicated to resilience in the city<br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br>11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs<br>11.3 Percentage of hospitals equipped with back-up electricity supply<br>12.1 Capacity of designated emergency shelters per 100 000 population<br>12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br>12.6 Annual number of residential properties flooded as a percentage of total residential properties in the city<br>12.7 Percentage of residential properties located in high-risk zones |

**Table D.2** *(continued)*

| **The seven global targets** | |
|---|---|
| | 15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population<br>18.1 Percentage of public transportation trips operating on schedule<br>18.2 Number of evacuation routes available per 100 000 population<br>19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency<br>20.1 Percentage of city area covered by publicly available hazard maps<br>20.2 Pervious land area as a percentage of total city land area<br>20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented<br>22.1 Number of different sources providing at least 5 percent of total water supply capacity<br>22.2 Percentage of city population that can be supplied potable water by alternative methods for 72 hours |
| (e) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020. | 10.1 Annual number of multi-stakeholder risk assessments<br>10.2 Frequency with which disaster management plans are updated<br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br>10.4 Percentage of essential city services covered by a documented continuity plan<br>10.6 Percentage of public meetings dedicated to resilience in the city<br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements |
| (f) Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030. | |
| (g) Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. | 15.1 Percentage of city population covered by multi-hazard early warning system<br>17.2 Percentage of city population that receives communications about emergency preparedness and disaster risk reduction |
| **The four priorities for action** | |

**Table D.2** *(continued)*

| **The seven global targets** | |
|---|---|
| Priority 1. Understanding disaster risk<br><br>Disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response. | 5.1 Historical disaster losses as a percentage of city product<br><br>5.2 Average annual disaster loss as a percentage of city product<br><br>5.3 Percentage of essential service providers that have a documented business continuity plan<br><br>5.4 Percentage of properties with insurance coverage for high risk hazards<br><br>5.5 Percentage of total insured value to total value at risk within the city<br><br>5.7 Percentage of the workforce in informal employment<br><br>10.1 Annual number of multi-stakeholder risk assessments<br><br>10.2 Frequency with which disaster management plans are updated<br><br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br><br>10.4 Percentage of essential city services covered by a documented continuity plan<br><br>10.5 Percentage of city electronic data with secure and remote back-up storage<br><br>10.6 Percentage of public meetings dedicated to resilience in the city<br><br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br><br>12.7 Percentage of residential properties located in high-risk zones<br><br>13.1 Vulnerable population as a percentage of city population<br><br>13.2 Percentage of population with access to social assistance programs<br><br>13.3 Percentage of population at high risk from natural hazards<br><br>13.5 Percentage of neighbourhoods with regular, open neighbourhood association meetings<br><br>13.6 Annual percentage of the city population directly affected by natural hazards<br><br>20.1 Percentage of city area covered by publicly available hazard maps<br><br>20.2 Pervious land area as a percentage of total city land area<br><br>20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented<br><br>20.4 Percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment |

**Table D.2** *(continued)*

| **The seven global targets** | |
|---|---|
| Priority 2. Strengthening disaster risk governance to manage disaster risk<br><br>Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation. It fosters collaboration and partnership. | 9.5 Annual expenditure on emergency management planning as a percentage of total city budget<br><br>9.7 Total allocation of disaster reserve funds as a percentage of total city budget<br><br>10.1 Annual number of multi-stakeholder risk assessments<br><br>10.2 Frequency with which disaster management plans are updated<br><br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br><br>10.4 Percentage of essential city services covered by a documented continuity plan<br><br>10.5 Percentage of city electronic data with secure and remote back-up storage<br><br>10.6 Percentage of public meetings dedicated to resilience in the city<br><br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br><br>13.5 Percentage of neighbourhoods with regular, open neighbourhood association meetings |
| Priority 3. Investing in disaster risk reduction for resilience<br><br>Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. | 5.4 Percentage of properties with insurance coverage for high risk hazards<br><br>5.5 Percentage of total insured value to total value at risk within the city<br><br>9.1 Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget<br><br>9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget<br><br>9.3 Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget<br><br>9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget<br><br>10.4 Percentage of essential city services covered by a documented continuity plan |

