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Performance Audit

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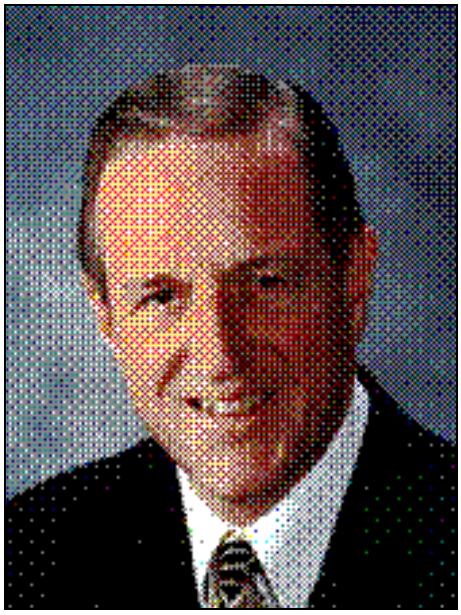


This report, my first to the Legislative Assembly for the 1997/98 year, contains the results of my Office's audit of the state of earthquake preparedness of British Columbia's provincial and local governments.

I was pleased to be able to carry out this audit while the "Blizzard of '96" is still fresh in many people's minds. The snowfalls that hit southwestern British Columbia at the end of last year awakened much of the general public to some of the issues that those in the emergency field are giving consideration to on a daily basis.

It is clear that a major—or catastrophic—earthquake will occur in our province at some point in the future. Even during the course of this audit, almost 1,000 small earthquakes were recorded in or near British Columbia, and three were strongly felt.

Earthquake preparedness covers a broad range of activities aimed at understanding the hazards, risks and vulnerabilities related to a major earthquake, mitigating the potential impacts of such an earthquake, and planning for the response to and recovery from one.

This was a challenging audit, as we were examining the state of preparedness of not just one government agency (the Provincial Emergency Program), but also the provincial government overall, and local governments.

We concluded that governments in British Columbia are not well prepared for a major earthquake. There are a number of factors that I believe have contributed to this situation. The Province is still relatively new to the business of preparing for a major earthquake, and it hasn't yet suffered the sort of serious earthquakes that other jurisdictions such as California have experienced. Consequently, the topic has never made it to the top of the political priority list, nor has it captured the interest of the public. Nevertheless, significant progress has been made over the years in some areas such as planning for response to an earthquake, and the fact that the Attorney General called for this audit suggests that the government is indeed interested in improving the state of preparedness.

This audit has highlighted many areas where specific improvements in preparedness are necessary, but also has resulted in nine strategic recommendations regarding action by government leaders that we believe is essential to create a more supportive and focused environment for earthquake preparedness activities.

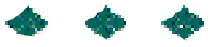
In formulating our recommendations, we have understood that preparedness for a major or catastrophic earthquake can never be absolute. Deaths, injuries and significant property damage are likely to be unavoidable. What preparedness can do, however, is reduce the scale of these impacts, help return life to normal sooner than would otherwise occur, and reduce the cost of recovery.

Achieving an adequate state of preparedness is a big task that will not be completed overnight. But I am sure it can be done over a reasonable length of time, providing there is continued commitment and leadership at all levels of government.

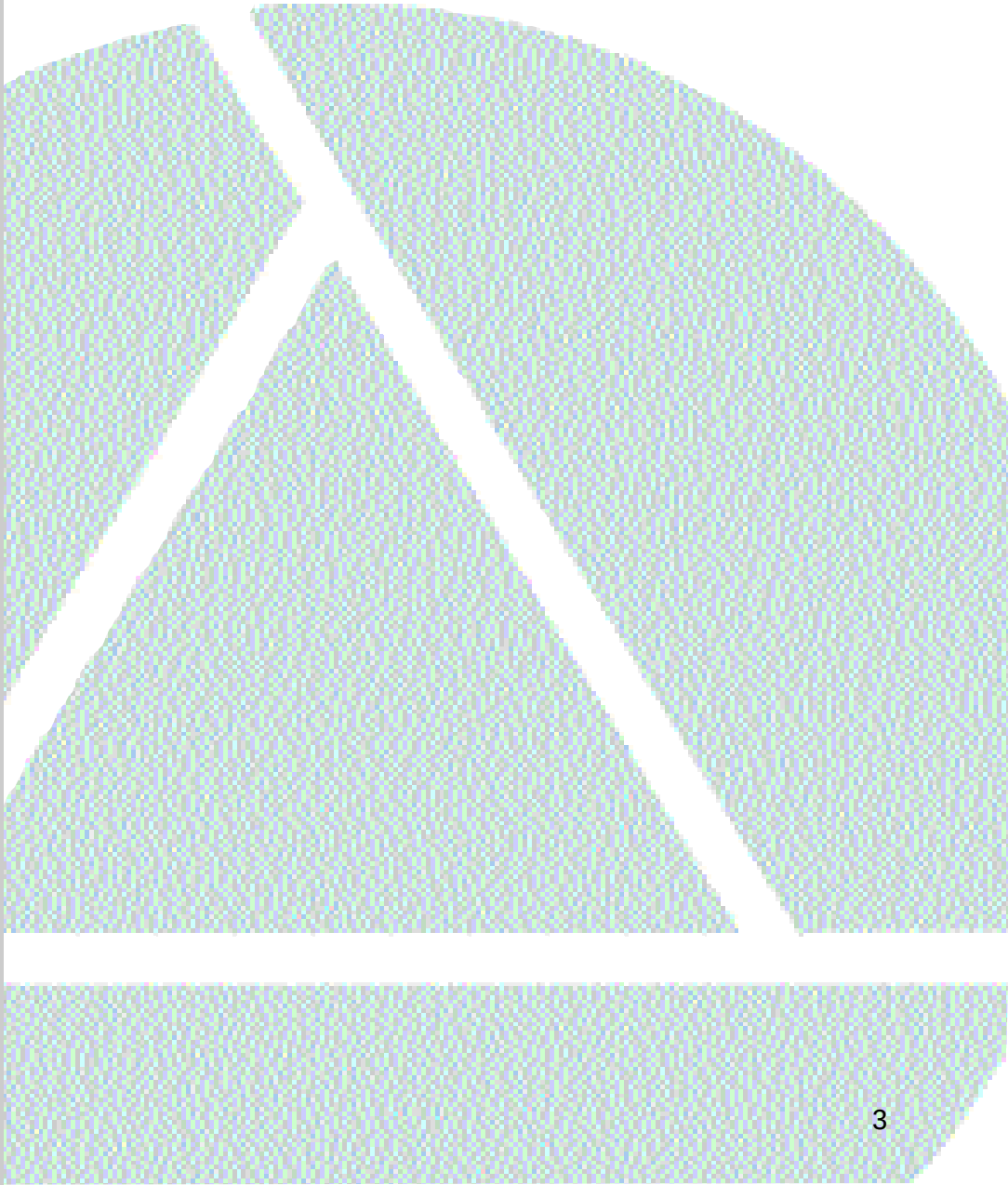
I greatly appreciate the full cooperation we have received from all those individuals we dealt with in municipal, provincial and federal government organizations and the private sector throughout the course of this audit.

