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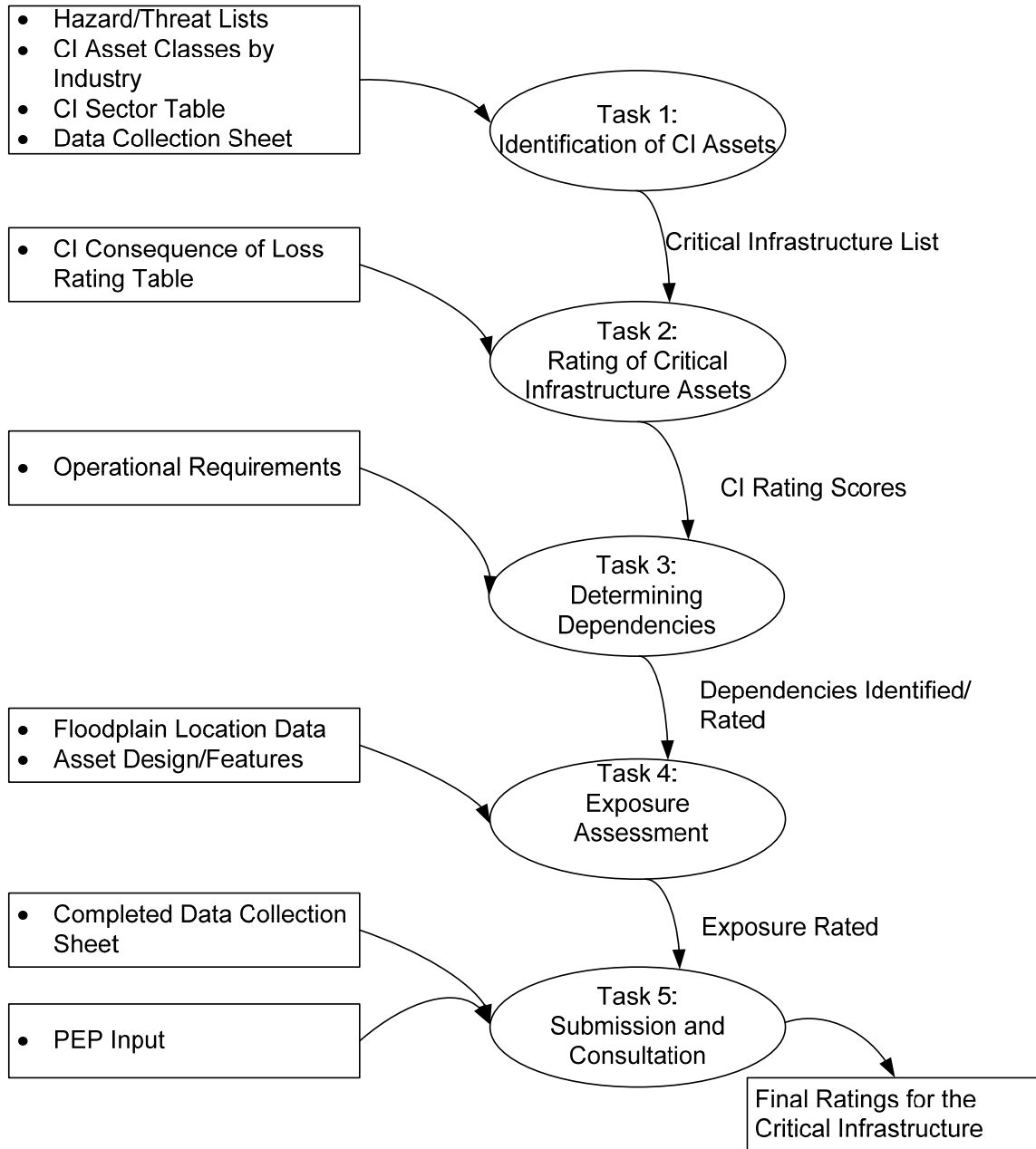
# **CRITICAL INFRASTRUCTURE RATING WORKBOOK**

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**Provincial Emergency Program**

**2007 May  
Freshet Pilot Version 2**

# Critical Infrastructure Rating Process Overview



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## INTRODUCTION

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### PURPOSE

The purpose of the Critical Infrastructure Rating Workbook is:

*To assist municipalities, industries and communities, in identifying and rating their Critical Infrastructure (CI) Assets within a defined geographic area that may be at risk from a hazardous event.*

“Critical Infrastructure Assets” are those physical resources, services, and information technology facilities, networks and assets which, if disrupted or destroyed, would have a serious impact on the operation of an organization, sector, region or government.

### OBJECTIVE

The workbook has been designed to be used for the rating of CI assets by the owners under all hazards and threats. However, its first use will be under the hazardous event of potential flooding within British Columbia (Freshet 2007). The objective of the rating is for the emergency planners and asset owners to identify the CI assets which may be at most risk and to help provide information for those in developing possible solutions to protect and minimize damage to these facilities.

### ACKNOWLEDGEMENT

The basic concepts and the rating material for this workbook were conceived and developed by the Greater Vancouver Joint Emergency Liaison Committee (JELC), Critical Infrastructure Working Group. JELC is co-chaired jointly by the Deputy Solicitor General for the Province of BC and the City Manager for Vancouver.

### OWNERSHIP AND SUPPORT

The CI Rating Workbook is designed to provide information to PEP in determining critical assets within the region the assessment is made. All information gathered within the process will be used for the purposes of PEP and JELC.

Any questions and comments on this workbook should be directed to:

**Critical Infrastructure Coordinator, PEP**  
(250) 952 4913

## TASK 1: IDENTIFICATION OF CRITICAL INFRASTRUCTURE

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### TASK OBJECTIVE

To assist owners in identifying all their Critical Infrastructure (CI) assets located within the defined geographic area.

### THE PROCESS

#### ***Task Strategies:***

The following strategies should be considered when completing this Task:

- Define your geographic area.
- Ensure you have identified all CI assets within your area. Cast the net as wide as possible initially, even though not all assets need to be rated.
- Refer to the “CI Asset Classes by Industry” list (Appendix - C) for identifying assets within key industries. If your industry is not reflected in this list, or is structured differently from the appendix, create one based on the samples given and use it.
- Granularity of Identification: Try to identify assets on a site basis, and not at the equipment level. For example, an electric utility may identify a generating station. That generating station may have several key components such as 4 units of generators, step-up transformers, a control building, a shop, a switch yard, 4 penstocks, and a spillway. All of these station components should be identified under a single CI asset for the purposes of this workbook.

