

*Q850 DOCUMENTATION REPORT*

**MANAGEMENT REVIEW OF VICTORIA HARBOUR  
NAVIGATION ACTIVITIES**

*Prepared for:*  
**TRANSPORT CANADA**

Prepared by:  
R.A. Malatest & Associates Ltd.  
*3<sup>d</sup> Floor, 910 View Street*  
*Victoria, BC*  
*V8V 3L5*

And  
GeoInfo Solutions Ltd.  
TEXTPILOT – Aviation Safety Consultants  
AXYS Environmental Consulting Ltd.

*Phone: (250) 384-2770*  
*Fax: (250) 384-2774*

*Date: August 2002*

## Table of Contents

<b>SECTION 1: INTRODUCTION.....</b>	<b>4</b>
1.1 Methodology.....	4
1.2 Objective of the Risk Management Process.....	4
1.3. Scope .....	5
<b>SECTION 2: DEFINITIONS AND REFERENCE PUBLICATIONS.....</b>	<b>6</b>
2.1 Definitions.....	6
2.2 Reference Publications.....	6
<b>SECTION 3: RISK MANAGEMENT DECISION PROCESS .....</b>	<b>8</b>
3.1 Steps .....	8
3.2 Benefits.....	9
3.3 Decisions .....	9
3.4 Introduction to The Risk Communication Process .....	9
3.4.1 Dialogue.....	9
3.4.2 Mix of Stakeholders.....	10
<b>SECTION 4: INITIATION .....</b>	<b>11</b>
4.1 General.....	11
4.2 Defining the Problem or Opportunity and the Associated Risk Issues .....	11
4.3 The Risk Management Team .....	12
4.4 Identifying Potential Stakeholders .....	12
4.4.1 Definition of Stakeholder .....	12
4.4.2 List of Stakeholders .....	13
4.5 Risk Communication Considerations .....	13
4.6 Documentation Requirements.....	14
<b>SECTION 5: PRELIMINARY ANALYSIS.....</b>	<b>15</b>
5.1 General.....	15
5.2 Defining the Scope of the Decision(S).....	16
5.3 Identifying Hazards Using Risk Scenarios .....	16
5.3.1 Risk Scenarios.....	16
5.3.2 Types of Hazard.....	18
5.3.3 Types of Loss .....	18
5.3.4 Hazard Identification .....	18
5.3.5 Identification of Risk Scenarios.....	19
5.4 Risk Communication Considerations .....	21
<b>SECTION 6: RISK ESTIMATION.....</b>	<b>22</b>
6.1 General.....	22
6.2 Defining Methods for Estimation Frequency And Consequences .....	23
6.2.1 Third-Party Review .....	24
6.2.2 Validation .....	24
6.3 Estimating Frequency of Risk Scenarios .....	25
6.4 Estimating Consequences of Risk Scenarios .....	26
6.4.1 Measuring Consequences .....	26
6.4.2 Presenting Frequency and Consequence Estimates .....	26
6.5 Risk Communication Considerations .....	28

<b>SECTION 7: RISK EVALUATION .....</b>	<b>30</b>
<b>7.1 General.....</b>	<b>30</b>
<b>7.1.1 Estimating Benefit and Cost Considerations .....</b>	<b>30</b>
<b>7.2 Assessing the Acceptability of the Risk to Stakeholders.....</b>	<b>30</b>
<b>7.2.1 General.....</b>	<b>30</b>
<b>7.2.2 Perceptions of Risk .....</b>	<b>31</b>
<b>7.2.2.1 Public Perceptions of Risk.....</b>	<b>31</b>
<b>7.3 Risk Communication Considerations .....</b>	<b>32</b>
<b>SECTION 8: RISK CONTROL AND FINANCING.....</b>	<b>33</b>
<b>8.1 General.....</b>	<b>33</b>
<b>8.2 Identifying Feasible Risk Control Options.....</b>	<b>34</b>
<b>8.3 Evaluating Risk Control Options in Terms of Effectiveness,         Cost and Risks .....</b>	<b>36</b>
<b>8.4 Assessing Stakeholder Acceptance of Proposed Action(s) .....</b>	<b>37</b>
<b>SECTION 9: ACTION .....</b>	<b>38</b>
<b>Appendix A: HRVA Qualitative Risk Ranking Measures</b>	
<b>Appendix B: Aviation Activity Observation Report</b>	
<b>Appendix C: Ranked Risk Scenarios</b>	

## SECTION 1: INTRODUCTION

---

### 1.1 Methodology

The 1999 *System Safety Review* completed by Transport Canada generally followed the Q850 standard and incorporated 'best practice' and Q850 Risk Communication with stakeholders impacted by potential hazards. A Q850 Preliminary Analysis and Risk Estimation activity produced realistic scenarios, a risk profile matrix and a priority group of hazards which were addressed by mitigation measures (i.e., Q850 Risk Control options).

The current study employed the Q850 methodology as well as a Hazard Analysis. The study utilized expert opinion to quantify marine and air hazard probability and consequence information, supported by a review of documentation pertaining to the Victoria Harbour, interviews, surveys and technical focus groups.

### 1.2 Objective of the Risk Management Process

The current study is a follow-up to the Transport Canada System Safety Review that was conducted in 1999. That study identified a number of risk areas that were subsequently addressed by implementing corrective mitigative measures. Some of these measures included certification of the airport, implementing new procedures and amending the Victoria Harbour Traffic Scheme.

The Terms of Reference for the *Management Review of Victoria Harbour Navigation Activities* are outlined in the *Request for Proposals* issued June 13, 2001. The eight objectives of the overall study, as outlined in the original *Request for Proposals*, were:

- a) To assess the effectiveness of the mitigation measures put in place to address safety risks and hazards identified in the 1999 "Report of a System Safety Review";
- b) To identify other, as yet unidentified, safety hazards that may exist in current marine and aviation operations in Victoria Harbour;
- c) To assess the effectiveness of the Transport Canada control framework in place to manage marine and aviation operations in Victoria Harbour;
- d) To assess the impact of aircraft noise and aircraft air pollution on harbour residents;
- e) To assess the adequacy of existing and proposed federal and, if applicable, municipal and provincial, legislation over the control of marine and aviation operations in the harbour;
- f) To assess the appropriateness of marine and aviation activities in relation to existing and proposed municipal land use in and around Victoria Harbour;
- g) To identify the issues involved with federal divestiture of port facilities including future deproclamation of Victoria Harbour and the transfer of the water aerodrome certificate to a local entity;
- h) To recommend additional mitigative measures, where required, including consideration of cost-benefit impacts on affected stakeholders.

The current report is a supplementary report to the main report produced as a result of the Victoria Harbour Management Review (*Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities*). The current report deals with objectives a), b), and h)<sup>1</sup>.

### 1.3 **Scope**

For the purposes of this study, the geographic scope included the Victoria Harbour, including the area bounded by the Johnson Street Bridge to Ogden Point. The study considered risks associated with marine and aviation operations in the harbour, and examined hazard types and control options. Control options included legislation, infrastructure, and operational measures.

---

<sup>1</sup> Objective (g) was subsequently deleted by Transport Canada as deproclamation of the harbour and the transfer of the water airport certificate are not planned in the near future.

## SECTION 2: DEFINITIONS AND REFERENCE PUBLICATIONS

---

### 2.1 Definitions

The following definitions were applied throughout the course of the current project<sup>2</sup>.

DEFINITIONS
<p>A <b>hazard</b> is a source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these.</p>
<p><b>Hazard identification</b> is the process of recognizing that a hazard exists and defining its characteristics. This usually involves defining a risk scenario that describes a chain of events.</p>
<p><b>Risk</b> is defined as “the chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment or other things of value”.</p>
<p><b>Risk analysis</b> is the systematic use of information to identify hazards and to estimate the chance for, and severity of, injury or loss to individuals or populations, property, the environment, or other things of value.</p>
<p><b>Risk control option</b>, risk mitigation measure, risk reduction measure or corrective action is an action intended to reduce the frequency and/or severity of injury or loss, including a decision not to pursue the activity.</p>
<p><b>Risk evaluation</b> is the process by which risks are examined in terms of costs and benefits, and evaluated in terms of acceptability of risk considering the needs, issues, and concerns of stakeholders.</p>
<p><b>Risk perception</b> is the significance assigned to risks by stakeholders. It is part of risk evaluation as it is derived from the stakeholder’s needs, issues, and concerns.</p>

### 2.2 Reference Publications

The following documents were referenced in the risk management study completed for the *Management Review of Victoria Harbour Navigation Activities*:

- CAN/ CSA – Q850-97. *Risk Management: Guideline for Decision-Makers*.
- CSA Standard CAN/CSA-ISO 9004-1-94, *Quality Management and Quality System Elements – Part 1: Guidelines*
- CSA Standard CAN/CSA – Q634-91, *Risk Analysis Requirements and Guidelines*

---

<sup>2</sup> Definitions taken primarily from *Risk Management: Guideline for Decision-Makers* (CAN/ CSA – Q850-97).