George L. Morfitt, FCA
Auditor General

Victoria, British Columbia
November 1997



highlights



highlights

An audit of how well prepared for a major earthquake the provincial government and local governments are in British Columbia

Southwestern British Columbia lies over the active Cascadia subduction zone in an earthquake environment comparable to that existing along the coasts of Japan, Alaska, and Central and South America. There is considerable earthquake activity along the fault lines of three plates lying to the west of the North American continent.

The stresses that arise along the fault lines between the North American and Juan de Fuca plates are considerable. Records show that major damaging earthquakes have occurred over this zone in 8 of the last 125 years, and that a catastrophic earthquake is likely once every 300 to 800 years. In recent years, earthquakes exceeding 7 on the Richter scale have been recorded in British Columbia.

Given this hazard, it is incumbent upon governments to take steps to prepare for a major earthquake. In British Columbia, local governments are the first responders, with the provincial government and, ultimately, the federal government providing assistance as required. However, it is the provincial government that has an overall leadership and coordination role in emergency management, and it has assigned responsibility for this role to the Provincial Emergency Program, an agency within the Ministry of Attorney General.

Audit Purpose and Scope

The purpose of the audit was twofold: to assess the degree to which governments in British Columbia are prepared for a major earthquake in high hazard areas of the Province; and to determine what actions, if any, are needed to raise the level of preparedness to an adequate standard.

Our audit focused on the critical elements of earthquake preparedness. These are:

- understanding the hazards, risks and vulnerabilities;
- mitigating the potential impacts of a major earthquake;
- planning for response to a major earthquake; and
- planning for recovery from a major earthquake.

Specifically, we were interested in examining how well all of these elements are being handled by the provincial

government and local governments (although one important segment of the work examined the relationship between the provincial and federal governments in emergency planning). This included examining the governments' roles in mitigating the potential impacts of a major earthquake through, for example, the appropriate design and enforcement of building codes and the fostering of public awareness. We also studied the extent to which current, tested plans are in place to respond in the immediate aftermath of a major earthquake. As well, we looked at the capability of governments to carry on providing essential services to the public through proper continuation and recovery plans. Our examination focused on the plans and procedures in place during the period April to July 1997.

Finally, although it was not part of the audit, we also carried out a limited review of the "Blizzard of '96" to determine which features of the emergency management system did and did not work well, and to assess the implications of this for earthquake preparedness in the Province.

Overall Conclusion

We have concluded that governments in British Columbia are not adequately prepared for a major earthquake. However, we were impressed by the amount of earthquake planning that has taken place in recent years. The federal government, agencies such as the Provincial Emergency Program, and emergency planning officials in many local government organizations have been working hard to further the preparedness of the Province for such an event.

The provincial government and local governments are, in a general sense, aware of the hazards, risks and vulnerabilities associated with a major earthquake. However, they are likely to experience difficulty (albeit to varying degrees) in planning mitigation, response and recovery programs effectively because they have not yet developed specific, comprehensive scenarios for all high hazard, high risk areas of the Province. Through these scenarios, governments would be able to assess the likely impacts of a major earthquake on citizens, critical facilities, lifelines and economies—information that would better focus planning and public awareness programs.

Governments also have a general understanding of the importance of mitigation. However, it is unclear whether resources invested by provincial and municipal governments to upgrade infrastructure (such as bridges and dams) are being targeted to the highest priorities because a coordinated approach and a long-term strategy have not been developed.

Furthermore, there is no assurance that all critical response facilities (such as fire and ambulance halls, and police stations) will remain operational after an earthquake, or that damage to hazardous buildings will not cause avoidable injury or death. Public apathy about preparing for an earthquake remains high, despite a number of public awareness programs having been implemented.