#### ***Required Information:***

The following documents should be referenced or used for completing Task 1:

- Definition of Terms (Appendix A – look up “Critical Infrastructure” and “Industry Sectors”)
- Hazards/Threat Lists (Appendix B)
- CI Asset Classes by Industry (Appendix C)
- CI Criticality Data Collection Sheet (Appendix D)
- CI Sector Table (Appendix F)

**Procedure:**

**Step 1:** Using the “CI Asset Classes by Industry” list (Appendix C) as a reference, identify all assets that are essential to deliver the core services for your organization. At this stage, list all those assets that may cripple the services to your customers. Do not worry about the exact criticality at this time, this will be explained later and filtering will come in next.

**Sample:** Below are samples of the CI assets for two different types of industries and a municipality. Additional industries are identified in Appendix C. Note that not all of the 10 industry sectors are detailed for asset types in the appendix. If you cannot find your own sector, use the existing sectors as examples to create one for your sector.

**Electricity Industry:**

- Dams and Reservoirs (together)
- Generating Station
- Substations (at transmission and distribution levels)
- Control Centres
- Others

**Highways & Transportation Industry:**

- Water Crossings (Bridges and Tunnels)
- Overpass/Underpass
- Highways and Roadways (by section)
- Materials and Equipment Yards (trucks, sands, asphalt, etc)
- Highways Operations Control Centre
- Fleet of Trucks
- Fuel Depots
- Dispatch Centre
- Others

**Municipal Facilities:**

- Fire Halls
- Community Centres
- Overpasses
- Dikes
- Reservoirs
- Pump Stations
- SCADA (Supervisory Control and Data Acquisition – a process control system)

**Step 2:** List the facilities on the “CI Criticality Data Collection Sheet” (Appendix D)

Fill in the following information:

- Owner:** The name of the organization who owns the asset.
- Operator:** The name of the organization that operates the asset for the owner. Sometimes, the owner and operators are different for a single asset.
- Contact:** The name, phone number and e-mail address of the person to contact for the asset and operations information.
- Sector:** Identify the sector from the “CI Sector Table” (Appendix F). Note a drop down list is provided on the electronic sheet.
- Asset Column:** Fill in the name of the asset or an identifying number if the anonymity of the asset is desired. For example, Lion’s Gate Bridge represents a full name while BC Hydro Asset 1 represents a masked name.

Leave the remaining columns blank for now. Do not complete the Geographic Rank column, it will be calculated by PEP in Task 5.

**Results:**

When you have completed this Task, you will have identified your CI assets on the “CI Rating Data Collection Sheet”.

**CONSIDERATIONS FOR SPECIAL EVENTS**

If you are using this workbook for evaluating your CI for the purposes of other hazard events such as the Earthquake, Landslides, 2010 games, World Cup, or G10, ensure the following are considered:

- All new or temporary assets that are being constructed for the event should be included within your assessment.
- Different threat/hazard conditions may exist for the event and should be added to the hazard/threat list.
- Geographic boundaries may shift for these events.

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## TASK 2: RATING OF CRITICAL INFRASTRUCTURE ASSETS

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### TASK OBJECTIVE

To assist owners in producing a criticality rating for the Consequence of Loss for each asset identified.

### PROCESS

#### *Task Strategies:*

The following strategies should be considered when completing this Task:

- Refer to the “Hazards/Threat Lists” (Appendix B) to identify the potential failure modes and associated consequences.
- Evaluate only for “Maximum Credible Damage”, not for all failure modes and consequences.
- It is recommended that the assets of one organization be rated by the same individual or the same set of people to maintain internal consistency. This may be best achieved by a group of people who are responsible for operations or risk management.

#### *Required Information:*

The following documents should be referenced for completing Task 2:

- Definition of Terms (Appendix A – look up “Maximum Credible Damage”)
- Hazards/Threat Lists (Appendix B)
- CI Criticality Data Collection Sheet (Appendix D)
- CI Consequence of Loss Rating Table (Appendix G)

#### *Procedure:*

**Step 1:** Develop a loss/failure scenario for the asset being rated based on the Maximum Credible Damage. If required refer to the “Hazards/Threat Lists” (Appendix B).

**Step 2:** Compare the loss scenario to the “CI Consequence of Loss Rating Table” (Appendix G) and estimate the consequence of loss in each of the six impact areas. Place these ratings on the “CI Criticality Data Collection Sheet” (Appendix D). Note that each of the values reflects a range. Pick the value that best reflects the consequence of loss of your asset in that impact area. No intermediate values are allowed.

<b>IMPACT AREAS</b>	1) Population Impact	4) Impact on Other Sectors
	2) Economic Impact	5) Service Impact
	3) Impact on Own Sector	6) Public Confidence Impact



**Sample:** Below are sample ratings of the CI assets for two industries and a municipality.

**Electricity Industry – A Substation:**

Assume the following for the asset:

- Situated in an urban centre
- A key station to serve three other substations
- About 50,0000 customers could be impacted
- Located in a 1/200 year floodplain
- No specific protection against floods

Potential rating for the asset:

Criterion	Score	Remarks
Impact on People and Assets	0.1	Not likely to produce a large number of fatalities, injuries or evacuations.
Economic Impact	3.0	Potentially \$10 to \$100 million damage.
Impact on Own Sector	1.0	There are other stations dependent on it.
Impact on Other Sectors	3.0	Large number of industry sectors affected.
Service Impact	5.0	It may take more than a month to repair.
Public Confidence Impact	3.0	High impact for the municipality/ region.
<b>Total Score for the Asset:</b>	<b>15.1</b>	

**Highways & Transportation – Water Crossings:**

Assume the following for the asset:

- Situated in an urban centre
- Carrying a national highway
- Carrying a large amount of traffic, including trucks
- Structure also carries other utilities: water, gas, telecommunications, etc.
- Clearance under the bridge may be an issue for the river traffic in high waters
- Collapse and/or repair of the bridge may block shipping routes
- Located in a 1/200 floodplain

