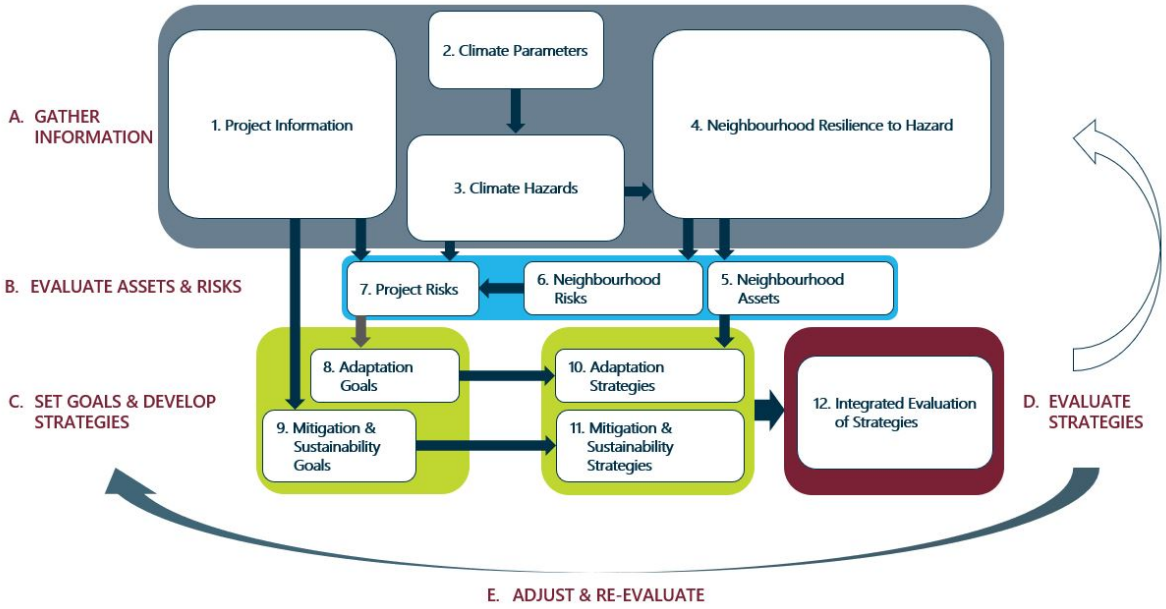


The **Integrated Building Adaptation and Mitigation Assessment (IBAMA)** framework is a tool to assist BC Housing project teams as well as other building industry stakeholders in BC, Canada, and beyond; to help increase their multi-unit residential building's *resilience to climate hazards (adaptation)* while optimizing *GHG reduction (mitigation)* and *sustainability* goals. IBAMA was conceived for new construction projects but can be adapted for retrofits and renovations.

Why IBAMA?

There are many policies and systems that focus on climate mitigation/sustainability in buildings, and a growing number of guidelines and frameworks that address climate adaptation/resilience. However, most don't adequately integrate mitigation/sustainability with adaptation/resilience approaches. This lack of integration can result in unintended consequences such as increased greenhouse gas (GHG) emissions, augmented risks, negative health outcomes, maladaptation, and added costs. By using IBAMA, project teams can investigate interactions between adaptation and mitigation strategies to maximize synergies, minimize conflicts, identify trade-offs, and achieve more holistic solutions.

What is IBAMA?

IBAMA is a roadmap and flexible decision-making tool rather than a checklist or set of prescriptive requirements. It is a step-by-step process that enables teams to respond to the unique context, vulnerabilities and circumstances of their project such as the location, potential climate hazards, occupant demographics, budgets, and management structures.

When are the various IBAMA tools used?

This document is a primer for introducing the IBAMA process at initial ownership discussions or project team meetings in the pre-design stage. The IBAMA reference guide and IBAMA Excel tool are more comprehensive documents that map out a detailed process for using the framework, team roles and responsibilities, milestones and deliverables. They should serve as the main resources throughout the project's development and can also be consulted for additional information and references when using the IBAMA Primer.