It is unlikely that all key aspects of the provincial government's response efforts for a major earthquake will work as intended. The Provincial Emergency Program and most provincial government organizations have developed response plans that deal with key response functions, and some testing of those plans has been carried out. However, the overall provincial response plan, while sound in concept, is still in interim form after five years, and needs updating and finalizing. Some provincial government response functions, such as emergency social services, appear well prepared; others, such as the medical and heavy urban search and rescue functions, do not.

We believe that local governments are not yet adequately prepared to respond. The quality of local government earthquake planning varies widely. Some jurisdictions have taken the earthquake threat very seriously and are continuing to improve their response plans. Other jurisdictions have given less attention to developing sound plans. Nearly 20% of the local governments who answered our survey reported that there was no earthquake preparedness plan in their jurisdiction.

At all levels, testing of response plans is insufficient, and there are indications that more training is required. The ability of responders to communicate with each other and with different levels of government continues to be a concern, although steps are being taken to improve the situation.

Neither the provincial nor local governments are prepared to manage the recovery that will be necessary after a major earthquake. Business continuation planning—critical to effective short-term recovery—is almost non-existent at the provincial level. It is also generally lacking at the local level, although some municipalities are currently developing such plans. Procedures for inspecting and posting unsafe buildings do not exist, and little thought has been given to how the debris resulting from a major earthquake would be dealt with. Also, few governments have plans for expediting the repairs and rebuilding that would be necessary, and none has analyzed the financial options for funding a rebuilding program.

Key Findings

Detailed analysis of the likely impacts of a major earthquake is required

The provincial government and local governments are, in a general sense, aware of the hazards, risks and vulnerabilities associated with a major earthquake. What they have not yet done, however, is develop specific, comprehensive scenarios for all high hazard, high risk areas of the Province to assess the likely impacts of a major earthquake on their citizens, critical facilities, lifelines and economies—information that would better focus planning and public awareness programs.

Some worthwhile scenario work has been undertaken for Lower Mainland communities within the last five years, but it was not intended to cover all of the critical components that scenarios generally include, such as potential damage to hospitals and schools. Overall, therefore, local governments and government organizations are likely to experience difficulty, albeit to varying degrees, in planning mitigation, response and recovery programs effectively.

Retrofitting is not well coordinated

In recent years, work has been undertaken at significant cost to upgrade the provincial and municipal infrastructure. We view this effort positively, but note that there has not been a coordinated approach to the effort. As a result, it is unclear whether resources are being invested in a way that reflects the highest priorities. Furthermore, it is unclear whether all critical response facilities will remain operational after an earthquake, or that damage to hazardous buildings will not cause avoidable injury or death, because there has not been an organized approach to assessing these structures and, where appropriate, strengthening them.

Public apathy about earthquake preparedness remains high

The consistent view of those to whom we spoke was that the public is generally apathetic about the risks of a major earthquake and is therefore not well prepared, despite the myriad public awareness programs delivered by all levels of government and several private sector organizations. This suggests the need for a new communications strategy.

The role of insurance is not clear, and there are questions about insurance capacity

The government has not developed an overall strategy for mitigation, and therefore has not clearly defined the role that insurance can and should play as a means of mitigating the financial impacts of an earthquake. Further, the government has not evaluated the most desirable balance of public and private sector involvement in offering affordable earthquake insurance to the public. And although discussions are taking place with representatives of the insurance industry on matters such as its capacity to meet all potential earthquake-related claims, there is still some way to go before these issues are resolved.

The provincial response plans need updating and finalizing

The British Columbia Earthquake Response Plan appears sound in concept. However, five years after its issue, the plan is still in interim form and some of the supporting ministry plans are incomplete or have not been adequately tested. Moreover, some of the assumptions on which it is based—such as the ability of all government ministries to carry out assigned response functions—may not be realistic.

Plans for the provision of emergency social services are well developed

We found that the emergency social services (ESS) plans adequately address assigned responsibilities, and are tested to an appropriate degree. The ESS function—the responsibility of the Ministry of Human Resources—is designed to handle a wide range of personal services after an emergency, such as counselling, greeting evacuees and providing support to dependent individuals, as well as providing clothing, shelter and food to responders and evacuees. It provides support and advice to municipalities on matters such as setting up emergency reception centres, and it trains and assists municipal ESS personnel.

The ability of the health care sector to respond is of concern

Of the key support functions, medical—the responsibility assigned to the Ministry of Health—is the one of most concern to us. There is not a system-wide plan for emergency preparation and response. This is particularly worrisome, as those hospitals who responded to our survey expressed a pessimistic view of their ability to provide adequate out-patient and care services after an earthquake.

Local government plans provide inadequate guidance

Overall, we found the earthquake response planning done by local governments to be inadequate, although the quality of the planning varies widely. Some jurisdictions have taken the earthquake threat very seriously and are continuing to improve their response plans. Other jurisdictions have given less attention to developing sound, viable plans. Nearly 20% of local government respondents reported that there was no emergency plan in their jurisdiction. We think this should be a matter of concern to the provincial government. (Our view of local government planning was supported by our survey respondents, the majority of whom concluded that their respective local governments had not made adequate preparations for a major earthquake. And, almost 50% believe their local government does not have the capacity to respond effectively to such an event.)