**Table D.2** *(continued)*

| **The seven global targets** | |
|---|---|
| | 10.5 Percentage of city electronic data with secure and remote back-up storage |
| | 11.3 Percentage of hospitals equipped with back-up electricity supply |
| | 12.2 Percentage of buildings structurally vulnerable to high-risk hazards |
| | 12.3 Percentage of residential buildings not in conformity with building codes and standards |
| | 12.4 Percentage of damaged infrastructure that was "built back better" after a disaster |
| | 12.7 Percentage of residential properties located in high-risk zones |
| | 18.1 Percentage of public transportation trips operating on schedule |
| | 20.1 Percentage of city area covered by publicly available hazard maps |
| | 20.2 Pervious land area as a percentage of total city land area |
| | 20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented |
| Priority 4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction<br>The growth of disaster risk means there is a need to strengthen disaster preparedness for response, take action in anticipation of events, and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phase is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures. | 6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction |
| | 6.2 Percentage of population trained in emergency preparedness and disaster risk reduction |
| | 6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities |
| | 6.4 Percentage of emergency preparedness publications provided in alternative languages |
| | 9.5 Annual expenditure on emergency management planning as a percentage of total city budget |
| | 9.7 Total allocation of disaster reserve funds as a percentage of total city budget |
| | 11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs |
| | 11.3 Percentage of hospitals equipped with back-up electricity supply |
| | 12.4 Percentage of damaged infrastructure that was "built back better" after a disaster |
| | 13.6 Annual percentage of city population directly affected by natural hazards |
| | 15.1 Percentage of city population covered by multi-hazard early warning system |
| | 15.2 Percentage of emergency responders that have received disaster response training |

**Table D.2** *(continued)*

| **The seven global targets** | |
|---|---|
| | 15.3 Percentage of local hazard warnings by national agencies annually that are received in a timely fashion by city |
| | 15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population |
| | 17.1 Percentage of emergency in the city equipped with specialised communication technologies able to operate reliably during a disaster event |
| | 17.2 Percentage of city population that receives communications about emergency preparedness and disaster risk reduction |
| | 18.2 Number of evacuation routes available per 100 000 population |
| | 19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency |
| | 22.1 Number of different sources providing at least 5 percent of total water supply capacity |
| | 22.2 Percentage of city population that can be supplied potable water by alternative methods for 72 hours |

# Annex E
(informative)

# Mapping of ISO 37123 indicators to ISO 37101 issues and purposes

| ISO 37101 Issues | ISO 37120 Purposes |
|---|---|
| Governance, empowerment and engagement | ATTRACTIVENESS (ISO 37101)<br>SOCIAL COHESION (ISO 37101)<br>WELL-BEING (ISO 37101)<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>RESILIENCE (ISO 37101)<br>5.3 Percentage of essential service providers that have a documented business continuity plan<br>9.1 Annual e1xpenditure on upgrades and maintenance of city service assets as a percentage of total city budget<br>9.5 Expenditure on emergency management planning as a percentage of total city budget<br>9.6 Annual expenditure on social and community services as a percentage of total city budget<br>10.1 Annual number of multi-stakeholder risk assessments<br>10.2 Frequency with which disaster management plans are updated<br>10.3 Percentage of city departments that are engaged in preparing for and responding to potential risks<br>10.4 Percentage of essential city services covered by a documented continuity plan<br>10.5 Percentage of city electronic data with secure and remote back-up storage<br>10.6 Percentage of public meetings dedicated to resilience in the city<br>10.7 Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br>20.1 Percentage of city area covered by publicly available hazard maps<br>20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented<br>20.4 Percentage of city departments and utility services that integrate the results of risk assessment in their planning and investment<br>PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Education and capacity building | ATTRACTIVENESS (ISO 37101)<br>SOCIAL COHESION (ISO 37101)<br>6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities<br>WELL-BEING (ISO 37101)<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>RESILIENCE (ISO 37101) |