How is IBAMA organized?

The IBAMA framework consists of twelve sequential parts grouped into five stages:

A. Information gathering on the project, climate scenarios, key hazards, and neighbourhood resilience.
B. Evaluation of project and neighbourhood assets and risks.
C. Development of adaptation, mitigation and sustainability goals and strategies.
D. Evaluation of proposed adaptation, mitigation and sustainability strategies to determine viability .
E. Adjustment of non-viable strategies and re-evaluation.

When using this primer, refer to the IBAMA reference guide for additional information and resources if needed.

1. Project Information & Vulnerabilities

What are the key program and project requirements?

- Project purpose & principles:
- Program:
- Budget:
- MEP, security, and other technical:
- Building performance:
- Operations & Maintenance:
- Occupant health & well-being:

What are your project's vulnerabilities?

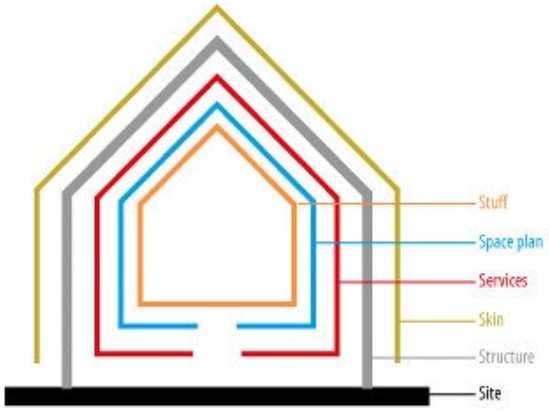
Vulnerability is the degree to which a system, or part of it, may react adversely during the occurrence of a hazardous event.

- Physical vulnerabilities (Site, Infrastructure, Adjacencies):
- Resident/Occupant Vulnerabilities:
- Operational/Management Vulnerabilities:
- Economic Vulnerabilities:
- Other Vulnerabilities:

2. Project Lifespan & Climate Projections

What is the anticipated lifespan of your project?

What is the anticipated lifespan of the following project systems?
It is important to consider the distinct lifespans of the main building systems in order to optimize the project's design for the duration of each system, as well as to consider how the systems work together as a whole.



6-18. Pace Layering in Buildings (Brand) ©Peter Morville, CC BY-NC 2.0

- Structure:
- Enclosure:
- HVAC:
- Plumbing:
- Electrical:
- Site infrastructure:

Which future climate scenarios and historical climate data do you anticipate using for the design of the project?
Future climate scenarios include Representative Concentration Pathway (RCP) 2.6, RCP 4.5, RCP 6, and RCP 8.5. It is important to consider both current climate and future projections when developing the project's design.

If you are not familiar with climate projection scenarios, consult with your municipality, an adaptation consultant, or the Pacific Impacts Climate Consortium. Climate projections for Metro Vancouver can be found here:
http://www.metrovancouver.org/services/air-quality/AirQualityPublications/ClimateProjectionsForMetroVancouver.pdf

Is there a climate analog location *(see Glossary for definition)* that can be referenced?

3. Climate Hazards

Based on the climate projections for the future climate scenario selected:

- What are the top three anticipated climate hazards?
  In determining the top hazards, consider factors such as hazard frequency, severity, duration, recovery time, project exposure, and hazard impacts.

  1. _____
  2. _____
  3. _____

- Describe any compounding hazards.
  Compounding Hazards are multiple natural or climate hazards occurring concurrently or at around the same time.

  _____

- Describe any cascading impacts related to the above hazards.
  Cascading Impacts are the secondary impacts or hazards from an initial natural or climate hazard event.