Potential rating for the asset:

Criterion	Score	Remarks
Impact on People and Assets	.5	Not likely to produce a large number of fatalities if only few spans damaged
Economic Impact	5.0	The repair costs may exceed \$100 million.
Impact on Own Sector	5.0	The loss of this bridge would likely have a provincial impact.
Impact on Other Sectors	5.0	Large number of industry sectors affected.
Service Impact	5.0	It may take more than a year to repair.
Public Confidence Impact	5.0	High impact for the confidence in provincial/regional government.
<b>Total Score for the Asset:</b>	<b>25.5</b>	

**Municipal - Fire Hall:**

Assume the following for the asset:

- One of the three fire halls covering 1/3 of the municipality
- The area covers a hospital, 2 schools and an oil & gas distribution centre

Potential rating for the asset:

Criterion	Score	Remarks
Impact on People and Assets	3.0	The loss could result in injuries to more than 100 people.
Economic Impact	1.0	The repair costs is likely to exceed \$5 million.
Impact on Own Sector	3.0	Loss of the fire hall (which is combined with town hall) could have a regional impact.
Impact on Other Sectors	1.0	Could impact other sectors municipally.
Service Impact	1.0	Some essential services could be restored in days.
Public Confidence Impact	1.0	Municipal risk is high but may not have much control over the risk.
<b>Total Score for the Asset:</b>	<b>10.0</b>	

**Step 3:** Add up the total and place in the **Total Score** column (if you are using an Excel spreadsheet for the data collection, this is done automatically for you.). You now have the initial rating for the asset.

***Results:***

When you have completed this task, you should have the numeric ratings for the six impact areas on the “CI Criticality Data Collection Sheet” with a total score calculated.

## TASK 3: DETERMINING DEPENDENCIES OF CRITICAL INFRASTRUCTURE ASSETS

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### TASK OBJECTIVE

To produce a list of industry sectors and service providers upon which the asset being rated depends on to assure the critical services. A Dependency is an “External resource or action by which the ability of the Critical Infrastructure service provider to provide that service is immediately, directly and measurably affected”.

### PROCESS

#### *Task Strategies:*

The following strategies should be considered when completing this Task for identifying dependencies:

- The dependencies are recorded only if the relationship is Immediate, and Direct. “**Immediate**” meaning from a few milliseconds to up to 72 hours and “**Direct**” meaning without going through other resources or dependencies.
- Only the “**Upstream**” dependencies (those services that you need to deliver your own services) are recorded for your asset. Do not consider “Down stream” dependencies (the effect on others of the loss of your asset). These will be identified by the industries that receive your services, and, you should have already considered these in the Impact on Own Sector and Impact on Other Sectors columns in Task 2.
- Identify only “**External**” dependencies, which are those dependencies not directly under the control of the service provider. For example, a trucking company who brings in the critical supplies to your plant. “Internal” dependencies, such as your dependence on your own staff, may be identified for asset owners’ uses. However, these will not be captured for the PEP purposes or considered within this workbook.

#### *Required Information:*

The following documents/information should be referenced for completing Task 3:

- Definition of Terms (Appendix A – look up Dependency)
- Knowledge of your operations (primary and backup) such as:
  - ... Where energy supply comes from
  - ... Raw material supplier
  - ... Transportation in/out
  - ... Others
  - ... Labour supply
  - ... Critical systems or information
  - ... Work Space

- CI Criticality Data Collection Sheet (Appendix D)

**Procedure:**

**Step 1:** For this workbook, 3 potential dependencies have already been identified for the owner: Energy Supply (Electricity and Natural Gas) and Communications (Telephone). A fourth column, "Other", is left for the owner to fill in. You may choose other dependencies either from your own industry sector which may already have a check list of typical dependencies for the industry, or from the list below which lists identified dependencies:

- Facilities and Structures rented (co-location)
- Alternate energy supply
- Labour and skilled staff supplied by others (E.g., Contractors or Consultants)
- Raw material and chemical supplies
- Contracted out services
- Critical systems
- Telecommunications
- Transportation

This list is by no means an all inclusive one. Asset owners are encouraged to look beyond this list. Note again that for this task, the Workbook captures only those "external" (purchased services) dependencies.

**Step 2:** On the dependency section of the "CI Criticality Data Collection Sheet" fill in using the coding provided for the following three criteria:

- i) Primary or Secondary dependencies

Primary: dependency under normal operations

Secondary: dependency under an emergency/recovery situation, such as fuel for a backup generator, after the initial dependency (electrical power) is compromised or helicopter for recovery work

- ii) Strength of dependency; (disregard 'weak' ones for this Workbook).

Debilitating: Asset A has a "debilitating" dependence on service B in the situation that if service B fails, the service or function of asset A cannot be performed or is not available.

Strong: Asset A has a "strong" dependence on service B in the situation that if service B fails, the service or function of asset A will experience noticeable delays, degradation and/or a reduction in service.

- iii) Hazard Dependency: A collocated asset belonging to others which can potentially cause harm to your asset.

Coding has been placed in drop-down menus on the electronic sheet. The coding to be used for these criteria is:

Dependency Coding	Debilitating	Strong
Primary Dependency	PD	pd
Secondary Dependency	SD	sd
Primary Dependency and Hazard	PDH	pdh
Secondary Dependency and Hazard	SDH	sdh
Hazard Dependency	H	h

If there are no dependencies for that category (e.g., electricity), pick the last item on the drop-down list – None. If there are no dependencies for any other services, pick “None” for all three columns.

If you find a collocated hazard for the asset being rated, upon which you are not dependent, show it as sdh in the required location.

**Sample:** Below are sample ratings of the CI assets for two industries and a municipality.

**Electric Industry – Substation/Generating Station Dependencies:**

CI ASSET	OWNER	OPERATOR	DEPENDENCIES				
			ENERGY SUPPLIES		COMMUNICATIONS	OTHER	
			ELECTRICITY	NATURAL GAS	TELEPHONE	DESCRIPTION	CODING
Generating Station	Electric Company A	Electric Company A	None	None	sd	Helicopter	SD
Substation	Electric Company B	Electric Company A	None	None	sd	Helicopter	SD

**Notes:**

1. The generating station is a hydroelectric station and thus does not require natural gas as fuel.
2. Helicopter service is critical in the emergency/recovery phases for both companies to assess the integrity of their assets, and to transport personnel and equipment.