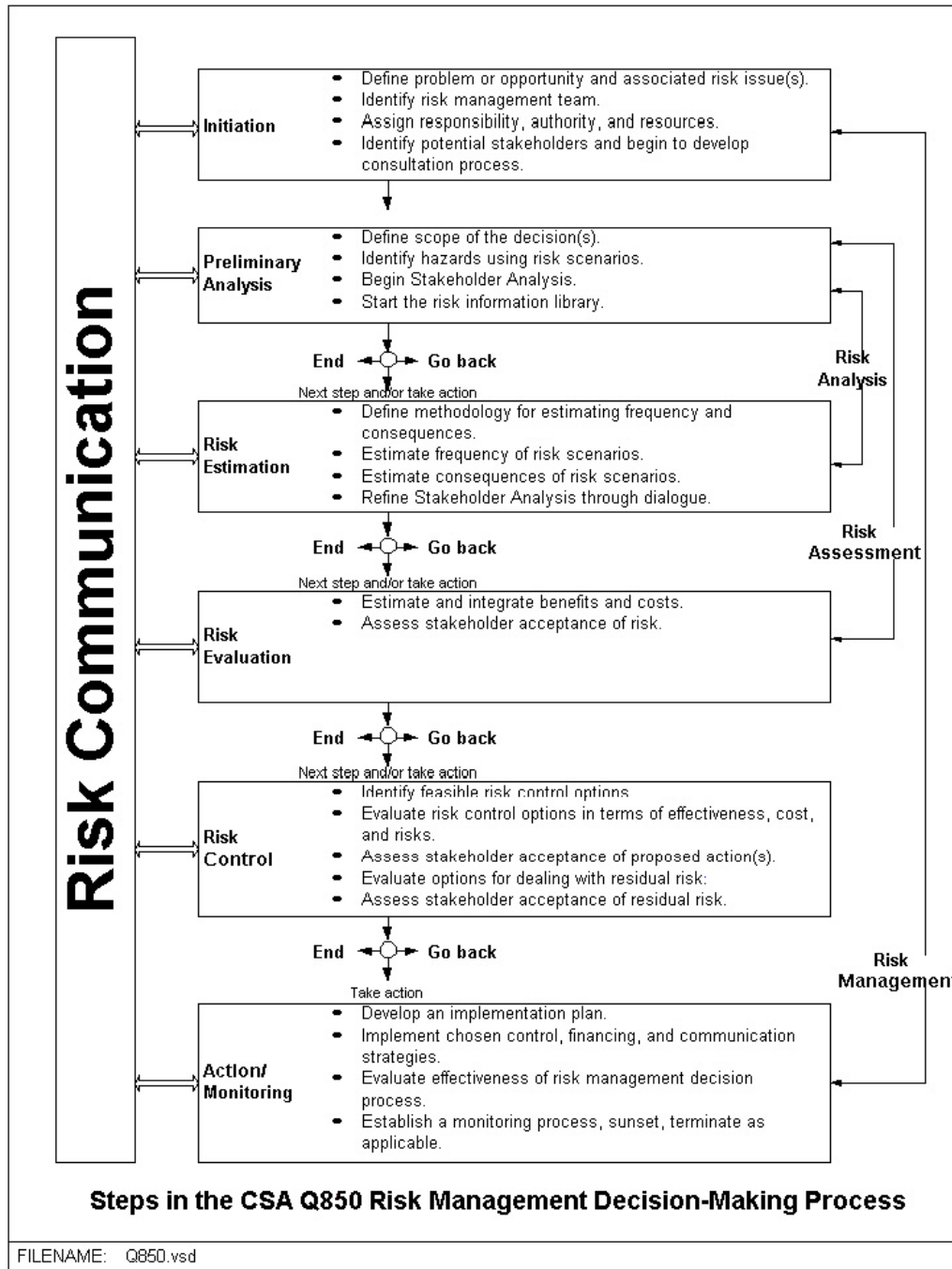
- International Civil Aviation Organization. (1984) *Accident Prevention Manual* (ICAO, Montreal, Quebec, Canada).
- International Civil Aviation Organization. (1998) *Human Factors Training Manual*. (Doc 9683) (ICAO, Montreal, Quebec, Canada)
- International Civil Aviation Organization (1993) *Human Factors Digest No. 7: Investigation of Human Factors in Accidents and Incidents*. (ICAO, Montreal, Quebec, Canada)
- International Civil Aviation Organization. (1993). *Human Factors Digest No. 10: Human Factors, Management and Organization*. (ICAO, Montreal, Quebec, Canada)
- Reason. (1997) *Managing the Risks of Organizational Accidents*. New York: Ashgate.
- Richard H. Wood. (1991) *Aviation Safety Programs: A Management Handbook*. Englewood, Colorado. Jeppesen Sandersen Inc.
- Waring, A., & Glendon, Al., (1998) *Managing Risk*. Toronto. International Thomson Business Press.

A list of documents referenced as part of the current study is provided in Appendix E of the main report (*Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities*).

## SECTION 3: RISK MANAGEMENT DECISION PROCESS

### 3.1 Steps

The steps used as part of a Q850 risk analysis are detailed in the following figure<sup>3</sup>:



<sup>3</sup> Schema from *Risk Management: Guideline for Decision-Makers* (CAN/ CSA – Q850-97).

## **3.2 Benefits**

There are significant benefits to using this decision process to deal with risk issues, including helping decision-makers manage risk. The Q850 is a comprehensive systems approach in which all aspects of risk problem identification are considered when making decisions.

Importantly, this approach to risk management incorporates stakeholder perceptions about the acceptability of risk, allowing decisions to be made based on a consideration of the concerns and interests of diverse stakeholder groups. Q850 also allows for the explicit treatment of uncertainty in its methodology. The Q850 process is a fully documented approach wherein the rationale for decisions can be examined. Finally, Q850 provides standard definitions and terminology, enhancing the ability to communicate effectively about risk issues.

## **3.3 Decisions**

This project is viewed as a continuation of the Q850 process. The project team was tasked with extending and continuing Transport Canada's *1999 System Safety Review* by completing the Q850 Risk Control step pertaining to existing mitigation measures, as well as identifying and evaluating additional opportunities to mitigate risk. This task is normally part of a periodic Q850 Action/Monitoring strategy.

## **3.4 Introduction to the Risk Communication Process**

### **3.4.1 Dialogue**

Risk communication activities were completed as part of each phase of the Risk Management Review. Different key publics were identified and were communicated with at appropriate steps in the Q850 process. Note that it is not appropriate that all key publics be contacted at every step in the Q850 process. The following activities were completed as part of the overall risk communication requirements:

- Ø Identification of potential stakeholders;
- Ø Introduction of the project through a Town Hall meeting (November 19, 2001);
- Ø Completion of 111 stakeholder interviews (November 26, 2001 – March 12, 2002), including interviews with 40 marine representatives and 13 aviation representatives;
- Ø Survey with 473 residents and 208 businesses, including those both in the Greater Victoria area as well as those in the Victoria Harbour vicinity;
- Ø Review of written submissions by stakeholders;
- Ø Completion of two safety technical focus groups (marine representatives / aviation representatives);
- Ø Multiple meetings with various groups such as the Greater Victoria Marine Air Safety Society and Transport Canada Civil Aviation;

- Ø Round Table meeting to present draft results (February 20, 2002) to community representatives, including representatives from resident groups, City of Victoria, Tourism Victoria, Greater Victoria Chamber of Commerce, aviation and marine operators, NAV CANADA and Transport Canada;
- Ø Resident meeting to present draft results of the study (March 21, 2002); and,
- Ø Communication of study findings through an Open House (April 11, 2002) and Town Hall meeting (April 11, 2002).

### 3.4.2 Mix of Stakeholders

The list of stakeholders that were interviewed as part of the current study is provided in Appendix A of the main report (*Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities*). Interviews with 111 individuals were conducted between November 26, 2001 and March 12, 2002. Specifically, the interviews were completed with the following groups:

<b>Stakeholder Group</b>	<b>Number of Interviews completed</b>
Residents <sup>4</sup>	28
Marine	40
Federal Government	10
Municipal, Community or Environmental Representatives	20
Aviation	13
<b>Total</b>	<b>111</b>

---

<sup>4</sup> Individual residents were interviewed, in addition to the 473 telephone interviews or surveys that were completed with Greater Victoria and Harbour Area residents.

## SECTION 4: INITIATION

### 4.1 General

The process associated with the Initiation Phase of the Q850 process is outlined below:

<b>Q850 Checklist for Step 1: Initiate the Process</b>		
<b>Process</b>	<b>Documents</b>	
<b>1. Name the emerging hazard</b>	Have I documented the emerging hazard?	Transport Canada 1999 System Safety Review, RFP
<b>2. Identify the risk</b>	Have I documented the risk involved with the emerging hazard?	Transport Canada 1999 System Safety Review, RFP
<b>3. Identify associated risk issues</b>	Have I documented the issues connected to the risk?	Transport Canada 1999 System Safety Review, RFP
<b>4. Select the Risk Management Team</b>	Have I documented the selection of the Risk Management Team members and leader?	Transport Canada, as a result of the RFP
<b>5. Assign accountability, authority and resources</b>	Have I documented roles, accountabilities and resources?	Project team. Management Proposal
<b>Stakeholder communications strategy</b>	Have I documented the identification of potential stakeholders and the process of consultation?	Appendix A of main report, Management Proposal
<b>Other requirements</b>	Have I filled out any other forms, official or not, at this stage?	n/a

### 4.2 Defining The Problem Or Opportunity And The Associated Risk Issues

Initiation of a Risk Management process may occur for a number of reasons. The current project is a periodic review supportive of Transport Canada's on-going mandate to ensure the safety of the Victoria Harbour. *The Management Review of Victoria Harbour Navigation Activities Request for Proposal* issued June 13, 2001 stated that "increasing aircraft and marine traffic, and the growth of residential neighborhoods near the harbour, have led to a number of social, legal, economic and safety issues as expressed by residents, mariners, aviator, business organizations and civic authorities." The combined growth of aircraft, marine and residential uses along the Victoria Harbour, as well as the often conflicting views on marine and aviation operations in the harbour, also provided impetus for the current study.