  Hazard 1

  1. _____
  2. _____
  3. _____

  Hazard 2

  1. _____
  2. _____
  3. _____

  Hazard 3

  1. _____
  2. _____
  3. _____

  Compounding Hazards

  1. _____
  2. _____
  3. _____

- Based on current or historical weather data, are there any additional hazards that should be considered for the project?

4. Neighbourhood Resilience

How resilient is the project's neighbourhood to the hazards listed above?

Resilience should be evaluated with respect to each hazard on a scale of 1-5 where 1= lowest resilience & 5= highest resilience. Consider time factors with respect to the lifespan of the project. See IBAMA Reference Guide Section 4 for further guidance on how to evaluate neighbourhood resilience and which stakeholders should be involved in the evaluation.

Categories	Hazard 1	Hazard 2	Hazard 3	Compounding Hazards	Other Hazard
Describe Hazard					
Infrastructure *(stormwater, sanitation, roads, power, water, communications, etc.)*					
Built Environment *(public buildings, services, community buildings, hospitals, etc.)*					
Natural Environment *(air quality, water quality, open space, green space, land area at risk, etc.)*					
Transportation *(bus, subway, train, bicycle network, walkability, points of entry to neighbourhood)*					
Government, Community & Health Services *(emergency management, community organizations, social services, health services, community health, businesses & retail, etc.)*					
Population *(age, language, family type, minorities, gender, POC, disabilities, etc.)*					
Local Economy *(income, employment, home ownership, etc.)*					

5. Neighbourhood Assets

Identify any potential neighbourhood assets that could be beneficial to the project with respect to the hazards identified.

List assets in left column and check off which hazards they apply to.
See IBAMA Reference Guide Section 5 for case study examples of neighbourhood assets.

Neighbourhood Assets	Hazard 1	Hazard 2	Hazard 3	Compounding Hazards	Other Hazard

6. Neighbourhood Vulnerabilities & Risks

Based on the neighbourhood resilience assessment, list key neighbourhood vulnerabilities. For each vulnerability, rate the level of risk to the neighbourhood with respect to each of the hazards listed.

See IBAMA Reference Guide Section 6 for further references on neighbourhood vulnerabilities and risks.

Risk levels should be evaluated with respect to each hazard on a scale of 1-5 where 1= low risk & 5= very high risk.

Neighbourhood Vulnerabilities	Risk Level to Hazard 1	Risk Level to Hazard 2	Risk Level to Hazard 3	Risk Level to Compounded Hazards	Risk Level to Other Hazard

7. Project Risks

Identify the highest project risks based on the combined assessment of the project vulnerabilities in Section 1 and each hazard listed. Include any neighbourhood risks that significantly impact the project.

See IBAMA Reference Guide Section 7 for further references on project vulnerabilities and risks.

Risk levels should be evaluated with respect to each hazard on a scale of 1-5 where 1= low risk & 5= very high risk.

Project Vulnerabilities	Risk Level to Hazard 1	Risk Level to Hazard 2	Risk Level to Hazard 3	Risk Level to Compounded Hazards	Risk Level to Other Hazard

8. Climate Adaptation & Resilience Goals

Based on the highest project risks identified in Section 7 and keeping in mind the highest neighbourhood risks identified in Section 6, list the project's adaptation goals. Goals can refer to the occupants, physical assets, or other factors.

Hazard	Risk	Goals

For goals that are occupant-related, determine the essential needs for occupants during and after the hazard. List essential needs in left column and check off which hazards they apply to.

Essential Needs	Hazard 1	Hazard 2	Hazard 3	Compounded Hazards	Other Hazard

9. Climate Mitigation & Sustainability Goals

List the key climate mitigation goals for the project. Focus on specific & measurable goals rather than general certifications. Mitigation goals can be categorized as either *Operational GHG reductions, Renewable energy generation, Embodied GHG reductions (GHG emissions related to the construction, materials, and demolition of a building), and Sequestration (capturing GHG emissions).*

1. _____
2. _____
3. _____
4. _____
5. _____

List the key sustainability goals for the project. Goals not captured under climate mitigation would likely fall under categories such as *Location & Site, Water, Materials, Human & Public Health, Indoor Environment* or *Community & Equity*.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

10. Climate Adaptation & Resilience Strategies

Based on the goals in Section 8 and taking into consideration the project's purpose and principles listed in Section 1, develop a list of potential adaptation and resilience strategies. Consider strategies that pertain to design and construction, management and operations, and neighbourhood assets/risks in Sections 5 & 6.