**Highways & Transportation – Water Crossing Dependencies:**

CI ASSET	OWNER	OPERATOR	DEPENDENCIES				
			ENERGY SUPPLIES		COMMUNICATIONS	OTHER	
			ELECTRICITY	NATURAL GAS	TELEPHONE	DESCRIPTION	CODING
Tunnel 1	Ministry A	Contractor A	PDH	None	pd	Diesel	SD
Bridge 1	Ministry A	Contractor B	None	h	sd	Specialist Equipment	SD

Notes:

1. The tunnel uses an electric motor to pump water seepage and a diesel standby generator to cover the temporary loss of the regular electric supply.
2. The bridge has electric lights but can carry out its function. As this is a weak dependency it is not captured for this CI rating. The bridge also has a natural gas transmission pipe co-located under the bridge deck and the gas pipe can pose a significant risk if the bridge structure is compromised. The bridge requires regular inspections by structural engineers with special measurement tools.

**Municipal – Fire Hall Dependencies:**

CI ASSET	OWNER	OPERATOR	DEPENDENCIES				
			ENERGY SUPPLIES		COMMUNICATIONS	OTHER	
			ELECTRICITY	NATURAL GAS	TELEPHONE	DESCRIPTION	CODING
Fire Hall 1	Municipality A	Municipality A	PD	Sd	PD	Radio	SD
Fire Hall 2	Municipality B	Municipality B	pd	pd	PD	Diesel	SD

Notes:

1. Fire Hall 1 relies heavily on electricity for its computers and telecommunications equipment. Even though it has a small gas standby generator, it is incapable of providing support for the equipment and has an operational time period of only 6 hours. Its recovery of the fire and rescue service will depend on the radio service in the areas where cell coverage is scarce.
2. Fire Hall 2 is a much larger asset housed in a public safety complex. It still has a strong dependency on electricity and natural gas. It also relies on a good sized diesel generator for standby power.

**Results:**

When you have completed this task, you will have identified key dependencies and the strength of each of these dependencies on the “CI Criticality Data Collection Form” (Appendix D).

## TASK 4: EXPOSURE ASSESSMENT

This section is applicable specifically for assessment of exposures against freshet hazard.

### TASK OBJECTIVE

Tasks 1 through 3 were directed at producing the CI Criticality Rating which indicates the importance of the CI asset to the community or region. Task 4 takes you into the area of identifying the level of exposure the asset has against the current hazards/threats. The exposure measures will give an indication of the likelihood of the asset being affected by the hazard/threat under consideration.

This Workbook deals specifically on the exposures from the freshet hazard/threat and the owner will focus on two exposure factors: location and asset design. It is the PEP long-term vision to include other exposure types over time.

### PROCESS

#### *Task Strategies:*

The following strategies should be considered when completing this Task. Note that the first four measures are generally static and identified only by the asset owners. The last measure is somewhat dynamic and will be assessed by PEP.

- The five potential areas of exposure measures are:
  1. **Location Criteria** of the asset relative to the hazards/threats being evaluated against (e.g., which part is in the floodplain). If the asset is in a 1/200 year floodplain, it is more likely to be affected by the freshet.
  2. Effectiveness of the **Preventive/Defensive Measures** (e.g., dike protection): if the asset is surrounded by a good dike system that can withstand a 1/200 year flood, the probability is low that the asset is impacted by the freshet.
  3. **Asset Design Characteristics** present (e.g., asset design against water damage such as raised floors or basements). If the asset is constructed in such a way that it can withstand the rising water, it is unlikely to be affected.
  4. **Other Exposures** which may cause the CI asset to perform at a reduced capacity or not at all
  5. **Snow Pack and Melt Predictions** for the watershed (e.g., the Basin Snow Water Index) and the floodplain. If the asset is in the watershed and a particular floodplain where the snow melt predictions indicate a good likelihood of flooding, the probability is deemed high.
- Actual assessments may not fit precisely within a defined level. If in doubt, pick the category which will give the most exposure (err on the more serious rating side). For



example, if the assessment for the Location factor is on the borderline between the 1/200 year floodplain and outside, pick the one “in the 1/200 year floodplain”.

**Required Information:**

The following documents/information should be referenced for completing Task 4:

- The location of the asset relative to the floodplain maps (from the Tool Kit CD).
- The location of the asset relative to the protective dikes (from the Tool Kit CD)
- Structural/design characteristics of the asset.
- Any other freshet related exposures that you are strongly concerned about.

**Procedure:**

**Step 1: Location**

Look up the table below and enter the rating most representative of the asset location in the column titled “Location relative to the 1/200 year floodplain”.

Location Criteria	Rating
Base of asset is located below 1:200 year projected flood level in an area susceptible to flooding and has experienced flooding since 1972.	High
Base of asset is located below 1:200 year projected flood level in an area susceptible to flooding, but has not experienced flooding since 1972	Medium
Base of asset is in an area susceptible to flooding but is located above the 1:200 year projected flood level	Low

**Step 2: Preventive/Defensive Measures - Dike Protection**

Look up the table below and enter the rating most representative of the dike protection your asset has:

Dike Protection	Rating
The location of the asset has no protection with dike system	High
The location of the asset is protected by a non-standard dike system*	Medium
The location is protected by a standard dike system*	Low

(Note: \* As defined by the Office of the Inspector of Dikes, Ministry of Environment, BC)

### Step 3: Asset Design

Look up the table below and enter the rating most representative of the asset design in the column titled "Design Characteristics of the Asset".

Asset Design Characteristics	Rating
Current design and condition of the asset are such that the function of the asset could be totally compromised by flooding	High
Current design and condition of the asset are such that the function of the asset would be significantly compromised by flooding	Medium
Current design and condition of the asset are such that the function of the asset would not be compromised by flooding	Low

### Step 4: Other Exposures

If there is any other major exposures, from the freshet, for the asset beyond the location, dike protection and the design factors, indicate such under the column "Other Exposures". Enter the description of the exposure under "Other Exposures - Description" and associated rating from the drop-down list under 'Rating'. If there are no other exposures, enter 'None' under description and pick 'N/A' for rating.