| ISO 37101 Issues | ISO 37120 Purposes |
|---|---|
| | 6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction |
| | 6.2 Percentage of population trained in emergency preparedness and disaster risk reduction |
| | 6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities |
| | 15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Innovation, creativity and research | ATTRACTIVENESS (ISO 37101) |
| | SOCIAL COHESION (ISO 37101) |
| | WELL-BEING (ISO 37101) |
| | RESPONSIBLE RESOURCE USE (ISO 37101) |
| | RESILIENCE (ISO 37101) |
| | 12.4 Percentage of damaged infrastructure that was "built back better" after a disaster |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Health and care in the community | ATTRACTIVENESS (ISO 37101) |
| | SOCIAL COHESION (ISO 37101) |
| | 11.4 Percentage of population with basic health insurance |
| | 13.2 Percentage of population with access to social assistance programs |
| | WELL-BEING (ISO 37101) |
| | 11.1 Average wait time in hospital emergency rooms |
| | 13.3 Percentage of population at high risk from natural hazards |
| | 14.1 Percentage of city population living within 0.5 km of public outdoor recreation space |
| | RESPONSIBLE RESOURCE USE (ISO 37101) |
| | RESILIENCE (ISO 37101) |
| | 11.1 Average wait time in hospital emergency rooms |
| | 11.2 Percentage of health care facilities equipped with capabilities and medical supplies for acute needs |
| | 11.4 Percentage of population with basic health insurance |
| | 12.1 Capacity of designated emergency shelters per 100 000 population |
| | 15.4 Number of health and educational facilities in the city destroyed or damaged by natural hazards per 100 000 population |
| | 19.1 Percentage of city population that can be served by city food reserves for 72 hours in an emergency |
| | 22.1 Number of different sources providing at least 5 percent of total water supply capacity |
| | 22.2 Percentage of population that can be supplied potable water by alternative methods for 72 hours |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |

| ISO 37101 Issues | ISO 37120 Purposes |
|---|---|
| Culture & community identity | ATTRACTIVENESS (ISO 37101)<br>SOCIAL COHESION (ISO 37101)<br>WELL-BEING (ISO 37101)<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>RESILIENCE (ISO 37101)<br>PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Living together, interdependence and mutuality | ATTRACTIVENESS (ISO 37101)<br>13.3 Percentage of population at high risk from natural hazards<br>SOCIAL COHESION (ISO 37101)<br>13.1 Vulnerable population as a percentage of city population<br>WELL-BEING (ISO 37101)<br>14.1 Percentage of city population living within 0.5 km of public outdoor recreation space<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>RESILIENCE (ISO 37101)<br>6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities<br>6.4 Percentage of emergency preparedness publications provided in alternative languages<br>12.1 Capacity of designated emergency shelters per 100 000 population<br>13.3 Percentage of population at high risk from natural hazards<br>PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Economy and sustainable production and consumption | ATTRACTIVENESS (ISO 37101)<br>SOCIAL COHESION (ISO 37101)<br>WELL-BEING (ISO 37101)<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>RESILIENCE (ISO 37101)<br>5.2 Average annual disaster loss as a percentage of city product<br>5.5 Percentage of total insured value to total value at risk within the city<br>5.7 Percentage of the workforce in informal employment<br>PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |

| ISO 37101 Issues | ISO 37120 Purposes |
|---|---|
| Living & working environment | ATTRACTIVENESS (ISO 37101)<br>13.3 Percentage of population at high risk from natural hazards<br>SOCIAL COHESION (ISO 37101)<br>WELL-BEING (ISO 37101)<br>5.4 Percentage of properties with insurance coverage for high risk hazards<br>5.7 Percentage of the workforce in informal employment<br>8.1 Magnitude of urban heat island effects (atmospheric)<br>14.1 Percentage of city population living within 0.5 km of public outdoor recreation space<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>RESILIENCE (ISO 37101)<br>12.2 Percentage of buildings structurally vulnerable to high-risk hazards<br>12.3 Percentage of residential buildings not in conformity with building codes and standards<br>12.4 Percentage of damaged infrastructure that was "built back better" after a disaster<br>12.7 Percentage of residential properties located in high-risk zones<br>PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101)<br>9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget |
| Safety and security | ATTRACTIVENESS (ISO 37101)<br>12.7 Percentage of residential properties located in high-risk zones<br>SOCIAL COHESION (ISO 37101)<br>6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities<br>6.4 Percentage of emergency preparedness publications provided in alternative languages<br>WELL-BEING (ISO 37101) |
| | 13.6 Annual percentage of the city population directly affected by natural hazards<br>RESPONSIBLE RESOURCE USE (ISO 37101)<br>9.5 Annual expenditure on emergency management planning as a percentage of total city budget |