Implementation of the British Columbia Emergency Response Management System is a good step

We strongly support the initiative to implement the British Columbia Emergency Response Management System for use in earthquake preparedness (as well as other emergencies). The system has the potential to provide the many different response agencies with a commonly understood command structure. It incorporates the Incident Command System used in many parts of the United States. This is a flexible structure designed to be followed in the handling of both minor accidents and major emergencies involving multiple jurisdictions and agencies. This should minimize confusion and duplication of effort.

National support plans are generally comprehensive and practical

There are comprehensive and practical arrangements with the federal government and the government of Alberta, to support the Province's response efforts in the event of a catastrophic earthquake. (As we did not have any authority to examine the completeness or currency of detailed federal departmental plans, we must qualify this conclusion somewhat.)

More plan testing and follow-up of tests is needed

Testing in recent years of the Province's response plans and their interface with the federal government's plans has shown that the plans appear viable. It has also demonstrated the benefit of such tests by identifying a number of issues that need resolving. However, many of the resulting recommendations

have not yet been acted on. At the individual local government level, we found plan testing to be inadequate to provide assurance that a response to a major earthquake will be effective. Priority should be given at all levels to more frequent testing.

The extent of training is inadequate

The nature of training offered both provincially and federally is good, but we have concerns about its extent. The major tests held since 1993 have identified as a problem the insufficient training of ministry personnel who would be called upon to staff Provincial Field Response Centres and make decisions about ministry plans and resource use in the event of an earthquake. The need for similar personnel at the local government level to be adequately trained is self-evident, yet there are indications that these front-line staff may also not be receiving required training.

Processes for damage assessment are inadequate

There is currently a lack of clarity about how initial damage assessment will be carried out, and by whom. As a result, were a major earthquake to occur tomorrow, damage assessment would likely be slow and uncoordinated in the early stages after the earthquake, and inconsistently carried out by the local and provincial authorities.

Communications systems need better coordination

The ability of responders to communicate with each other and with different levels of government is a concern. Testing has concluded that the current emergency radio communications resources available to the Province cannot effectively support a coordinated response effort to a major earthquake or, indeed, any other serious emergency that causes telephone service to be disrupted for a significant time. Governments are aware of this problem and some significant steps are being taken to deal with it, in particular the building of a regional communications centre in Vancouver to serve southwestern British Columbia.

Public information and warning systems are not well developed

Plans for issuing warnings to the public and for keeping the public informed after an earthquake are not well developed. An interim British Columbia Emergency Public Information Plan was prepared in 1994, but it has not been finalized or updated to reflect current circumstances. And, only a minority of local governments and police forces felt that they had the

capacity to provide accurate, timely and useful information during an emergency period. This could result in uncertainty and confusion in the minds of the public. In particular, prerecorded messages are rarely developed and multilingual messages for use after an earthquake are virtually non-existent. Given the ethnic diversity of the province's population, the latter is a serious limitation.

There is very little business continuation planning for governments

Business continuation planning—important to governments' ability to continue to provide essential services in the aftermath of a major earthquake—is almost non-existent at the provincial government level. It is also generally lacking at the local government level, although some municipalities are currently developing such plans.

Ability to inspect and post the state of unsafe buildings is inadequate

We found no organized, coordinated, province-wide approach to the inspection and posting of buildings in British Columbia. Few guidelines are in place and, particularly at the local government level, it seems unlikely that sufficient qualified personnel would be available to complete the task in a satisfactory way. This could result in unsafe buildings being accessed by the public after an earthquake, thereby possibly causing injury or loss of life.

Little planning for debris removal

Very little thought has been given to the post-earthquake removal of debris. Most local governments do not have plans to coordinate debris removal. Of those that do, few have identified potential sites to which to move debris. As a result, emergency vehicles could be impeded, and other recovery activities slowed down unnecessarily.

Factors Influencing the State of Earthquake Preparedness in British Columbia

In addition to assessing the state of earthquake preparedness, we considered the general environment in which earthquake preparedness activities have been carried out. We concluded that there are a number of factors that have influenced in a general way the state of earthquake preparedness in the Province.

- British Columbia has not yet experienced a major earthquake in a heavily populated area, such as those that have caused

significant damage in other parts of the world. As a result, while there is clearly some political will to achieve an adequate level of preparedness, the threat of an earthquake is generally not seen to be sufficiently real or imminent to make preparedness a matter of political priority.

- British Columbia is relatively new to the field of earthquake preparedness. Although it has had various forms of civil defence planning over the last 40 years, it is really only since the 1980s—with the growing understanding of the risk—that serious consideration has been given to preparing for a major earthquake. Most of the effort to date has gone into planning for response; planning and establishing mitigation and recovery programs have been slower to develop.
- Strategic planning—setting long-term goals and objectives, and implementing a plan designed to achieve them—has not been carried out. In part, this reflects the lack of consistent interest and commitment shown by politicians and senior management. Those individuals involved in earthquake preparedness in the Province, though dedicated and enthusiastic, have had limited success in gaining the attention and support of senior management. We believe this is one of the reasons that some emergency plans are neither current nor tested, and that even when tests are carried out, it has been difficult to get the involvement of those who would actually be called upon to make decisions in the event of a major earthquake. Lack of strategic direction reduces the likelihood of a consistent effort toward mitigation and recovery activities. Tangible progress in improving overall preparedness is only likely to happen if it responds to an explicit statement of what government wants to achieve.
- The absence of specific and comprehensive earthquake planning scenarios has reduced the incentive to plan effectively. Such scenarios can be powerful tools in: helping elected officials visualize the threat and commit themselves to leadership in mitigating the hazard and planning for response; helping provincial and local government officials focus their decision-making for emergency planning; helping private sector managers understand the scope of the hazard and consider it in their business decisions process; helping educators and journalists ensure that the public is correctly informed about the character of the threat and the importance of being prepared to mitigate its effects; and helping the general public appreciate the extent of their vulnerability, and support public mitigation efforts and develop personal strategies for earthquake preparedness.