Other Freshet Exposures	Rating
High probability that the exposure described will occur at the asset during the freshet	High
Medium probability that the exposure described will occur at the asset during the freshet	Medium
Low probability that the exposure described will occur at the asset during the freshet	Low
Not applicable (since no other exposures identified)	N/A

**Sample:** Below are sample ratings of the CI assets for two industries and a municipality.

**Electricity Industry – Substation Rating:**

- “Medium” for the Location factor, since it is in a 1/200 floodplain, but has not experienced flooding.
- “Medium” for the Dike Protection, since it is behind a non-standard dike.
- “High” for the Design factor, since an inundation of more than 30 cm would make the substation inoperable.
- “None” for Other Exposures since there are no other critical exposures.

**Highways & Transportation – Water Crossing Rating:**

- “Medium” for the Location factor, since it is in a 1/200 floodplain, but has not experienced flooding.
- “Low” for the Dike Protection”, since its approaches are both behind standard dikes.
- “Low” for the Design factor, since the bridge is designed to withstand 1/200 year flood.
- “River Debris” for Other Exposures, since with the high water flow, there is likely a large volume of debris accumulating against the bridge footing.

**Municipal – Fire Hall Rating:**

- “High” for the Location factor, since it is in a 1/200 floodplain and has experienced flooding in 1972.
- “High” for the Dike Protection, since it has no dikes protecting the asset.
- “Medium” for the Design factor since the fire hall could still operate from an alternate location, even if at a reduced functional level.
- “None” for Other Exposures since there are no other critical exposures.

**Results:**

When you have completed this task, you should have three (four if you had “Other Exposures”) columns under exposures completed on the CI Criticality Data Collection Sheet. Appendix E has an example of the CI Criticality Data Collection Sheet completed for two industries and a municipality.

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## TASK 5: SUBMISSION AND CONSULTATION

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### TASK OBJECTIVE

You may contact PEP Critical Infrastructure Coordinator at any point in the above process, and they will be able to assist you with the methodology and any related questions.

At minimum, though, when you have completed the Tasks 1 to 4, you are asked to submit the completed CI Criticality Data Collection Sheet (or the EXCEL spreadsheet) to the PEP CI Coordinator for review. The review process will ensure that the results of the methodology are applied consistently and comparably across the industries and the geographic area which is being assessed.

### PROCESS

#### *Task Strategies:*

The following strategies and points should be considered when completing this Task:

- Identification of critical dependency by your CI service “receiver” may change the Criticality Rating of the service “provider”.
- It is recommended that the dependency identification and ratings should be reviewed by a peer group of service receivers.
- The Total Score (the CI Rating) for an asset may be used to determine levels of criticality (at a municipal, regional, provincial, and national level). The greater value is in the comparisons of these numbers. Hence the consistency of the application of the scoring is important.

#### *Required Information:*

The following documents should be referenced for completing Task 5:

- The completed CI Criticality Data Collection Sheet.

#### *Procedure:*

**Step 1:** Submit the draft CI Criticality Data Collection Sheet (or the Excel spreadsheet) to PEP securely. This could be done by faxing, e-mailing with an encoded attachment, sending an encoded CD, personal delivery, etc.

**Step 2:** The PEP CI Coordinator will schedule a review session. This could be accomplished either over the phone, or by a conference call (using such methods as Microsoft Live Meeting) or if preferred, meeting in person.

**Step 3:** You may wish to adjust your rating and submission based on what comes out of the review session. Remember that the rating is considered dynamic since your rating could be affected by your downstream dependency factor (your customers' critical needs) which may be outside of your control.

**Step 4:** When you are satisfied with the rating, re-submit the adjusted CI Criticality Data Collection Form to PEP.

**Step 5:** PEP will assign ranking within the Geographic area based on the rating and resubmit to you for review. You will be given an opportunity to discuss this ranking with PEP.

***Results:***

When you have completed this task, a reviewed version of the CI Criticality Data Collection Sheet will have been submitted and ranked by PEP.

**END OF THE RATING PROCESS**

Thank you for following these instructions to the last step!

## APPENDIX A: DEFINITION OF TERMS

Term	Definition
<b>Co-Location</b>	Facilities located in the same physical structure or locale. These could be at risk when the host structure or location is threatened by hazards and threats.
<b>Consequence of Loss</b>	The consequence of losing the asset being evaluated. This is estimated based on Maximum Credible Damage basis (see below for its definition).
<b>Critical Infrastructure Asset (CI)</b>	Those physical resources; services; and information technology facilities, networks and assets which, if disrupted or destroyed, would have a serious impact on the operation of an organization, sector, region or government.
<b>CI Sector</b>	<p>A part or division of infrastructure that is deemed critical under the federal (Public Safety Canada) definition. The 10 nationally defined CI Sectors are:</p> <ol style="list-style-type: none"> <li>1) Energy and Utilities</li> <li>2) Communications and Information Technology</li> <li>3) Manufacturing</li> <li>4) Finance</li> <li>5) Health Care</li> <li>6) Food</li> <li>7) Water</li> <li>8) Transportation</li> <li>9) Safety</li> <li>10) Government</li> </ol>
<b>Dependency</b>	<p>External resource or action by which the ability of the Critical Infrastructure service provider is to provide that service immediately, directly and measurably affected.</p> <p>Definition of <b>“External”</b>: not directly under the control of the service provider. For example, a trucking company who brings in the critical supplies to your plant.</p> <p>Definition of <b>“Internal”</b>: directly under the control of the service provider. For example, engineering staff allocations to critical operations. It should be noted that ‘internal’ dependencies are captured within the organization under review and assessed internally.</p> <p>Definition of <b>“Immediate”</b>: from a few milliseconds to up to 72 hours</p> <p>Definition of <b>“Direct”</b>: without going through other resources or dependencies.</p>