### **4.3 The Risk Management Team**

The risk management consulting team assembled for the current project includes over six<sup>5</sup> experienced marine and aviation representatives. These key project team members are described below:

*Mr. Brad Judson, MA, Master Foreign-going, Marine Traffic Risk Specialist  
GeoInfo Solutions Ltd.*

*Mr. John Pottinger, aviation safety specialist, over one hundred investigations of accidents and incidents over twenty-five years.*

*Mr. Tom Storey, former Regional Manager for the Pacific Region with the Canadian Transportation Safety Board*

*Captain Alec J. Provan, Master Foreign-going Steamship, 20 year career in Canadian Coast Guard (managed Canadian Coast Guard Base Facility in Victoria, BC)*

*Captain Bart Terwiel, Ship's master, Commercial Seaplane Pilot*

*Major General Scott Eichel (retired), former Commander of Airforce training (Canadian Forces), 8500 hours of flying time*

### **4.4 Identifying Potential Stakeholders**

Stakeholders were identified using a number of mailing lists utilized by Transport Canada, and augmented by stakeholders proposed by the current project team based on research and suggested contacts from initial interviewees. In addition, approximately 6,000 notices were sent to residents in the Victoria Harbour vicinity at the commencement of the Management Review process (Victoria West / Songhees, James Bay, Esquimalt, and downtown Victoria), and advertisements were placed in *Monday Magazine*, *Victoria News*, *Times Colonist*, and *Harbour Views* at the beginning of the Management Review. As a result of these communication activities, numerous stakeholders contacted the research team and asked to be interviewed.

#### **4.4.1 Definition of Stakeholder**

The *CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers* defines a stakeholder as any individual that can affect or may be affected by a decision or activity relating to the risk management study. Stakeholder groups included as part of the current study include, but are not limited to:

- Decision-makers;
- Marine and aviation operators that have a direct interest in the Victoria Harbour;
- Residential groups that live in proximity to harbour operations;

---

<sup>5</sup> Additional TEXTPILOT consultants assisted in the completion of this study, in addition to the list of project team members provided in this report.

- Selected governmental representatives;
- Non-governmental organizations such as environmental and safety organizations in the community;
- Businesses that operate near the Victoria Harbour (non-marine and non-aviation); and,
- Individuals or groups who are interested in the management of the Victoria Harbour, including the Greater Victoria residential and business community.

#### 4.4.2 List Of Stakeholders

As outlined in Section 3.4.2, 111 stakeholders were interviewed as part of the current study. This group included representatives from government, marine and aviation operators, Greater Victoria resident and business groups, and community organizations. The list of stakeholders interviewed as part of the current project is provided in Appendix A of the main report (*Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities*).

### 4.5 Risk Communication Considerations

The project team initiated a dialogue with stakeholders on November 19, 2001. A Town Hall meeting held on November 19, 2001 introduced the risk management team, outlined the process to be used for the analysis and identified the opportunity for participation in the study. Specifically, the following were identified as opportunities for participation in the Management Review:

- Ø Initial consultation, including opportunities for input at the Town Hall;
- Ø Stakeholder interviews. Specifically, individuals not contacted by the project team were invited to contact the team if they were interested in completing an interview;
- Ø Upon completion of the review, opportunities to comment on the draft findings, including Round Table meetings, and an Open House event.

Prior to the Town Hall meeting held in November, 2001, approximately 6,000 notices were sent to individuals in Victoria West / Songhees, James Bay (near Victoria Harbour), downtown Victoria, and Esquimalt (near Victoria Harbour) areas which requested public input. Notices inviting participation in the review were also placed in the following publications:

- Ø *Monday Magazine*;
- Ø *Victoria News*;
- Ø *Times Colonist*;
- Ø *HarbourViews*.

In addition, approximately 130 letters were mailed between October and November, 2001 to identified stakeholders asking them to complete an interview.

#### **4.6 Documentation Requirements**

The documentation requirements were extensive for the current project. Documents reviewed for the current project were compiled and indexed as part of the final deliverable for the *Management Review of Victoria Harbour Navigation Activities*. This indexed list of documents is provided in Appendix E of the main report (*Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities*).

## SECTION 5: PRELIMINARY ANALYSIS

### 5.1 General

Steps associated with the Preliminary Analysis Phase of the Q850 process, as well as corresponding actions taken by the project team, are provided below:

<b>Q850 Checklist for Step 2: Perform Preliminary Analysis</b>		
<b>Process</b>	<b>Documents</b>	
<b>1. Describe the parameters of the risk</b>	Have I documented the scope of the risk?	Described in Section 1 of this document.
<b>2. Develop risk scenarios</b>	Have I documented risk scenarios?	Scenarios were developed based on reviewed documents, input from interviews and input from the risk management team.
<b>3. Establish consequences</b>	Have I documented the consequences of the risk scenarios?	Consequences were documented as part of each hazard scenario
<b>4. Begin Information Library</b>	Have I begun the information library?	Appendix E of report: <i>Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities</i>
<b>Stakeholder communications strategy</b>	Have I documented the profile of the stakeholders and developed a communications strategy?	See List of Stakeholders (Appendix A of <i>Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities</i> ), and current report.
<b>Other requirements</b>	Have I filled out any other forms, official or not, at this stage?	n/a

According to the *CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers*, the preliminary analysis is designed to define the basic dimensions of the risk problem and then to undertake an analysis and evaluation of potential risks. The preliminary analysis may result in a decision that corrective action should be taken immediately. The preliminary analysis may also result in a decision to undertake further analysis, or to end the analysis if it is decided that risk is not a significant issue.

## 5.2 Defining the Scope of the Decision(s)

Defining the scope of the decisions to be made helps to maximize the effectiveness of the study. Definition of the scope should include:

- Ø The activity presenting the opportunity or problem. In this case, the subject of the risk management review is marine / aviation operation in the Victoria Harbour, as defined in Section 1;
- Ø The possible risks associated with the activity, as determined by the risk assessment;
- Ø The decisions that have to be made, and the decision-makers. In this case, the primary decision maker is Transport Canada;
- Ø Stakeholders who might affect or be affected by these decisions (as indicated by the list of stakeholder groups provided in Section 3.4.2); and
- Ø Any assumptions and constraints governing the decisions.

## 5.3 Identifying Hazards Using Risk Scenarios

### 5.3.1 Risk Scenarios

A risk scenario is defined as a sequence of events with an associated frequency and consequence. The sequence of events includes the hazard and the potential consequences this hazard may generate.

The list of risk scenarios identified as part of the Transport Canada *1999 System Safety Review* are included in Table 5-1 below. These risk scenarios formed the initial documented list of hazards that were considered by the project team.

**Table 5-1  
Hazards identified as part of Transport Canada's 1999 System Safety Review**

No.	Hazard	Effect	Probability <sup>6</sup>	Severity <sup>7</sup>
1.1	Conflict between two aircraft in the air	Mid air collision	Remote	Catastrophic
		Collateral damage on ground arising from a mid air collision	Improbable	Catastrophic
1.2	Conflict between an aircraft operating on the water and an aircraft that is taking off or landing	Collision	Remote	Catastrophic
1.3	Conflict between two aircraft operating on the water in the landing or take-off areas or taxiing to or from the dock	Collision	Occasional	Major
2.1	Conflict between two large vessels in the harbour	Collision	Remote	Major
2.2	Conflict between a large vessel and a water taxi	Collision	Remote	Catastrophic

<sup>6</sup> As determined by the *1999 System Safety Review*.

<sup>7</sup> As determined by the *1999 System Safety Review*.

No.	Hazard	Effect	Probability <sup>6</sup>	Severity <sup>7</sup>
2.3	Conflict between a large vessel and a small vessel	Collision	Occasional	Catastrophic
2.4	Conflict between small vessels	Collision	Frequent	Minor
3.1	Conflict between aircraft and large vessels	Collision involving an aircraft that is landing or taking off	Remote	Catastrophic
		Collision involving an aircraft that is taxiing	Remote	Catastrophic
3.2	Conflict between aircraft and small vessels	Collision between a small vessel and an aircraft that is taking off or landing	Occasional	Catastrophic
		Collision between a small vessel and an aircraft that is taking off or landing	Occasional	Catastrophic
		Upset of a small vessel by the propeller wash from an aircraft	Occasional	Minor
3.3	Conflict between aircraft and water taxis	Collision between a water taxi and an aircraft that is landing or taking off	Occasional	Catastrophic
		Collision between a water taxi and an aircraft that is taxiing	Remote	Catastrophic
4.1	Conflict between aircraft and foreshore, docks, wharves, pilings, buoys, markers, moored boats or aircraft etc.	Collision during landing or take off	Remote	Catastrophic
		Collision during taxi	Occasional	Minor
5.1	Conflict between vessels and foreshore, docks, wharves, pilings, buoys, markers, moored boats, or aircraft etc.	Conflict with large vessels	Remote	Catastrophic
		Conflict with water taxis	Remote	Minor
		Conflict with small vessels	Probable	Minor
6.1	Conflict between aircraft and existing or planned land facilities such as streets, bridges, public areas and residential, commercial or government structures	Ground collision involving an aircraft taking off eastbound from or landing westbound in Area A/B	Occasional	Catastrophic
		Ground collision involving an aircraft taking off westbound from or landing eastbound in Area A/B	Remote	Catastrophic
		Ground collision involving an aircraft taking off or landing in Area C	Remote	Catastrophic
		Ground collision involving an aircraft that is in the approach or departure phase of flight and has completed its take off or landing or is not yet in the process of landing. (above 500 feet ASL)	Remote	Catastrophic
		Ground collision involving an aircraft that has been upset by rotor down wash from a large helicopter that is arriving or departing from the heliports at Camel Point or Shoal Point	Improbable	Catastrophic
7.1	Bird Activity	Aircraft bird strike	Occasional	Minor
8.1	Environmental Health Effects of Aircraft Operations	Effect of aircraft noise on the health of area residents	Remote	Minor
		Effect of aircraft pollution on the health of area residents	Remote	Minor

In addition to consideration of this initial list of hazards, the project team completed hazard identification activities (see Section 5.3.4) resulting in a list of 38 hazard scenarios. This list of identified hazards is listed in Table 5-2.