- The positioning of the Provincial Emergency Program (PEP) in government does not give it a sufficient profile to be effective. Many people we spoke with felt that PEP's relatively minor position within the Ministry of Attorney General signifies the degree of importance placed on the program by the provincial government. We agree that this issue does appear to have affected PEP's ability to influence others to do what needs to be done.
- PEP has not had the resources to carry out many of the tasks its staff know should be done. In its headquarters in Victoria, it has two planners, one of whom spends a considerable part of his time on earthquake preparedness. Around the Province it has six regional offices, each staffed with just one professional and one administrative assistant (apart from the southwestern region, which has two full-time professionals and one full-time and one half-time administrative assistant) who must deal with all aspects of disaster management in the Province, not just earthquake preparedness. This means that much of staff's time is taken up handling day-to-day crises.
- No agency has been charged with the responsibility of monitoring compliance with the *Emergency Program Act* and associated regulations. Nor has any agency been given the responsibility of monitoring the overall state of earthquake preparedness in the Province. As a result, government may not have had full information to support its policy decisions regarding the direction and funding of emergency preparedness activities.
- The Inter-Agency Emergency Preparedness Council—established by legislation to facilitate the coordination of ministry and Crown corporation emergency planning and procedures—has not been as effective as it could have been, although it does have some positive achievements to its credit (for example, introducing the British Columbia Emergency Response Management System). A number of factors have imposed serious limitations on the Council's effectiveness: the composition of the Council has changed frequently; attendance of some members has been inconsistent; and it is questionable whether some of the members have been sufficiently empowered to commit their organizations to actions approved by the Council. Also, there has been no body overseeing the activities of the Council, and thus no one to encourage participation and remove any impediments to progress.
- The need for regional coordination has not been given sufficient emphasis. Existing legislation enables regional districts to assume emergency planning responsibility for a

region, but only where the member jurisdictions want this shift to take place. Where this has not happened, regional coordination depends on voluntary participation of municipalities.

The provincial government clearly has an interest in the overall success of regional planning initiatives, but this interest has not been articulated either in existing legislation or in any other formal way. Nor has a way been set out for the provincial government to ensure that lack of consensus and non-participation do not jeopardize a region's ability to deal with key emergency planning issues.

Key Recommendations

The following strategic recommendations describe the most important steps that we believe must be taken to address the problems described in the context above. Unless these issues are dealt with, we think there is little likelihood of significant improvement in the overall state of preparedness for earthquakes in British Columbia.

These recommendations focus mostly on the provincial government's role in providing a solid foundation for earthquake planning and management in the Province. Among other things, this role involves providing appropriate direction, creating and supporting the agencies needed to effect change, and monitoring and reporting progress made toward desired levels of preparedness. These initiatives, we believe, will create the environment needed to improve the current state of preparedness throughout the Province. A number of more operational recommendations are set out in Part 5 of this report.

1. The provincial government should establish a Seismic Safety Commission

Bringing together the experts scattered throughout the Province, the commission would review relevant scientific and other information from British Columbia and elsewhere, provide advice to all stakeholders, and make specific policy recommendations to the minister responsible (the Attorney General) with respect to enhancing:

- earthquake planning scenarios;
- public awareness programs;
- mitigation programs;
- response capabilities; and
- strategies for recovery.

2. The provincial government should develop long-term goals for earthquake preparedness

Achieving an adequate state of preparedness for an earthquake is a long-term endeavour; the provincial government should have a clear sense of where it would like the Province to be in its earthquake preparedness state after the next 5, 10 and 15 years have elapsed, and even longer. We believe the provincial government needs to establish specific and measurable long-term goals on which to focus its earthquake preparedness activities. To be of practical value, these goals should be established in the areas of mitigation, planning for response, and recovery. For each of these goals, substantive and measurable objectives must also be set.

It is not enough that goals merely be set. There also has to be a plan to achieve the goals, a specific timetable for carrying out the plan, and an accurate process for measuring the extent to which progress is being made toward achieving the goals. Such a process would require more intensive monitoring by PEP of, for example, the adequacy of municipal plans and the extent to which important activities such as plan testing and exercising have been carried out.

3. The provincial government should provide more focus to its earthquake preparedness program

We believe that the provincial government needs to clarify the scope of its earthquake preparedness program if it is to reach the long-term goals for earthquake preparedness we have recommended be set.

Among the objectives of the earthquake program should be to:

- develop a provincial resource and information system to support preparedness activities;
- evaluate, adapt and disseminate existing information from the United States and other sources;
- develop and disseminate guidelines and methodologies for earthquake hazard mitigation and post-earthquake recovery and reconstruction planning;
- provide appropriate technical assistance to local officials to improve their preparedness, response, and recovery capabilities, as well as hazard mitigation efforts;
- participate in a broad spectrum of public education and information efforts to increase public awareness of earthquake

hazards, and to improve public understanding of the need for preparedness and mitigation;

- promote programs to encourage individual, family, institutional and business preparedness and mitigation, coordinated with other governmental preparedness and mitigation efforts; and
- encourage the effective use of all resources available to the Province to develop comprehensive and integrated approaches to preparedness.