Term	Definition
<p><b>Dependency (...continued)</b></p>	<p>Definition of <b>“Primary”</b>: dependency under normal operations.</p> <p>Definition of <b>“Secondary”</b>: dependency under an emergency/ recovery situation</p> <p>Definition of <b>“Strength”</b>: see the “Degree of Dependencies” below</p> <p><b>Debilitating</b>: Asset A has a “debilitating” dependence on service B in the situation that if service B fails, the service or function of asset A cannot be performed or is not available.</p> <p><b>Strong</b>: Asset A has a “strong” dependence on service B in the situation that if service B fails, the service or function of asset A will experience noticeable delays, degradation and/or a reduction in service.</p> <p><b>Weak</b>: Infrastructure A has low dependence on infrastructure B in that if infrastructure B fails, the service or function of infrastructure A will experience minor disruptions in service. This could be due to the ready availability of substitute products or services.</p> <p>Definition of <b>“Hazard Dependency”</b>: A collocated asset belonging to others which can potentially cause harm to your asset. (Note that this is different from simple ‘Hazards’ definition below)</p> <p>Definition of <b>“Upstream Dependencies”</b>: Resources or actions that are required to produce the CI service.</p> <p>For example,</p> <ul style="list-style-type: none"> <li>• For a banking sector, ATM machines requiring both electricity and telecommunications networks</li> <li>• For a poultry processing plant needing water supply</li> <li>• A thermal generating station requiring natural gas, bunker oil or coal supply</li> </ul>

Term	Definition
	<p>Definition of “<b>Downstream Dependencies</b>”: Those organizations who receive the services of the service provider.</p> <p>For example,</p> <ul style="list-style-type: none"> <li>• Hospital depending on telecommunications and electricity</li> <li>• Steele depending upon natural gas for its foundry</li> <li>• Brewery depending on the delivery of city water</li> </ul>
<b>Exposures</b>	Weaknesses, if exploited by threats or exposed by natural hazards that can cause the asset owners to miss their organizational objectives.
<b>Geographic Area</b>	An area to be defined by the body collecting the data (such as PEP).
<b>Granularity of Identification</b>	Assets are identified on a per location basis, and not at the equipment level. For example, an electric utility may identify a generating station. That generating station may have several key components such as 4 units of generators, step-up transformers, a control building, a shop, a switch yard, 4 penstocks, and a spillway. All of these station components should be identified under a single CI asset for the purposes of this workbook.
<b>Hazards</b>	A source of potential harm. (Source: AS/NZS 4360:2004 on Risk Management)
<b>Infrastructure</b>	The framework of interdependent networks and systems comprising identifiable industries, institutions (including people and procedures) and distribution capabilities that provide a reliable flow of products and services, the smooth functioning of governments at all levels, and society as a whole.
<b>JELC</b>	Joint Emergency Liaison Committee (JELC), a partnership between Local Governments in the Lower Mainland and the Province of British Columbia that uses a cooperative and collaborative model to focus on cross-jurisdictional emergency planning and preparedness through establishment of task focused working groups.
<b>Maximum Credible Damage</b>	The maximum amount of damage reasonably expected to occur to an asset and impacts to its services, under the hazards listed in the Hazards/Threat lists.
<b>Owner</b>	The name of the organization who owns the asset.



<b>Operator</b>	The name of the organization that operates the asset for the owner. Sometimes, the owner and operators are different for a single asset.
<b>PEP</b>	Provincial Emergency Program office of the BC Government
<b>Risk</b>	<p>The chance of something happening that will have an impact on objectives.</p> <p>Notes:</p> <ol style="list-style-type: none"><li>1: A risk is often specified in terms of an event or circumstance and the consequences that may flow from it.</li><li>2: Risk is measured in terms of a combination of the consequences of an event and their likelihood.</li><li>3: Risk may have a positive or negative impact.</li></ol> <p>(Source: AS/NZS 4360:2004 on Risk Management)</p>
<b>Threats</b>	A subset of hazards that is man-made and intentional.

## APPENDIX B: HAZARDS/THREAT LISTS

Users of these lists are reminded that these are representative samples of hazards and threats and not an all inclusive list. Each industry sector may supplement this list with its unique hazards and threats.

### NATURAL HAZARDS

Event	Threat Types
1. Weather	
1.1	Floods
1.2	Wind Storms
1.3	Snow Storms
1.4	Ice Storms/Freezing Rain
1.5	Lightning
1.6	Hail Storms
1.7	Magnetic Storms
1.8	Cold Temperatures
1.9	Tornados
1.10	Avalanches
1.11	Heat Wave
2. Geotectonic	
2.1	Earthquake
2.2	Tsunami
2.3	Volcanic Eruption - Ash
2.4	Volcanic Eruption – Lava
3. Other Geological Events	
3.1	Landslides
3.2	Ground Subsidence
3.3	Debris Flows
3.4	River Bank/Bottom Scouring
4. Health	
4.1	Pandemic Disease

**INTENTIONAL THREATS - PHYSICAL**

Event	Threat Types
1. Explosives:	
1.1	Vehicle Bombs (Vehicle Borne IED)
1.2	Placed Bombs (Improvised Explosive Devices)
1.3	Suicide Bombs
1.4	Rocket Propelled Grenades
1.5	Shoulder Launched Missiles
2. Incendiary Devices:	
2.1	Arson
2.2	Molotov Cocktails
2.3	Small Aircraft/Vehicle loaded w/Fuel
2.4	Gasoline Tanker
2.5	Commercial Aircraft
2.6	Thermite Bomb
3. Chemical, Biological & Radiological:	
3.1	Botulism, Anthrax
3.2	Toxins (e.g., Ricin)
3.3	Poison Gases (e.g., Sarin)
3.4	Release of On-site Chemicals
3.5	Dirty Bombs
4. Physical Assault:	
4.1	Earth Moving Equipment
4.2	Sabotage
4.3	Unauthorized Operations
4.4	Stealth Intrusion/Sabotage
4.5	Blocked Access to Facilities
4.6	Small Arms - Rifles/Handguns
5. Electromagnetic Assault:	
5.1	High altitude Electro Magnetic Pulses (HEMP)
5.2	Radio Frequency (RF) Guns
5.3	Carbon Fibre, Aluminum Foils
6. Abduction, Kidnapping & Extortion:	
6.1	Abduction of Key Personnel
6.2	Extortion