### 5.3.2 Types of Hazard

A variety of hazard types were considered as part of the current study. Hazards were considered if they were related to marine and aviation activities in the Victoria Harbour. Numerous types of natural hazards (such as floods) were therefore not considered as primary areas of concern for the current study. Technical hazards, such as fire or explosion, were considered as well as human hazards, such as human error resulting in an aviation or marine accident, and hazards resulting from terrorism, were all included as part of the current project.

### 5.3.3 Types of Loss

*CAN/CSA-Q850-97 Risk Management: Guideline for Decision Makers* outlines numerous types of loss that can be considered as part of a Q850 Risk Management Review. These include health losses such as death or injury, loss in property value, loss of income, liability loss and environmental loss. While various types of losses were reviewed as part of the current risk management study, health losses were most commonly considered associated with marine or aviation navigation activities.

### 5.3.4 Hazard Identification

*CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers* identifies multiple methodologies for identifying risk scenarios. The current project utilized expert input, structured observations<sup>8</sup>, a review of published and unpublished documentation, and numerous other research activities. Specifically, hazard identification activities completed as part of the current study included:

- Ø A structured review of known sources of hazards or initiating events, based on the preliminary analysis;
- Ø Observation of aircraft and vessel operations in Victoria Harbour (231 hours of observation / over 1,500 movements);
- Ø Review of Transport Canada Surveillance Reports for Victoria Harbour;
- Ø Review of Transportation Safety Board data for Victoria Harbour;
- Ø Review of Transportation Safety Board data for comparable locations;
- Ø Review of Transport Canada files relevant to hazards at Victoria Harbour including:
  - Internal memoranda,
  - Correspondence to and from stakeholders,
  - Compliance and Enforcement data.

---

<sup>8</sup> A report summarizing the findings from the structured observations is provided in Appendix B of this report.

- Ø Examination of regulatory and legislative issues;
- Ø Review of literature from comparable locations in other jurisdictions;
- Ø Review of written submissions;
- Ø Interviews of Victoria Harbour air (13) and marine (40) operators;
- Ø Interviews with other stakeholders (including residents and resident groups); and
- Ø Interviews of NAV CANADA and Transport Canada personnel<sup>9</sup>.

The current project also included the use of technical focus groups to rank order the priority of risk scenarios.

### 5.3.5 Identification of Risk Scenarios

As a result of the data collection and assessment activities outlined in Section 5.3.4, a list of 38 hazard scenarios were created. Table 5-2 identifies each hazard scenario created as a result of the hazard identification phase. Note: the hazards listed in Table 5-2 are NOT sorted in priority order.

**Table 5-2  
38 Hazard Scenarios Resulting from Hazard Identification Activities**

Count	No.	Hazard	Scenario
1	1 a	Collision - aircraft/small vessel	Summer - good weather - taxi holding area inner harbour: aircraft collision with pleasure craft, pleasure craft sinking. 6 fatalities
2	2 a	Collision - aircraft/small vessel	Summer, good weather, take-off runway 25, glare, congestion, rower on runway, collision with aircraft. 5 fatalities
3	2 b	Collision - aircraft/small vessel	Summer, good weather, take-off runway 19, aircraft engine failure. Collision with large pleasure craft in the vicinity of harbour entrance, fire explosion. 11 fatalities
4	3 a	Collision - aircraft/small vessel	Summer, landing runway 25. Glare, wind 270@20, mech turbulence, congestion, boat speeds onto runway, aircraft collides with vessel 12 fatalities
5	3 b	Collision - aircraft/small vessel	Summer, good weather, Landing runway 01, glare, congestion, vessel outbound in VHTS deviates across runway, aircraft collides with vessel. 14 injuries, 4 fatalities
6	3 c	Collision - aircraft/small vessel	Summer, good weather, long landing runway 07, congestion, vessel outbound VHTS deviates, speeds across runway, glare, aircraft collides with vessel. 18 fatalities
7	4 a	Collision - aircraft/small vessel	Winter, poor weather, taxi towards runway 19, dusk, patches of mist, winds SW 10 -15, aircraft collides with speeding rowing scull. 20 fatalities
8	5 a	Collision - aircraft/small vessel	Winter, poor weather, runway 25, near dusk: DH-6 collides with rowing skull and tender, sinking. 18 fatalities
9	6 a	Collision - aircraft/small vessel	Winter - poor weather - landing - runway 25 dawn: DH-6 collides with harbour ferry crossing runway, fire, explosion, sinking, 12 fatalities
10	6 b	Collision - aircraft/small vessel	Winter - poor weather - landing - runway 01 dawn: DH-6 collides with harbour ferry crossing runway, sinking, 12 fatalities
11	7 a	Collision - aircraft/small vessel	Summer, congestion, glare, strobes on, 2 aircraft, first T.O runway 25: harbour ferry crosses runway area , 2nd aircraft, landing, aircraft collides

<sup>9</sup> The complete list of stakeholders who participated in this study is provided in Appendix A of the main report (*Victoria Harbour Management Review: Management Review of Victoria Harbour Navigation Activities*). Stakeholders were identified using a number of methods, including mailing lists established by Transport Canada, individuals that volunteered to be interviewed, research into the background of Victoria Harbour issues and suggested contacts from initial interviews.

Count	No.	Hazard	Scenario
			with ferry. 13 fatalities
12	8 a	Collision - aircraft/Condominium	Aircraft landing runway 07, congestion, vessel deviates VHTS to runway area, glare, aircraft overshoots, banked attitude, stalls and collides into condominium. 25 fatalities
13	8 b	Collision - aircraft/Condominium	Winter, poor weather, landing runway 07, wind 130@25 KTS, short final, wind sheer, overshoot, engine fails, collides with condominiums, 50 fatalities
14	9 a	Collision - aircraft/large vessel	Poor weather, Special VFR, Idg DH-6, runway 07, Winds 135 near aircraft limits. Motor yacht >50M VHTS, vessel deviates onto runway area, collision with vessel. 25 fatalities
15	9 b	Collision - aircraft/large vessel	Winter, poor weather, Special VFR, landing DH-6, runway 25, Tug and Fuel Barge outbound, vis 1 mile, aircraft collides with barge on landing. 6 fatalities
16	10 a	Collision - aircraft/Coho	Poor weather, DHC-2 landing runway 07, DHC-2 landing adjacent outbound Coho, congestion, wind shear, Beaver collides with Coho. 6 fatal, 60 injuries
17	11 a	Collision - Aircraft/Johnson St Bridge	Winter, poor weather, SW wind near aircraft limits, DHC-2, TO runway 07, mechanical turbulence, L turn, stall, spins into Johnson Street bridge. 7 fatal, 10 injuries
18	12 a	Collision - aircraft/aircraft	Poor vis, Special VFR, DHC-2 take off runway 25, wind 235 @ aircraft limits. DHC-2 Takes off, Heli Jet lift off. Two aircraft collide near Ogden Pt. 11 fatalities
19	13 a	Aircraft upset	Area A or B operations - large vessel wake or waves, landing C-185 capsizes, injuries lead to drowning of occupants. 4 fatalities
20	14 a	Fire, on board Cruise ship	Accommodation Fire vessel alongside Ogden Point, night, 50+ fatalities
21	14 b	Fire, on board Cruise ship	Accommodation Fire while vessel is underway within harbour limits, injuries 75,
22	14 c	Fire, on board Factory Trawler	Engine Room fire with bunker barge alongside, 6 fatal, 15 injuries
23	15 a	Collision, Large Vessels	Victoria Clipper and Purse Seiner in vicinity of Shoal Point, ship handling, sinking. 2 fatalities
24	15 b	Collision, Large Vessels	Victoria Clipper and Coho, inner harbour, near Laurel Point. Injuries, vessel damage
25	15 c	Collision, Large Vessels	Cruise Ship and Deep Water Trawler, Ogden Point, 20+ injuries
26	16 a	Collision, Large / Small Vessel	Victoria Clipper and small vessel, Shoal Point, congestion. 10 injuries
27	16 b	Collision, Large / Small Vessel	Coho and Small vessel, Songhees/Laurel Point narrows, congestion, 10 injuries, 2 fatal (fire)
28	17 a	Grounding, large Vessel	Coho, inner harbour, maneuvering, strong westerly, vessel damage, injuries, property damage ashore.
29	17 b	Grounding, large Vessel	Cruise Ship, Ogden Point break water jetty. 6 injuries
30	17 c	Grounding, large Vessel	Coho, Pelly Island/ Sleeper Rock, ship handling error, fire on car deck, 5 fatal, 20 injuries
31	18 a	Collision, Small Vessels	Rowing Skiff and Harbour Ferry, inattention, 10 injuries, 2 fatalities
32	18 b	Collision, Small Vessels	Rowing Skiff and Tug boat, 8 fatal, twilight, 8 fatalities
33	18 c	Collision, Small Vessels	Pleasure craft and Sailing Craft, Shoal Point Fuel Dock, vessel fire spreads to all vessels, congestion, major property damage,
34	19 a	Grounding, Small Vessel	Rowing Skiff at Discovery Rock, nav error, 4 fatalities, 5 injuries.
35	19 b	Grounding, Small Vessel	Harbour Ferry, Sleeper Rock/ Pelly Island, low vis, 4 injuries, no fatal, lawsuits.
36	19 c	Grounding, Small Vessel	Whale Watching Vessel, Ogden Point Break water, high speed, nav error. 12 fatalities.
37	20 a	Collision Aircraft/small vessel	DH-6 landing runway 01. Rigid Inflatable whale-watching vessel loaded is inbound Victoria. Speeding, crab pot, hard to port, collision with landing aircraft. 4 fatalities, 5 injuries