We believe that the earthquake program should continue to be under the direction and control of PEP, which would be responsible for its proper design and implementation, and be accountable for its results (but see recommendation 5).

4. The Provincial Emergency Program, regional and local governments should extend the development of earthquake planning scenarios

PEP should work with regional and local governments to refine the development of specific, regional earthquake planning scenarios and to extend their application to all communities within the high hazard, high risk areas of the Province. We believe the development of these scenarios is critical if the level of earthquake preparedness is to evolve beyond its present state.

These scenarios would articulate in some detail the hazards, risks and the potential impacts of a major earthquake on citizens, critical facilities (such as hospitals, schools and highways), lifelines and economies. This information could then be used by planners to better decide the nature and extent of mitigation necessary, the specific risks that need to be planned for, and the extent of recovery planning that is appropriate. And, just as importantly, this information could help to focus elected officials on the real risks for those living in their constituencies.

5. The provincial government should reposition the Provincial Emergency Program

In view of PEP's difficulty in providing effective leadership for earthquake planning, we believe that the repositioning of the agency is a matter requiring the government's immediate attention. Dealing with this matter now rather than later will also be seen as a clear statement of the importance that government attaches to earthquake preparedness, and of its commitment to improving that preparedness.

6. The provincial government should increase funding for the Provincial Emergency Program

Many of the recommendations that we have made call for a more active role for PEP. The provincial government should provide PEP with sufficient resources to meet the government's expectations for corrective actions. Specifically, we believe that resources should be made available to PEP to allow it to recruit the sort of expertise necessary to carry out the functions we identified in recommendation 3. We also believe that PEP should be provided additional resources to allow it to work more closely with local governments.

7. The Provincial Emergency Program should report annually on the state of earthquake preparedness in British Columbia

We believe that PEP should publish an annual report on the state of earthquake preparedness in British Columbia. The report, to be completed within 90 days of the end of each fiscal year, should be from PEP to the Attorney General, who in turn should table it in the Legislative Assembly. The report should include:

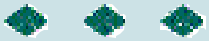
- an assessment of the overall state of earthquake preparedness of the Province;
- the status of recommendations made by the Seismic Safety Commission (see recommendation 1, above);
- a report on the plans and achievements of the Inter-Agency Emergency Preparedness Council; and
- accountability information regarding PEP's own performance in relation to its annual objectives.

8. The provincial government should raise the profile of the Inter-Agency Emergency Preparedness Council

Deputy ministers and Crown corporation chief executives should take steps to increase the profile and effectiveness of the Inter-Agency Emergency Preparedness Council. First, they should ensure that their representatives to the Council are empowered to commit their organization to supporting and acting on Council initiatives. Second, they should, through their own councils, monitor the operations of the Council and make sure that any lack of participation or consensus is not allowed to impede its work.

9. The provincial government should strengthen regional emergency planning and coordination

The provincial government should establish a framework that requires regional planning and coordination to occur, and should specify the results to be obtained. And the government's role and interest in regional planning and coordination should be formalized through amendments to legislation to allow the minister to intervene in certain circumstances. This is not a new concept for the provincial government; in other community-focused legislation, it has clearly indicated its willingness to intervene in the public good in cases where consensus cannot be found. An alternative approach is to define the minister's role through prior agreement with all parties.



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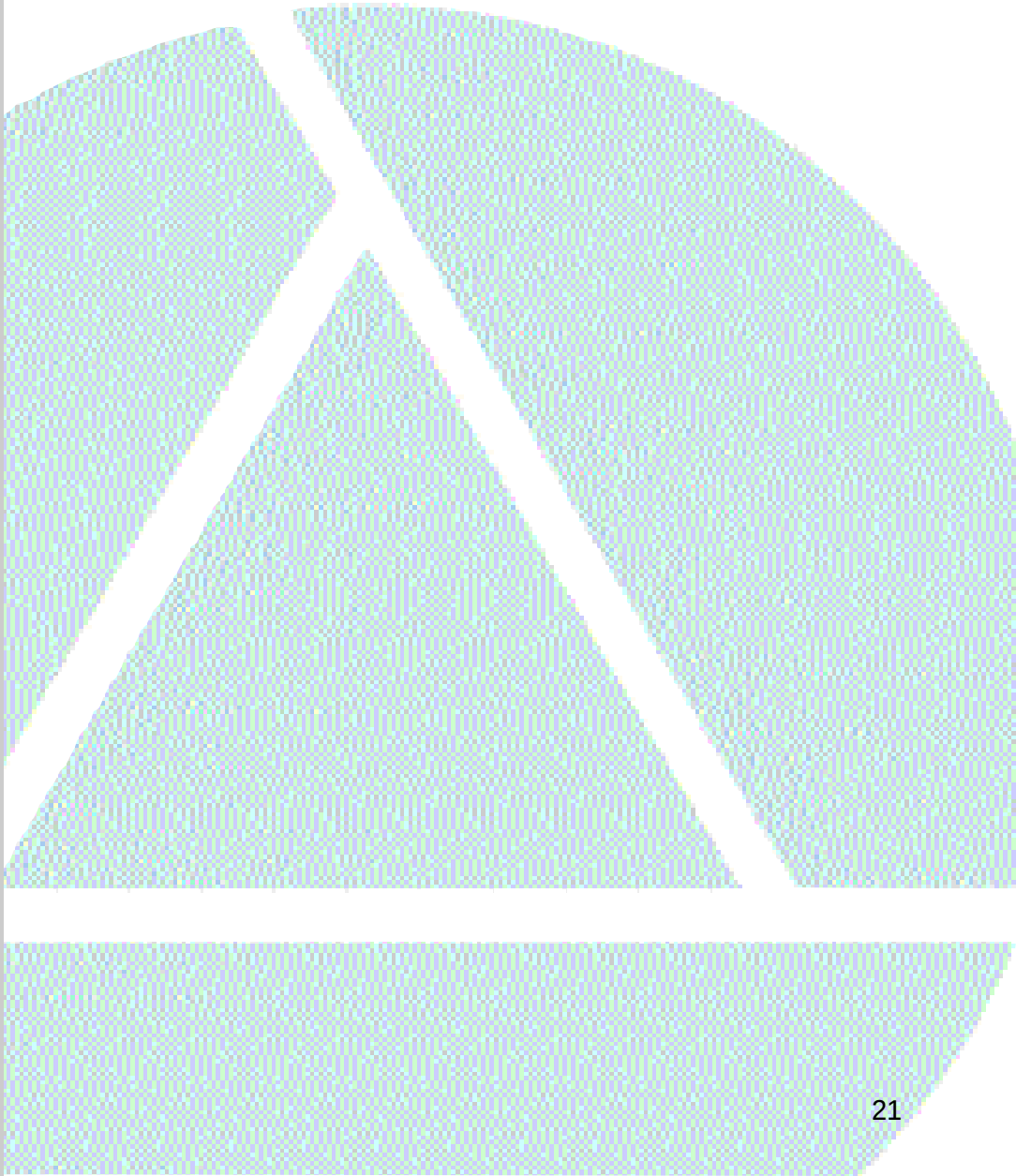