When proposing strategies, keep in mind climate projections over the project's and building systems' lifespans, as well as limitations related to proposed solutions, such as time or reliance on external services. Verify that proposed strategies for each hazard meet regulatory requirements, the project requirements in Section 1, and do not conflict with adaptation and resilience goals for the other main hazards.

Hazard	Climate Adaptation & Resilience Goals	Proposed Adaptation & Resilience Strategies

11. Climate Mitigation & Sustainability Strategies

Based on the goals in Section 9 and taking into consideration the project's purpose and principles listed in Section 1, develop a list of potential climate mitigation and sustainability strategies. Consider strategies that pertain to design and construction as well as management and operations. Strategies should take into account the changing climate throughout the building's lifespan.

When proposing strategies keep in mind climate projections over the project's and building systems' lifespans, as well as time and other limitations. Verify that the proposed strategies meet regulatory requirements, the project requirements in Section 1, and do not conflict with other mitigation and sustainability goals.

Mitigation or Sustainability Goals	Proposed Mitigation & Sustainability Strategies

12a. Evaluation of Strategies – Adaptation

Evaluate each of the proposed adaptation strategies for each hazard to determine how well they meet the following six criteria. Criteria deemed not significant to the owner can be eliminated. Use multiple copies of the table if needed.

Evaluation scale: 1-5 where 1= Doesn't sufficiently meet the criteria, 3= Somewhat meets the criteria, 5= Meets the criteria

Technical Requirements include simplicity of implementation, operations and maintenance, durability, and degree of independence from other systems and services.

Project Requirements include the owner's project requirements, project program, and occupant well-being.

Direct Costs include design costs, construction costs, and operations & maintenance costs.

Indirect Costs & Benefits are hazard-related costs not borne by or directed to the project owner or developer, but by or to entities external to the project such as municipalities or health services.

Adaptation Strategy	Adaptation Goals	Mitigation & Sustainability Goals	Technical Requirements	Project Requirements	Direct Costs	Indirect Costs & Benefits

12b. Evaluation of Strategies – Mitigation & Sustainability

Evaluate each of the proposed mitigation and sustainability strategies to determine how well they meet the following six criteria. Criteria deemed not significant to the owner can be eliminated. Use multiple copies of the table if needed.

Evaluation scale: 1-5 where 1= Doesn't sufficiently meet the criteria, 3= Somewhat meets the criteria, 5= Meets the criteria

Technical Requirements include simplicity of implementation, operations and maintenance, durability, and degree of independence from other systems and services.

Project Requirements include the owner's project requirements, project program, and occupant well-being.

Direct Costs include design costs, construction costs, and operations & maintenance costs.

Indirect Costs & Benefits are hazard-related costs not borne by the project owner but by entities external to the project, or additional co-benefits to the project or community.

Mitigation & Sustainability Strategy	Adaptation Goals	Mitigation & Sustainability Goals	Technical Requirements	Project Requirements	Direct Costs	Indirect Costs & Benefits

12c. Selection of Adaptation, Mitigation & Sustainability Strategies

Select strategies for further development that meet the following criteria:

- Minimum score of 3 in all categories **AND**
- Minimum score of 4 in adaptation goals category **AND**
- Minimum score of 4 in mitigation & sustainability goals category

Strategies that do not meet the above criteria should be reassessed, and/or project goals re-evaluated.