Count	No.	Hazard	Scenario
38	21 a	Collision Aircraft/water	Poor weather, circuit. DHC-2 inbound, twilight, holding S. of the shoreline for IFR helijet. Ground ref. lost. Low, banked attitude, stall, crash. 5 fatalities.
		<b>Notes:</b> hazards are <b>not</b> sorted by priority	* <b>Special VFR</b> refers to absolute minimum weather for visual flight.

#### 5.4 Risk Communication Considerations

The following risk communication activities were undertaken as part of the hazard identification phase of the project:

- Ø A list of potential stakeholders was documented, and stakeholders were identified from diverse groups. Specifically, stakeholders were identified from the following groups:
  - Ø Marine and aviation operators in the Victoria Harbour vicinity;
  - Ø General residential community (Greater Victoria area as well as the harbour vicinity);
  - Ø Residential groups such the Victoria Harbour Residents Association, and the West Bay Residents Association;
  - Ø General business community (Greater Victoria area as well as the harbour vicinity);
  - Ø Municipal government including the City of Victoria and Township of Esquimalt;
  - Ø Federal government, including the Ministry of Transportation;
  - Ø Environmental organizations such as the Health Protection & Environmental Services - Capital Health Region.
- Ø 111 interviews were completed with stakeholders in order to identify risk issues and to identify specific scenarios.

Hazard scenarios continued to be examined throughout the current study through discussions and interviews with stakeholders. The following sections document these risk communication activities.

## SECTION 6: RISK ESTIMATION

### 6.1 General

Seven steps completed as part of the Q850 Risk Estimation Phase are described in the following table.

<b>Q850 Checklist for Step 3: Risk Estimation</b>		
<b>Process</b>	<b>Documents</b>	
<b>1. <i>Set the criteria for choosing methods of estimation</i></b>	Have I documented identifying the criteria by which to choose the most appropriate analytical methods for estimating risk?	Expert input, see Section 6.2.
<b>2. <i>Choose methods of estimation</i></b>	By applying the criteria, have I selected the most appropriate analytical methods?	Expert input using a qualitative ranking of hazard frequency and consequences.
<b>3. <i>Select third parties to validate</i></b>	Have I chosen the most appropriate third parties to validate the analyses?	The technical focus groups were monitored by air and marine experts that did not influence the ranking process.
<b>4. <i>Check integrity of analysis</i></b>	Have I ensured that the third parties have reviewed all critical components of the analysis?	See Section 6.2.1.
<b>5. <i>Locate information sources</i></b>	Have I researched appropriate sources of information?	Air and marine accident information for the harbour was examined.
<b>6. <i>Prepare estimates for the risk scenarios</i></b>	Have I estimated the frequency of each risk scenario, both quantitatively and qualitatively?	Hazard frequency was assessed in qualitative terms only. The BC PEP process was used.
<b>7. <i>Estimate the consequences</i></b>	Have I estimated the value of the loss with each risk scenario, both quantitatively and qualitatively?	The severity of impact was assessed in qualitative terms only. The BC PEP process was used.
<b><i>Stakeholder communications strategy</i></b>	Have I documented dialogue with stakeholders?	Interviews have been collated internally by the safety review team.
<b><i>Other requirements</i></b>	Have I filled out any other forms, official or not, at this stage?	n/a

## **6.2 Defining Methods for Estimating Frequency and Consequences**

The Risk Estimation phase of the Q850 process included two technical focus groups, comprised of marine and aviation operators in the Victoria Harbour, as well as NAV CANADA. The focus group research was used to rank the likelihood of a subset of hazard scenarios.

After hazard identification, all 38 hazard scenarios were ranked by each member of the risk management team, including:

*Mr. Brad Judson, MA, Master Foreign-going, Marine Traffic Risk Specialist  
GeoInfo Solutions Ltd.*

*Mr. John Pottinger, aviation safety specialist, over one hundred investigations of accidents and incidents over twenty-five years. President, TEXTPILOT – Aviation Safety Consultants*

*Mr. Tom Storey, former Regional Manager for the Pacific Region with the Canadian Transportation Safety Board*

*Captain Alec J. Provan, Master Foreign-going Steamship, 20 year career in Canadian Coast Guard (managed Canadian Coast Guard Base Facility in Victoria, BC)*

*Captain Bart Terwiel, Ship's master, Commercial Seaplane Pilot*

This ranking was completed based on interview data, safety team experience, and historical information. Information from this preliminary ranking was used in conjunction with an analysis of the 38 hazard scenarios to select a subset of hazard scenarios for the technical focus groups. Scenarios were selected from the full set of 38 hazard scenarios for inclusion in the technical focus group, if they were reasonably distinct from other scenarios included as part of the focus group, and if they met a suitable consequence threshold<sup>10</sup>.

A set of 15 hazard scenarios was selected to be considered as part of the technical focus groups. The focus group included eight marine and six air representatives, including representatives from the following groups:

- Ø Prince of Whales Whale Watching
- Ø Cooper Air
- Ø Island Tug & Barge
- Ø NAV CANADA
- Ø Harbour Ferry Co.
- Ø Blackfish Wilderness Expeditions
- Ø Seaspan International

---

<sup>10</sup> Consequence threshold was defined as having risk of serious injury or death.

- Ø Helijet International
- Ø Harbour Air Seaplanes
- Ø West Coast Air
- Ø Victoria Fisherman's Association
- Ø Clipper Navigation
- Ø Council of BC Yacht Clubs

Major General Scott Eichel (retired) also participated in the technical focus group (former Commanding Officer of the first Canadian Aurora Squadron) as an independent aviation expert.

Each focus group participant was asked to rank the probability of a set of 15 scenarios with specified consequences. The rankings from the technical focus group were tabulated, and results of the individual<sup>11</sup> rankings were shared with the group. The results indicated a high level of agreement between focus group participants with respect to the absolute ordering of scenario probabilities. The assessments of the technical focus groups were also compared to the rank ordering of the Safety Review Team. Again, these comparisons indicated a high level of agreement amongst the Safety Review Team, independent expert and marine and aviation representatives.

#### 6.2.1 Third-Party Review

The technical focus groups were monitored by the following air and marine experts<sup>12</sup>:

*Mr. Brad Judson, MA, Master Foreign-going, Marine Traffic Risk Specialist  
GeoInfo Solutions Ltd.*

*Mr. John Pottinger, aviation safety specialist, over one hundred investigations of accidents and incidents over twenty-five years. President, TEXTPILOT – Aviation Safety Consultants*

*Mr. Tom Storey, former Regional Manager for the Pacific Region with the Canadian Transportation Safety Board*

*Captain Alec J. Provan, Master Foreign-going Steamship, 20 year career in Canadian Coast Guard (managed Canadian Coast Guard Base Facility in Victoria, BC)*

*Captain Bart Terwiel, Ship's master, Commercial Seaplane Pilot*

#### 6.2.2 Validation

A number of validation activities were completed as part of the current Risk Management study. Specifically, the results of the current Risk Management study were compared to the 1996 *City of Victoria Hazard Assessment* that was completed by Thomas Marcinkiewicz for

<sup>11</sup> Results were presented in a way that protected the confidentiality of individual respondents.

<sup>12</sup> Transport Canada may validate the technical analyses through a third party if desired.

the Victoria Emergency Program. In addition, hazard ranking data provided by focus group participants were compared across participants, and against rankings provided by aviation and marine experts on the risk management team. Finally, rankings provided by focus group participants were also compared to published statistics concerning aviation and marine accidents in the Victoria Harbour and comparable locations.

### **6.3 Estimating Frequency of Risk Scenarios**

Assessing the likelihood of hazard scenarios and the magnitude of impacts requires the application of a consistent method of measurement. Appendix A of this report contains the information that was provided to focus group participants about the methodology used to assess risk scenario probability and consequence.