part 1 the audit: its purpose, scope, and process

There is little doubt that a major earthquake will happen at some time in British Columbia. It is not a question of "if"; it is a question of "when."

What Led to the Audit

Living in the Province of British Columbia is a privilege that most of its citizens appreciate—few other locations offer such an attractive blend of climate, scenery and lifestyle. However, choosing to live here does involve assuming one risk that is much greater than in most other parts of Canada: the risk that a major earthquake may occur. This risk is particularly high in the southwestern region of the Province.

When this event occurs (and there is much evidence that it will), experts suggest there is high probability of significant loss of life as well as costly damage to infrastructure such as buildings, roads, and water, electrical and sewer services. To understand the importance of being "ready" in British Columbia, one need only look at the damage, destruction and loss of life that occurred in San Francisco in 1989, in the Northridge area of Los Angeles in 1994, and in Kobe, Japan, in 1995.

The state of emergency preparedness in southwestern British Columbia was tested during the winter of 1996/97 by the exceptionally heavy snowfalls that occurred on the Lower Mainland and Vancouver Island. While not being major disasters on their own, the snowfalls did raise several questions about the capability of governments to deal with such events. In many communities, transportation routes remained impassable for several days, the flow of public information was disrupted, and other challenges similar to those that might result from a major earthquake had to be met.

In the aftermath of the storm, the Attorney General of British Columbia called for a review of how well prepared government organizations are to respond to disasters occurring in the Province. Our Office was already in the process of planning a performance audit of earthquake preparedness in the Province and, after reviewing the purpose and scope of our work, the Attorney General decided that his objectives would be met by the audit we were undertaking.

Courtesy: Office of Emergency Services, State of California

Extensive building damage can be expected

The Audit Purpose

The purpose of the audit was twofold: to assess the degree to which governments in British Columbia are prepared for a major earthquake in high hazard areas of the Province; and to determine what actions, if any, are needed to raise the level of preparedness to an adequate standard.

By *governments,* we meant both the provincial government, and local governments, the latter having primary responsibility for response in the event of an earthquake.

By *major earthquake,* we meant an earthquake greater than 6.0 on the Richter scale.

By *high hazard areas,* we meant Vancouver Island, the Queen Charlotte Islands, the Lower Mainland, and the coastline extending north to the British Columbia-Yukon border.

And by *adequate standard of preparedness,* we meant one that reflects the generally accepted principles of emergency management and that is reasonable in relation to other earthquake-prone jurisdictions.

What the Audit Covered

Our audit focused on the critical elements of earthquake preparedness. These are:

- understanding the hazards, risks and vulnerabilities;
- mitigating the potential effects of a major earthquake;
- planning for response to a major earthquake; and
- planning for recovery from a major earthquake.

Specifically, we were interested in examining how well all of these elements are being handled by the provincial government and local governments (although one important segment of the work examined the relationship between the provincial and federal governments in earthquake planning). This included examining the governments' roles in mitigating the potential impacts of a major earthquake through, for example, the appropriate design and enforcement of building codes and the fostering of public awareness. We also studied the extent to which current, tested plans are in place for responding in the immediate aftermath of a major earthquake. As well, we looked at the capability of governments to carry on providing essential services to the public through proper continuation and recovery plans. Our examination focused on the plans and procedures in place during the period April to July 1997.

It was not practical for us to assess the degree of preparedness in all areas of the Province. We therefore limited the bulk of our information gathering to the areas of high hazard and high risk. In emergency preparedness literature, a *hazard* is defined as the threat of a disaster arising from a natural or human-made occurrence. A *risk* is the potential threat that the hazard presents to persons and infrastructure.