Selected Strategies	Follow Up

Glossary of Terms

Cascading Impacts	The secondary impacts or hazards following an initial natural or climate hazard event. Examples include power outages due to wildfires, heavy rain causing landslides, reduced road and transportation access after flooding, or supply chain interruptions following an earthquake.
Climate Adaptation	A gradual process of maintaining points of resilience to climate change that ultimately results in a future state of being.
Climate Analog	Climate-analog mapping involves matching the expected future climate at a location with the current climate of another, potentially familiar, location - thereby providing a more relatable, place-based assessment of climate change.
Climate Hazard	Agent of disaster for human settlements or to the environment. Includes wildfires, tropical cyclones, thunderstorms, tornadoes, drought, flooding, rain, hail, snow, lightning, fog, wind, temperature extremes, air pollution, and climatic change.
Climate Mitigation	Reducing of net greenhouse gas (GHG) emissions to decrease global warming.
Climate Resilience	The capacity of a building or community to absorb external climate stresses; retain function; reduce risk; and enable people, organizations, and systems to persist.
Co-benefit	Benefit(s) of a mitigation and/or adaptation strategy that contributes to additional project or community goals.
Compounding Hazards *(Synonyms: compounding processes, compounding events)*	The effects of multiple natural or climate hazard events occurring concurrently or at around the same time. Examples include wildfires occurring during periods of extreme heat and drought, with ensuing poor air quality. A compounding hazard can also include the same hazard occurring multiple times within a short period, such as multiple heavy rainfalls over consecutive days.
Conflict	Adaptation action that has negative consequences for mitigation, or vice-versa.
Embodied GHG Emissions *(or Embodied Carbon)*	The total impact of all the greenhouse gases emitted by the materials and construction of a building. This includes the impacts of sourcing raw materials, manufacturing, transportation, wastage, maintenance, repairs, and disposal or recovery.
Equity	A concept concerned with the fair and equitable provision, implementation, and impact of services, programs, and policies for all community members.
Independence from external systems/services	The degree to which a strategy is reliant on the functioning of an externally provided system or service such as an electric utility, municipal transportation service, or community centre.
Indirect Costs or Benefits	Hazard-related costs or benefits that are not borne by or directed to the project owner or developer, but entities external to the project such as municipalities or health services.
Maladaptation	Reducing short-term risk at the expense of long-term vulnerability, or increasing the vulnerability of other systems, sectors or social groups over any time horizon.

Representative Concentration Pathways (RCPs)	Greenhouse concentration (not emissions) trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC). Four pathways were used for climate modeling and research for the IPCC fifth Assessment Report (AR5) in 2014. The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases (GHG) emitted in the years to come. The original RCP scenarios are RCP2.6, RCP4.5, RCP6, and RCP8.5. Additional RCP scenarios have been developed since AR5.
Risk	The possibility of injury, loss, damage or negative environmental impact created by a hazard. Risk is a function of the probability and severity of a hazard event, exposure to the hazard, and the vulnerability of the people or physical assets exposed.
Sustainability	• Meeting present needs without compromising ability of future generations to meet their needs. • Increasing quality of life with respect to environmental, social and economic considerations, both in present and future generations.
Synergy	Interaction between adaptation and mitigation strategies when the combined effect of the strategies is equally or more beneficial than the effects of the individual strategies.
Trade-off	Action that balances mitigation and adaptation when it is not possible to fully carry out both objectives.
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.

IBAMA was developed as part of BC Housing's Mobilizing Building Adaptation and Resilience (MBAR) initiative. The project was led by Ilana Judah, architect and MSc Student at The Institute for Resources, Environment and Sustainability at The University of British Columbia, under the supervision of Dr. Stephanie Chang. Funding and project management support were provided by the Pacific Institute for Climate Solutions (PICS).

IBAMA Version 1.0 will be piloted on a BC Housing case study/ies in order to produce a baseline assessment, optimize the tools and incorporate additional references.