Definitions from the Provincial Emergency Program were utilized in assessing risk scenario probability or frequency<sup>13</sup>. Specifically, the following categories for likelihood / frequency were utilized:

<b>Score</b>	<b>Likelihood/Frequency</b>
6	1-3 years (frequent)
5	3-10 years (moderate)
4	10-30 years (occasional)
3	30-100 years (unlikely)
2	100-200 years (rare)
1	200+ years (almost impossible)

*CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers* states that estimations of the frequency of risk scenarios often draw from expert experience and judgement as well as from historical data. As part of the current project, expert input from interviews, the safety team, and the technical focus groups was used in estimating the frequency of risk scenarios in conjunction with historical statistical data.

---

<sup>13</sup> Appendix A of this report provides specific documentation that was used in defining a methodology for ranking hazard scenarios.

## 6.4 Estimating Consequences of Risk Scenarios

### 6.4.1 Measuring Consequences

In addition to assessing probability or frequency of risk scenarios, information about measuring consequences was provided to technical focus group participants. Seven categories of impacts were reviewed with focus group participants, including death, injury, critical facility, lifelines, property, environment and social impacts. The current study defined consequence using two measures: death and injury / critical injury.

The following consequence scale reflects the number of deaths or injuries associated with varying consequence levels:

Score	Consequence (impact of hazard in terms of injury or death)
4	50 deaths/2000+ injuries
3	10-50 deaths, 50-2000 injuries
2	4-10 deaths, 4-50 injuries
1	0-4 deaths, 0-4 injuries

### 6.4.2 Presenting Frequency and Consequence Estimates

As a result of Risk Estimation and Evaluation research activities, several risks were identified, but most were of a low or occasional probability. The highest three risks included:

- Ø Cruise ship fire (docked);
- Ø Collision between aircraft and small vessels; and,
- Ø Cruise ship fire (underway).

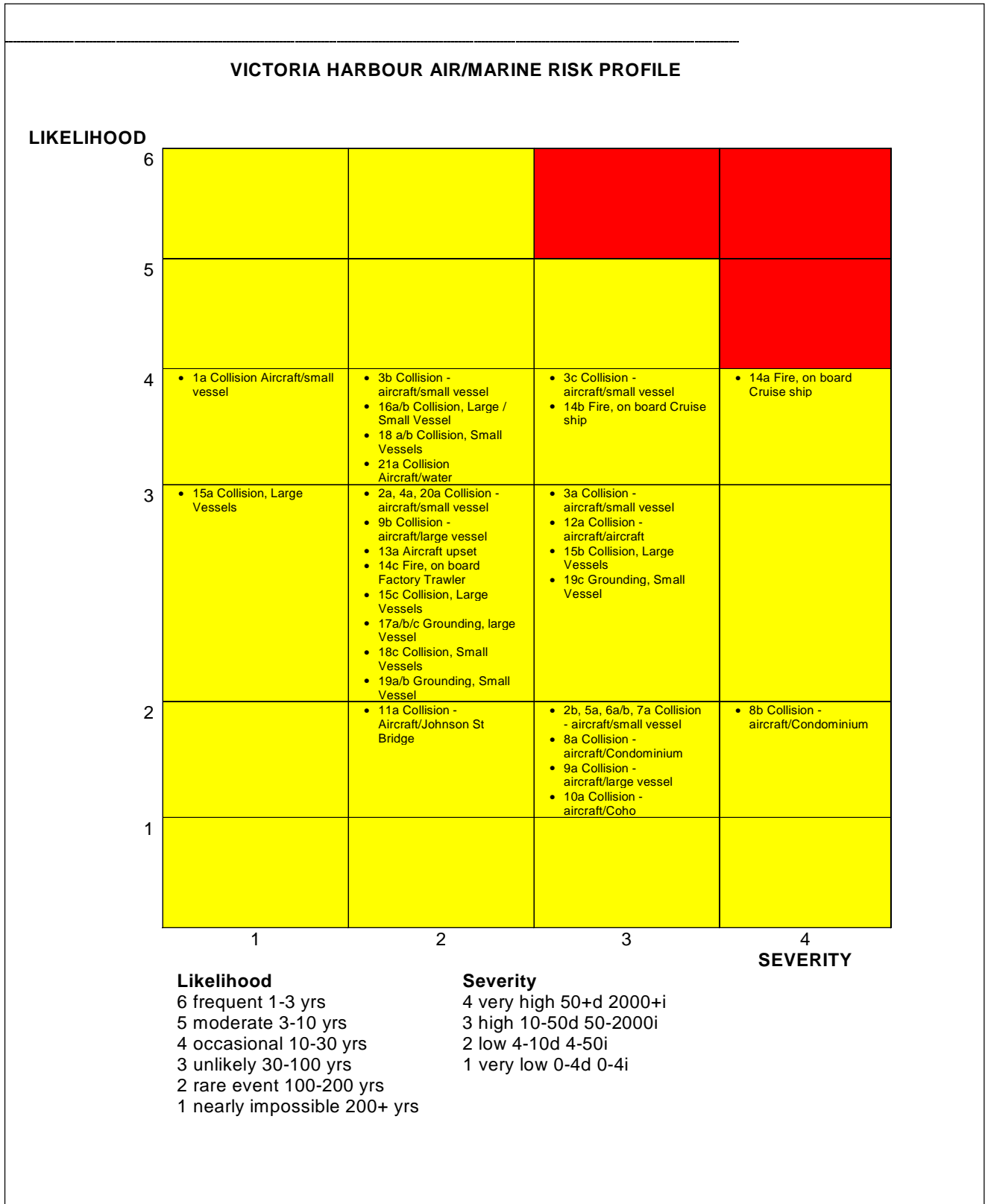
Notwithstanding the finding that none of these scenarios were rated as moderate or frequent in terms of likelihood, they were assigned a higher probability and consequence than were other risks. In general, most hazards were assigned a relatively low risk score, which suggests that marine / aviation experts agree that operations in the Victoria Harbour are associated with a low to moderate level of risk.

Detailed in Figure 6-1 are the rankings of the various hazard scenarios for the Victoria Harbour<sup>14</sup> based on the technical focus groups. Severity (consequence) is documented along the horizontal axis, and Likelihood is depicted along the vertical axis. This figure indicates that the current risk management review did not identify any hazards that were frequent or moderate in combination with high or very high consequence.

---

<sup>14</sup> The full list of ranked hazard scenarios is provided in Appendix C.

Figure 6-1



Findings from this component of the Q850 study indicate that the maximum risk found in the Victoria Harbour was quantified as a 16 out of 24. While not high, this does suggest that some mitigation should be considered to reduce risks. It should be noted that these hazards were based on current activity levels in the harbour.

The findings of this study were compared to *A City of Victoria Hazard Assessment* that was completed in 1996 for the Victoria Emergency Program by Thomas Marcinkiewicz. This 1996 hazard assessment study indicated that air disasters and maritime disasters were expected within a time span of 20 years. This estimate is consistent with the current estimate of 10 to 30 years for the highest rated air and marine scenarios identified as part of the current study, as outlined in Figure 6-1. The marine and air hazard scenario rankings for likelihood and consequence severity are consistent with the all-hazard analysis completed earlier by the City of Victoria which forms part of the City's Emergency Response Plan.

The outcome of this Risk Evaluation phase was compared to historical data concerning marine and aviation incidents. Historical data indicates a high level of safety associated with Victoria Harbour aviation and marine operations. Specifically, four accidents involving seaplanes have been reported in Victoria Harbour since 1980, none resulting in fatalities or serious injuries. In addition, historical data pertaining to passenger ship fires was examined. While data from Transport Canada indicates that there have been 92 accidents<sup>15</sup> involving passenger ships (and 14 involving fires) since 1976, there have been a total of 6 fatalities and 7 injuries since 1976 involving passenger ship fires in the West Coast region<sup>16</sup>. As a result, the historical data indicates a very low frequency associated with the scenarios identified as part of the current study.

## **6.5 Risk Communication Considerations**

The *CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers* states that the following risk communication steps should be undertaken as part of the Risk Estimation phase of the project:

- Ø Communicate with stakeholders about the methods that will be used to accomplish the analyses;
- Ø Acknowledge any assumptions and uncertainties associated with the analyses;
- Ø Advise stakeholders of the results of any analyses.

Previous sections of this report outline the communication activities that were completed in order to outline research activities that would eventually occur as part of the current study. Specifically, the initial Town Hall meeting in November 2001 outlined the use of technical focus groups with marine and aviation operators in the Victoria Harbour to address likelihood of occurrence, severity of consequence, and prioritization of hazardous events in the Victoria Harbour. The reliance on expert experience and judgement, along with empirical data and documentation in completing this analysis was also communicated to stakeholders during the project. The Town Hall Meeting also outlined the collection of data about perceived safety of operations in the community through a survey of businesses and residents.

---

<sup>15</sup> Subject to a Transportation Safety Board review or investigation.

<sup>16</sup> Out of a total of 17 fatalities and 25 injuries involving passenger ships since 1976. Data provided by Transport Canada.

Following the risk estimation analysis, numerous presentations were made, outlining initial results of study. Specifically,

- Multiple meetings with various groups such as the Greater Victoria Marine Air Safety Society and with representatives from the Victoria Harbour Residents Association outlining the methodology that was used to rank hazard scenarios, and to collect additional information about perceived hazard scenarios;
- Round Table meeting to present draft results (February 20, 2002) to community representatives, including representatives from resident groups, City of Victoria, Tourism Victoria, Greater Victoria Chamber of Commerce, aviation and marine operators, NAV CANADA, and Transport Canada. This presentation again outlined the methodology that was used to complete the risk analysis;
- Resident meeting to present the methodology and draft results of study (March 21, 2002); and,
- Communication of draft study findings through an Open House (April 11, 2002) and Town Hall meeting (April 11, 2002).