| ISO 37101 Issues | ISO 37120 Purposes |
|---|---|
| | 9.7 Total allocation of disaster reserve funds as a percentage of total city budget |
| | RESILIENCE (ISO 37101) |
| | 6.1 Percentage of schools that teach emergency preparedness and disaster risk reduction within their curriculum |
| | 6.2 Percentage of population trained in emergency preparedness and disaster risk reduction |
| | 6.3 Percentage of the vulnerable population that has been engaged with emergency preparedness and disaster risk reduction activities |
| | 6.4 Percentage of emergency preparedness publications provided in alternative languages |
| | 12.7 Percentage of residential properties located in high-risk zones |
| | 15.1 Percentage of city population covered by multi-hazard early warning system |
| | 15.2 Percentage of emergency responders that have received disaster response training |
| | 15.3 Percentage of local hazard warnings by national agencies annually that are received in a timely fashion by city |
| | 17.1 Percentage of emergency in the city equipped with specialised communication technologies able to operate reliably during a disaster event |
| | 17.2 Percentage of city population that receives communications about emergency preparedness and disaster risk reduction |
| | 20.3 Percentage of city land area in high-risk zones where risk reduction measures have been implemented |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |

| ISO 37101 Issues | ISO 37120 Purposes |
|---|---|
| Community infrastructures | ATTRACTIVENESS (ISO 37101) |
| | SOCIAL COHESION (ISO 37101) |
| | WELL-BEING (ISO 37101) |
| | RESPONSIBLE RESOURCE USE (ISO 37101) |
| | RESILIENCE (ISO 37101) |
| | 7.1 Number of different electricity sources providing at least 5 percent of total energy supply capacity |
| | 9.1 Annual expenditure on maintenance and upgrades of city service assets as a percentage of total city budget |
| | 9.2 Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget |
| | 9.6 Annual expenditure on social and community services as a percentage of total city budget |
| | 22.1 Number of different sources providing at least 5 percent of total water supply capacity |
| | 22.2 Percentage of population that can be supplied potable water by alternative methods for 72 hours |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Mobility | ATTRACTIVENESS (ISO 37101) |
| | 18.1 Percentage of public transportation services trips operating on schedule |
| | SOCIAL COHESION (ISO 37101) |
| | WELL-BEING (ISO 37101) |
| | RESPONSIBLE RESOURCE USE (ISO 37101) |
| | RESILIENCE (ISO 37101) |
| | 18.1 Percentage of public transportation trips operating on schedule |
| | 18.2 Number of evacuation routes available per 100 000 population |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| Biodiversity and Ecosystem | ATTRACTIVENESS (ISO 37101) |
| Services | SOCIAL COHESION (ISO 37101) |
| | WELL-BEING (ISO 37101) |
| | RESPONSIBLE RESOURCE USE (ISO 37101) |
| | RESILIENCE (ISO 37101) |
| | 20.2 Pervious land area as a percentage of total city land area |
| | PRESERVATION AND IMPROVEMENT OF ENVIRONMENT (ISO 37101) |
| | 8.1 Magnitude of urban heat island effects (atmospheric) |
| | 8.2 Percentage of natural areas within the city that have undergone ecological evaluation for their protective services |
| | 9.4 Annual expenditure on green and blue infrastructure as a percentage of total city budget |
| | 20.2 Pervious land area as a percentage of total city land area |

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