**INTENTIONAL THREATS - CYBER**

Event	Threat Types
1. Malicious Codes:	
1.1	Viruses
1.2	Worms
1.3	Trojans
1.4	Spy Ware
1.5	Time Bomb
2. Denial of Service:	
2.1	DOS
2.2	DDOS
2.3	Incapacitating DNS Servers
3. Hackers:	
3.1	Data modification/deletion
3.2	Unauthorized Use & Access
3.3	WEB defacing
3.4	Unauthorized execution of arbitrary program codes
4. Stolen Equipment and Parts:	
4.1	Stolen Laptops
4.2	Stolen Hardware
4.3	Unauthorized Operations
4.4	Stealth Intrusion/Sabotage
4.5	Stolen backup tapes
5. Physical Damage or Access:	
5.1	De-gaussing storage media
5.2	Magnets on processors
5.3	Cut network cables
5.4	Unauthorized physical access
6. Transaction Hi-jacking , Spoofing, snooping:	
6.1	Spoofing
6.2	High jacking
6.3	Snooping
7. Phishing:	
7.1	Social engineering
7.2	WEB site hijacking/surveillance
7.3	Identity Theft via Key Stroke Tracking
7.4	Social Engineering for accessing sensitive data

Event	Threat Types
8. SPAM:	
8.1	SPAM Volume
8.2	SPAM with malicious payloads
9. Network Snooping:	
9.1	Unauthorized planting of agents
9.2	Modifications to Routers
9.3	Unauthorized access to wireless access points (hotspots)
9.4	Unauthorized use of wireless devices
10. Equipment Failure or Mis-Operation:	
10.1	Equipment breakdown
10.2	Equipment mis-operation
11. Power Failure:	
11.1	Lack of alternate power source
11.2	Lack of UPS protection
12. Breakdown in Security Management/Control:	
12.1	Access Control Admin
12.2	Change Management
12.3	Version and Release Control
12.4	Delay in Patch Management
12.5	Source Code Protection
12.6	Executables Protection
12.7	Production Control Protection
12.8	Policy Non-Compliance
12.9	Regulatory Non-Compliance
12.10	Loose Definition of Roles/Responsibilities

**UNINTENTIONAL - MAN-MADE**

Event	Threat Types
1. Equipment Failure or Material Fatigue:	
1.1	Critical Equipment Failure
1.2	Equipment Mis-operation
1.3	Equipment Fire/Explosion
1.4	Chemical Release
2. Operator Errors:	
2.1	Human Error
2.2	Judgment Error

Event	Threat Types
3. Accidents:	
3.1	MVAs
3.2	Suicide attempts
3.3	Fire in Adjacent Building
3.4	Animals
4. Defective products:	
4.1	Software Logic Error

## APPENDIX C: CI ASSET CLASSES BY INDUSTRY

Industry	Class
<b>Electric</b>	Reservoirs and Dams
	Generating Stations
	Transmission Lines
	Control Centres
	Substations
	Distribution Feeder Lines
	Material and Equipment Yards
	Pole Yards
	SCADA
<b>Natural Gas</b>	Wellheads
	Processing Plants
	Transmission Pipeline:
	<ul style="list-style-type: none"> <li>• Bulk Transmission Lines</li> <li>• Compression/De-compression Stations</li> </ul>
	Regulator Stations
	Gate Stations
	Gas Control Centres
	Storage Facilities
	Distribution Facilities
	Materials Yards and Equipment
	Telecommunications Facilities
	<ul style="list-style-type: none"> <li>• Micro Wave Systems</li> <li>• Optical Fibre</li> <li>• Radio, etc.</li> </ul>
	Pump Stations
	SCADA
<b>Oil &amp; Gas</b>	Wellheads
	Processing Plants
	Transmission Lines
	Terminals
	Refineries
	Storage Facilities
	Distribution Centres
	Retail Outlets
	SCADA
<b>Liquid Propane Gas</b>	Bulk Distribution Centres
	Distribution Retailers
	Residential and Industrial Tanks

Industry	Class
<b>Liquid Propane Gas</b>	Storage
	Bulk Distribution Centres
	Distribution Retailers
	Residential and Industrial Tanks (too many to inventory)
<b>Drinking Water</b>	Lakes and Reservoirs
	Bulk Transmission Lines and Hubs
	Filtration and Treatment Plants (Primary and Secondary)
	Pumping Stations
	Operations Centre
	Chemical Storage
	SCADA
	Valve Vaults/Chambers
	Pressure Reducers
<b>Waste Water Treatment</b>	Sewer Pipes
	Treatment Plants
	Effluent Holding Ponds
<b>Solid Waste Incineration Plant</b>	
<b>Telecommunications</b>	Transmission Conduit
	• Cable
	• Fibre
	• Microwave
	• UHF/VHF
	• Satellite
	• Others
	Switching Stations
	Repeater/Cell Towers
	Network Control/Operations Centre
	Crew Headquarters
	Materials and Equipment Yards



Industry	Class
<b>Highways and Roads</b>	Highways
	Roads
	River Crossings
	<ul style="list-style-type: none"> <li>• Bridges</li> </ul>
	<ul style="list-style-type: none"> <li>• Tunnel</li> </ul>
	Overpass/Underpass
	Retaining Walls
	Provincial Highways Condition Centre (PHCC)
	Traffic Signals
	Materials Yards
	Service Vehicle Garage
	Weigh Stations
<b>Passenger Transport</b>	Substations – Rectifier
	Fuel Depots
	Bridges and Tunnels
	Skytrain Control Centre
	Stations, Terminals and Transit Centres
	Bus Loops and Exchanges
	Ferries
<b>Government: Municipality</b>	Municipal Halls
	Fire Halls
	Police Headquarters
	Community and Recreation Centres
	Emergency Operations Centre
	Municipal Water Distribution Systems
	Water Reservoirs
	Telephone Systems
	Road Systems including under/overpasses
	Dikes
	Pumping Stations
	Weather Stations



**APPENDIX E  
CI CRITICALITY DATA COLLECTION SHEET (EXAMPLES)**

Defined Geographic Area:

Rank in Defined Geographic Area (completed by PEP)	CI Asset	Owner	Operator	Contact	Sector	IMPACT FACTORS - Consequence of Loss - Normal Context							DEPENDENCIES					EXPOSURES				
						Population Impact	Economic Impact	Impact on Own Sector	Impact on Other Sectors	Service Impact	Public Confidence Impact	Total Score	Energy		Comms	Other		Characteristics of Environment - Location Criteria	Flood	Other Exposures		
													Electricity	Natural Gas	Telephone	Description	Coding			Description	Rating	
	Substation	Electric Company B	Electric Company A	John Doe 604 943 1009 john.doe@eleccob.com	Energy and Utilities	0.1	3	1	3	5	3	15.1	None	None	sd	Helicopter	SD	Medium	Medium	High	None	N/A
	Generating Station	Electric Company A	Electric Company A	John Brown 604 663 1234 john.brown@genco.com	Energy and Utilities	3	3	1	2	15	5	29.0	None	None	sd	Helicopter	SD	High	High	Low	None	N/A
	Tunnel 1	Ministry A	Contractor B	Jane Doe 604 582 2911 jane.doe@gov.bc.ca	Transportation	3	5	3	5	15	5	36.0	PD	None	sd	Diesel Generator	SD	Medium	Low	Low	None	N/A
	Bridge 1	Ministry A	Contractor C	Jane Doe 604 582 2911 jane.doe@gov.bc.ca	Transportation	0.5	5	5	5	5	5	25.5	None	sdh	sd	Specialist	SD	Medium	Low	Low	River Debris	Medium
	Fire Hall 1	Municipality A	Municipality A	James Dodge 604 250 1121 james_dodge@city-A.bc.ca	Government	0.1	0.1	0.5	1	1	1	3.7	PD	sd	PD	Radio	SD	High	High	Medium	None	N/A
	Fire Hall 2	Municipality B	Municipality B	John Brown 604 270 1121 jbrown@muniB.bc.ca	Government	3	1	3	1	1	1	10.0	pd	pd	PD	Diesel	SD	High	High	Medium	None	N/A

## APPENDIX F – CI SECTOR TABLE

These are divisions of infrastructure that is deemed critical under the federal (Public Safety and Emergency Preparedness Canada, which is the predecessor to Public Safety Canada) definition. The 10 nationally defined CI Sectors are:

CI Sector	Representative Industries
Energy and Utilities	Electricity, Natural Gas, Oil & Gas, Propane, Steam
Communications and Information Technology	Telephone (landline, wireless, satellite), radio, TV, software, hardware
Manufacturing	Petrochemical, Defence, Wood, Concrete, Metal, Shipbuilding
Finance	Banks, Credit Unions, ATM operators, Insurance
Health Care	Hospitals, Clinics, Urgent Care Centres, Blood Services
Food	Food producers, processors, wholesalers, distributors
Water	Potable Water, non-potable water, Sewage Water, Solid Waste
Transportation	Highways and Roads, Waterways, Air, Rail
Safety	Police, Fire, Ambulance, Prisons, HAZMAT, Search and Rescue
Government	Federal, Provincial, Regional, Municipal

## APPENDIX G – CI CONSEQUENCE OF LOSS RATING TABLE

JELC Critical Infrastructure - Consequence of Loss Criteria – Lower Mainland Region of British Columbia

Impact Factor	Severe	Very High	High	Medium	Low	Very Low
Score	15	5	3	1	0.5	0.1
<b>Population Impact</b> <ul style="list-style-type: none"> <li>Estimate number of possible fatalities, serious injuries or people evacuated due to loss of asset being ranked</li> <li>Do not include people inconvenienced</li> <li>Consider maximum credible damage only</li> </ul>	Greater than 10,000 people	Between 1,000 and 10,000 people	Between 100 and 1000 people	Between 50 and 100 people	Between 4 and 50 people	Less than 4 people
<b>Economic Impact</b> <ul style="list-style-type: none"> <li>Estimate cost to restore the asset to a functional state</li> <li>Consider alternate solutions if less costly</li> </ul>	Direct damage and restoration > \$1 billion	Direct damage and restoration \$100 million to \$1 billion	Direct damage and restoration \$10 to \$100 million	Direct damage and restoration \$5 to \$10 million	Direct damage and restoration \$1 to \$5 million	Direct damage and restoration under \$1 million
<b>Impact on Own Sector</b> <ul style="list-style-type: none"> <li>Estimate effect of loss of the asset on the sector in which asset resides (i.e. Transportation)</li> <li>Consider redundancies, alternate suppliers if available</li> </ul>	Sector may shut down nationally or debilitating impact internationally	Debilitating impact on sector nationally	Debilitating impact on sector provincially or regionally	Debilitating impact on sector municipally <b>Or</b> Significant impact on sector provincially or regionally	Significant impact on sector municipally	Moderate impact on sector municipally
<b>Impact on Other Sectors</b> <ul style="list-style-type: none"> <li>Estimate effect of loss of the asset on the other sectors (not the one in which asset resides)</li> <li>Consider redundancies, alternate suppliers if available</li> </ul>	Debilitating impact on other sectors nationally	Debilitating impact on other sectors provincially or regionally	Debilitating impact on other sectors municipally <b>Or</b> Significant impact on other sectors provincially or regionally	Significant impact on other sectors municipally	Moderate impact on other sectors municipally	Minor impact on important missions of other sectors (municipally)
<b>Service Impact</b> <ul style="list-style-type: none"> <li>Estimate the time to repair or replace the asset</li> <li>Consider maximum credible damage only</li> </ul>	High cross-sectoral cost, recovery time longer than one year (years)	High cost, long recovery time (months -- year)	Medium cost, significant recovery time (days -- weeks)	Low cost, brief recovery time (hours -- days)	No Rating below 1	No Rating below 1
<b>Public Confidence Impact</b> <ul style="list-style-type: none"> <li>Estimate the effect of the loss of the asset on public confidence in the ability of the relevant government to preserve public health and safety, economic security, or to assure the provision of essential services.</li> </ul>	High National risk & ability to control in doubt	Perceived high National risk & low ability to control risk <b>Or</b> High Provincial or Regional risk & ability to control in doubt	Perceived high Provincial or Regional risk & low ability to control risk <b>Or</b> High Municipal risk & ability to control in doubt	Perceived high Municipal risk & low ability to control risk	Perceived moderate Municipal risk & moderate ability to control risk	Perceived low Municipal risk & high ability to control risk