The Open House and Town Hall meeting were widely advertised in order to ensure broad participation from business, community, government, marine / aviation operators, and resident groups. Specifically, letters were sent to approximately 110 individuals that were interviewed during the study to invite them to attend the Open House and Town Hall meeting. In addition, advertisements were placed in *Monday Magazine*, *Victoria News*, and the *Times Colonist* inviting the public to attend the Town Hall and Open House. The *Marina Mirror* also published information in advance of the Town Hall and Open House. Specifically, the advertisements indicated that the Open House would allow interested individuals to speak to the project team about the methodology and results and to provide input on the findings. The advertisements also indicated that the Town Hall meeting would feature a presentation from the project team on the findings of the review.

As part of the Open House and Town Hall meetings, feedback forms were distributed to attendees. Approximately fifteen submissions were received subsequent to the Open House and Town Hall meetings, and numerous follow-up communication activities were completed. On the basis of this feedback, some modifications were made to subsequent versions of the Management Review Report.

## SECTION 7: RISK EVALUATION

---

### 7.1 General

Activities completed as part of the Risk Evaluation phase of the Q850 process are documented below:

Q850 Checklist for Step 4: Risk Evaluation		
Process	Documents	
1. <i>Estimate and integrate benefits and costs</i>	Have I documented the balance of benefits and cost of the risk activity?	Informal consideration.
<i>Stakeholder communications strategy</i>	Have I documented stakeholder acceptance of the risk?	Acceptance of risk documented by R.A. Malatest & Associates Ltd. as a result of a survey.
<i>Other requirements</i>	Have I filled out any other forms, official or not, at this stage?	n/a

#### 7.1.1 Integrating Benefit and Cost Considerations

During the Risk Evaluation phase of a risk management review, the risks as identified during the Risk Estimation phase are to be evaluated according to the needs, issues, and concerns of stakeholders, the benefits of the activity and its costs. The current study did **not** include a cost-benefit analysis. No risks identified as part of the current study were assessed as frequency or moderate in conjunction with catastrophic consequences. The mitigation measures identified, therefore, were consistent with the magnitude of risk identified; mitigation measures generally represented modifications to the current operating procedures to further enhance the safety of the Victoria Harbour operations.

A discussion of cost / benefit issues that may be considered as a result of the current Management Review is provided in Section 8.3.

### 7.2 Assessing the Acceptability of the Risk to Stakeholders

#### 7.2.1 General

Prior to determining the acceptability of risk, the Q850 Risk Management process allows for the estimation of the acceptability of the risk, benefits of the activity and possible costs. As zero risk is generally not possible, the goal of the risk evaluation phase is to reduce risk as much as is reasonably achievable.

### 7.2.2 Perceptions of Risk

In addition to multiple meetings and 28 interviews with residents, a survey was completed with residents and businesses in Victoria. The purpose of the survey was to assess the perception of risk in the Greater Victoria community as well as among residents and businesses in the Victoria Harbour vicinity. Specifically, surveys were completed with the following groups<sup>17</sup>:

<b>Survey</b>	<b>Location</b>	<b>Number of Surveys completed</b>
Resident	Victoria Harbour Area <sup>(1)</sup>	210
	Greater Victoria	263
Business	Victoria Harbour Area <sup>(1)</sup>	105
	Greater Victoria	103
<b>Total</b>		<b>681</b>

<sup>(1)</sup> defined as those households/businesses residing within 3 blocks of the Victoria Harbour.

As part of the survey, residents were asked to assess the perceived level of safety or lack of safety associated with each of the following Victoria Harbour marine and aviation activities:

- Ø Float planes to or from Victoria;
- Ø Intercity ferries to or from Victoria Harbour, such as the Clipper, the Coho or the Express;
- Ø Harbour ferries;
- Ø Marine tours, such as scenic tours, whale watching; and
- Ø Other Victoria Harbour operations or services.

The business survey was slightly shorter than the resident survey. Businesses were asked to evaluate the perceived level of safety or lack of safety associated with the following:

- Ø Float planes to or from Victoria; and
- Ø Marine services offered in the Victoria Harbour.

#### 7.2.2.1 Public Perceptions of Risk

The results of the survey indicate that on the whole, a majority of residents and businesses report a low level of perceived risk associated with Victoria Harbour marine and aviation activities. Specifically, 70% of harbour area residents and 66% of Greater Victoria residents perceived that float plane activities were safe, as well as 72% of harbour area businesses and 75% of Greater Victoria businesses. With respect to marine operations in the harbour, a majority of all respondents felt that these operations were of low risk.

---

<sup>17</sup> Details about the methodology used in collecting data for the resident and business survey may be found in the *Victoria Harbour Management Review Resident and Business Survey Methodology Report* and attached data tables.

**Table 7-1  
Percentage of Respondents Perceiving Harbour Operations as Safe (Unsafe)**

Type of Operation	Residents		Businesses	
	Harbour area	Greater Victoria	Harbour area	Greater Victoria
Float Planes	70 (17)	66 (11)	72 (5)	75 (8)
Major / Intercity ferries (e.g., Coho)	88 (4)	86 (2)	96 (0)*	84 (5)*
Harbour ferries	84 (5)	78 (4)		
Marine tours such as whalewatching	66 (8)	64 (10)		

\* Businesses were asked to evaluate perceived risk associated with marine services offered in the Victoria harbour overall.

The survey results did indicate that there was a group of stakeholders concerned about the level of risk in the Victoria Harbour. Specifically, 17% of harbour area residents and 11% of Greater Victoria residents felt that the float plane operations in the Victoria Harbour were unsafe. Table 7-1 illustrates the percentage of respondents that felt that harbour operations were unsafe in parentheses.

Further analysis was completed of harbour area residents that perceived float plane operations to be unsafe with respect to possible suggestions for mitigation suggested by this group. Among this group, 56% stated that the float plane operations were important, and 78% felt that the mixture of uses in the Victoria Harbour was appropriate. When asked whether there should be restrictions on the type and extent of uses in and around the Victoria Harbour, 33% of those individuals that felt the float planes were unsafe felt that there should be a restriction on seaplane operations in the harbour.

Overall, while a majority of residents stated that they felt that the current mix of residential, commercial, recreation, and transportation uses was appropriate (harbour area residents, 90%, Greater Victoria residents, 88%), respondents did feel that there should be some restrictions on the type and extent of uses in and along the Victoria Harbour (harbour area residents, 73%, and Greater Victoria residents 76%). Respondents were also asked to state an opinion with respect to possible mitigation measures in the Victoria Harbour. Suggestions from respondents are provided verbatim in the *Victoria Harbour Management Review Resident and Business Survey Methodology Report* and attached data tables.

### **7.3 Risk Communication Considerations**

The *CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers* indicates that steps to be taken as part of the Risk Evaluation Phase of the project include:

- Ø Discussion with stakeholders about the purpose of the risk evaluation step;
- Ø Discussion with stakeholders about the benefits of the activity;
- Ø Collection of information about stakeholder perceptions of the risks; and
- Ø Assessment of information about acceptability of the risk to stakeholders.

Please refer to Section 7.2 and 6.5 for a description of these activities.

## SECTION 8: RISK CONTROL AND FINANCING

### 8.1 General

The following table lists activities often completed as part of a Risk Control and Financing stage of the Q850 process:

<b>Q850 Checklist for Step 5: Risk Control</b>		
<b>Process</b>	<b>Documents</b>	
<b>1. Identify the feasible options for controlling the risk</b>	Have I documented the various options for controlling the risk?	Single list of mitigation measures. Marine and air stakeholders were surveyed about perceived top 5 effective measures for each hazard scenario.
<b>2. Establish the criteria for choosing the most appropriate option</b>	Have I established the results I want to achieve in selecting a risk control plan?	Results of survey with marine and aviation operators, as well as information from all data collection activities completed.
<b>3. Attribute a weight to each criterion</b>	Have I given a value of from 1 to 10 for each of the comparison criteria?	Not applicable
<b>4. Compare the options to each criterion</b>	Have I given each option point score based on its comparison to each criterion?	Not applicable
<b>5. Make a preliminary choice among the risk control options</b>	Have I selected the most appropriate option based on the sum of its weighted scores?	Not applicable
<b>6. Identify any residual risks</b>	Have I identified any residual risks; assessed them in terms of probability and seriousness; and identified ways to manage them?	The risks were assessed with existing mitigation measures in place. Therefore, 'residual risks' were analyzed. Public stakeholders can provide the line of protection to show the higher risks that might be mitigated further.
<b>Stakeholder communications strategy</b>	Have I documented the impact and acceptability by the stakeholders of the chosen risk control option?	Not applicable. Choice of control options is a consideration after this study is complete.
<b>Other requirements</b>	Have I filled out any other forms, official or not, at this stage?	n/a

The purpose of the risk control and financing component of the Q850 process is to identify risk control options for reducing risk.

## **8.2 Identifying Feasible Risk Control Options**

Control for newly identified risks was assessed through in-depth interviews with marine and aviation operators. In addition, further information was obtained from a survey that was sent to 48 marine and aviation operators in the Victoria Harbour area. This survey contained a list of 38 hazard scenarios. Operators were asked to evaluate the effectiveness of current mitigation measures in addressing each risk. In addition, operators were asked to identify additional mitigative measures that would be effective in addressing each risk.

The results from this aviation and marine operator mitigation survey give some useful information regarding mitigation. The most common mitigation measures suggested for the top 10 scenarios<sup>18</sup> are presented below:

---

<sup>18</sup> Ranked by risk score.

**Table 8-1  
Expert Rankings of Selected Hazards**

<b>Hazard</b>	<b>Most Common Proposed Mitigation Measures*</b>
1. Fire, Cruise Ship (docked)	Emergency Response (30%) Designated Search & Rescue (15%)
2. Collision – Aircraft / small vessel	Mariner Education (14%) Strobe (13%)
3. Fire, Cruise Ship (underway)	Emergency Response (25%) Designated Search & Rescue (15%)
4. Collision – Aircraft / Aircraft	Pilot Education (25%) Flight Service Station (20%)
5. Collision – Aircraft / Small Vessel (inflatable boat)	Mariner Education (15%) Harbour Patrol Vessel (11%)
6. Collision – Large Vessels (Clipper / Coho)	Emergency Response (18%) Mariner Education (13%)
7. Grounding Small Vessel (inflatable hits breakwater)	Emergency Response (19%) Mariner Education (17%)
8. Collision – Aircraft / Condominium	Emergency Response (30%) Pilot Education (20%)
9. Collision – Aircraft collision on Water (no vessels involved)	Emergency Response (24%) Pilot Education (24%)
10. Collision – Large Vessel with Small Vessel	Emergency Response (18%) Mariner Education (12%)

\* Percentage is calculated of the total number of responses provided for each scenario. Number of rank responses provided by survey participants can thus vary between hazard scenarios. The current results reflect surveys completed by 12 individuals that completed the mitigation survey, representing a response rate of 25%.

In addition to information provided through the survey of marine and aviation operators, information that was collected throughout the entire Management Review was considered in compiling a list of recommendations concerning marine and aviation operations in the Victoria Harbour.

Consistent with *CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers*, risk mitigation strategies may seek to control risk in a number of ways such as through avoiding exposure to risk, reducing the frequency of the loss (e.g., through training, etc.), or reducing the consequence of a loss (e.g., through increased emergency response preparedness). The risk control measures recommended as part of the current study are provided below:

**Table 8-2  
Safety and Risk Mitigation Recommendations**

	<b>Action by:</b>	<b>Recommendation:</b>
1.	Transport Canada	Maintain, with some adjustments and enhancements, the vessel traffic scheme implemented as a result of the 1999 traffic safety study. Transport Canada should continue its pro-active approach in the dissemination of, and education about, the traffic scheme.
2.	Transport Canada, aviation operators	Continue education sessions provided by Transport Canada to the air operators.
3.	Transport Canada	Examine the potential to enhance the effectiveness of the strobe lights by: <ul style="list-style-type: none"> <li>Ø working to strengthen the procedures for ensuring strobe activation;</li> <li>Ø examining potential of different lighting patterns for different aircraft activity with the possibility of strobes being activated for landings only, or having strobe activation that indicates which runway is in use; and,</li> <li>Ø examining alternate methods of apprising vessels of aircraft movements.</li> </ul>
4.	Transport Canada / City of Victoria	Work with the City of Victoria/other agencies to strengthen emergency response capabilities as well as possibly strengthen marine fire fighting capabilities.
5.	Transport Canada	Expand use and responsibility of harbour patrol boats to increase compliance with the Port of Victoria Traffic Scheme and minimize conflict between small vessels and aircraft.
6.	Transport Canada	Review the feasibility of introducing administrative penalties (fines) to help ensure compliance among marine operators with harbour rules and regulations.
7.	Transport Canada	Place signage, visible to and readable by mariners, at a suitable location to inform inbound vessels of the existence of a traffic scheme and the proximity of aircraft landings and takeoffs.
8.	Transport Canada / City of Victoria	Examine possible dock space solutions to reduce aircraft holding in the Inner Harbour. <ul style="list-style-type: none"> <li>Ø aircraft in "holding patterns" waiting for free dock space was cited as a contributor to harbour noise and poor air quality.</li> </ul>
9.	Transport Canada	Consider options to respond to heavy usage / marine activity in Victoria Harbour Water Airport during special events.
10.	Transport Canada	As the population of Greater Victoria grows, its popularity as a tourist destination increases, and the volume and mix of both vessels and aircraft in the harbour increase: <ul style="list-style-type: none"> <li>Ø Continue to routinely monitor aviation and marine operations in the harbour to ensure adherence to prescribed regulations and procedures; and</li> <li>Ø Evaluate existing practices and procedures regularly, both marine and air, to ensure their adequacy in maintaining acceptable levels of safety in the face of changing conditions.</li> </ul>
11.	Transport Canada	Adopt a more active information dissemination strategy to inform key stakeholders about compliance of air / marine operators with current regulations.
12.	Transport Canada	Assess current levels of general knowledge concerning the Port of Victoria Traffic Scheme, specifically amongst recreational and itinerant boaters, as well as the dissemination of the PVTs, with a view to increased compliance.

### **8.3 Evaluating Risk Control Options in Terms of Effectiveness, Cost, and Risks, and Stakeholder Acceptance**

Evaluation of risk control effectiveness can only occur after implementation. With respect to cost, the cost of risk control measures should not exceed the expected value of the loss. A number of the control options provided in Table 8-2 indicate that that Transport Canada should work with other agencies to determine the appropriate risk control measure, and this

may include consideration of costs and benefits of proposed risk control options. For instance, Transport Canada has recently joined the Victoria and Esquimalt Harbours Emergency Response and Protective Services Committee. The purpose of this committee is to provide a forum to exchange information concerning the development of fire fighting, policing, marine and air rescue in the Victoria and Esquimalt Harbours. Numerous issues will need to be considered in determining the best method to enhance the emergency response preparedness or fire fighting capabilities in the Victoria Harbour, including regulatory requirements, etc.

As a result, choice of control options (in some cases) and an evaluation of risk control measure effectiveness will continue to be a consideration after this study is complete.

#### **8.4 Assessing Stakeholder Acceptance of Proposed Action(s) and Assessing Stakeholder Acceptance of Residual Risk**

Numerous communication activities were completed in order to obtain feedback with respect to proposed recommendations. The full set of draft recommendations was provided as part of the Open House and Town Hall meeting on April 11, 2002. In addition, feedback forms were available, including a printed list of all draft recommendations, with space for stakeholders to provide feedback. As a result of these public events, numerous submissions were received concerning the draft recommendations. Subsequent to the April, 2002 Town Hall and Open House, numerous consultation activities occurred, in order to solicit in-depth information and opinions about the proposed mitigation recommendations, including follow-up meetings and a review of written submissions.

With respect to the possible consideration of residual risk, the risks considered as part of this study were assessed with existing mitigation measures in place. Therefore, 'residual risks' were analysed. Further work may be completed by Transport Canada to provide information concerning stakeholder acceptance of risk after mitigation measures arising from the current study are implemented.

## SECTION 9: ACTION<sup>19</sup>

<b>Q850 Checklist for Step 6: Action/Monitoring</b>		
<b>Process</b>	<b>Documents</b>	
<b>1. Name the Risk Control Plan</b>	Have I brought forward the risk control option and identified who has overall accountability for implementation?	Not applicable
<b>2. List the activities and rework them</b>	Have I brainstormed and reworked all the activities associated with the Risk Control Plan?	Not applicable
<b>3. Sequence the tasks</b>	Have I set the activities in their order of occurrence?	Not applicable
<b>4. Identify problems of implementation</b>	Have I identified any potential problems associated with the roll-out of any of the activities of the plan?	Not applicable
<b>5. Assess problems</b>	Have I assessed these problems in terms of probability and seriousness?	Not applicable
<b>6. Identify likely causes</b>	For problems with high probability and seriousness, have I identified the most likely reason for the problem occurring?	Not applicable
<b>7. Set preventive actions</b>	Have I determined actions that could prevent the problem from taking place?	Not applicable
<b>8. Set contingent actions</b>	For each cause, have I identified an action to minimize the effects of the risk, should preventive action fail?	Not applicable
<b>9. Set triggers for contingent actions</b>	Have I identified an indicator to tell me when to engage the contingent action(s)?	Not applicable
<b>10. Select control features</b>	Have I documented the features necessary to control the implementation plan?	Not applicable
<b>11. Select monitoring features</b>	Have I chosen what features to monitor?	Not applicable
<b>12. Select the review date</b>	Have I identified an appropriate date for examining the monitoring features?	Not applicable
<b>13. Assemble as a monitoring plan</b>	Have I established the sequence of activities for monitoring?	Not applicable
<b>14. Assess effectiveness</b>	Have I identified what went well and what concerns exist around each of the steps and each of the parameters of the Risk Management Process?	Not applicable
<b>15. Plan corrective action</b>	Have I planned what is required to improve the Risk Management Process?	Not applicable
<b>Stakeholder communications strategy</b>	Have I documented the impacts of the Risk Control Option on the stakeholders?	Not applicable
<b>Other requirements</b>	Have I filled out any other forms, official or not, at this stage?	Not applicable

<sup>19</sup> Transport Canada will implement actions associated with the current risk review.