Within the high hazard areas, we focused primarily on the high risk areas (high risk, for this purpose, being those areas of high population density): Greater Vancouver and Greater Victoria. However, we also gathered and assessed information with respect to the state of preparedness of local governments in other parts of the high hazard areas. As a result, we believe that many of our recommendations and suggestions will strengthen the provincial government's and local governments' ability to prepare for and respond to earthquakes no matter where these occur.

Ultimately, effective preparedness depends upon the involvement and cooperation not only of governments at all levels, but also of the private sector and the public. It was,

however, beyond the scope of this audit to ascertain the state of preparedness of these sectors. Nevertheless, we did examine the general ways in which governments communicate with these sectors and, when examining preparedness plans, we assessed the extent to which these sectors were duly considered.

Finally, although it was not part of the audit, we also carried out a limited review of the "Blizzard of '96" to determine which features of the emergency management system did and did not work well, and to assess the implications of this for earthquake preparedness in the Province.

How the Audit Was Done

Our examination was performed in accordance with value-for-money audit standards recommended by the Canadian Institute of Chartered Accountants and included such tests and other procedures we considered necessary in the circumstances.

In designing the audit and interpreting and reporting the findings arising from it, we sought the advice of several emergency planning experts from Canada and the United States. Their contributions helped us assess what would be a reasonable state of preparedness for British Columbia, relative to what is being done in other jurisdictions.

Our experts were:

Project consultant:

Bruce Ward (Deputy Director, Emergency Operations, Planning and Training, Governor's Office of Emergency Services, State of California)

Project advisors:

Major General Clive Addy (Retired) (former Chief of Staff of Canadian Forces in Europe and Chief of Staff of Canadian Army and, from 1994 to 1996, responsible for the Canadian Forces response to crises and disasters in the four western Canadian provinces)

Mark Egener (former CEO, Alberta Public Safety Services and Chairman, Major Industrial Accidents Council of Canada)

Henry Renteria (Emergency Services Manager, City of Oakland, California)

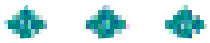
Ray Williams (Deputy Regional Director, Region 10—Alaska, Idaho, Oregon and Washington—United States Federal Emergency Management Agency)

Our process for gathering evidence of earthquake preparedness in the Province had three main thrusts.

First, we interviewed officials of the Provincial Emergency Program and representatives with responsibilities for emergency planning in federal and provincial ministries and Crown corporations. As well, we spoke to elected representatives, municipal administrators and emergency coordinators in a selected number of local government organizations, and to individuals outside the immediate government sector for whom the extent of earthquake preparedness has significant business implications, such as representatives from ports, airports and the insurance industry.

Second, we examined earthquake plans, agreements and other documentation that together constituted the current arrangements in place and the planned initiatives for future developments.

Third, we distributed a questionnaire to all local governments, police forces, fire departments and hospitals in the high hazard areas. The aim of this survey was to discern how well local governments would be likely to respond to, and recover from, a major earthquake.



part 2 earthquakes in British Columbia: why we should be concerned

In the immediate term, the extent to which individuals are able to look after themselves and their families can make the difference between surviving the aftermath of a major earthquake or not. In the longer term, it may be impossible for governments to compensate the public in any significant way for the value of property losses arising from a catastrophic earthquake. Such losses could run to many billions of dollars, and may exceed by far the current total annual budget of the Province.

After the Earthquake

We take many things in life for granted. We are generally aware of what these are, because we get reminders of them from time to time. Occasional ill health, for example, reminds us (at least until we recover) of how much we take good health for granted. However, there are other matters we never think about—and because we don't, when an event happens that does make things drastically different, it is a traumatic and disorienting ordeal for those who experience it.

One of these matters is the firmness of the ground beneath our feet. There is little doubt, however, that a major earthquake will happen at some time in British Columbia. It is not a question of "if"; it is a question of "when."

What can we expect in the aftermath of a major earthquake? Initially, buildings will be damaged and some may even collapse, resulting in injuries and loss of life. Lifelines may be disrupted—electricity and gas facilities may be extensively damaged, and it may be some days or weeks before these services are available again.

Most earthquakes are followed by aftershocks. Any shocks that come after the largest one, or mainshock, are referred to as aftershocks, and the larger the mainshock, the larger are likely to be the aftershocks. The largest aftershock is usually about one magnitude less than the mainshock. Any large earthquake is likely to produce several strongly felt aftershocks within the first hours, yet occasionally large aftershocks may occur months after the mainshock.

In the epicentre region of a large earthquake, transportation routes may be unusable. Landsliding and liquefaction (a process in which water-saturated, soft, loose soil is transformed to a liquid as a result of earthquake shaking) may damage highways, airport runways, and port facilities. Evacuating people and

The Cost of an Earthquake

Major earthquakes in North America and other locations have produced catastrophic results. In San Francisco, for example, the Loma Prieta earthquake of 1989 resulted in the loss of 64 lives, injuries to 300 people, and $10 billion in property damage. A similar number of lives were lost in Los Angeles' Northridge earthquake in 1994, and property damage exceeded $40 billion. In Kobe, Japan, the earthquake of 1995 killed 5,000 people, injured 3,000, made 300,000 homeless (40,000 still remain in temporary modular trailer homes pending completion of high rise condominiums), and caused more than $200 billion in property damage.

bringing in relief resources may be difficult. Providing accommodation to people rendered homeless will be a major challenge. And, the closure of ports and commercial facilities may produce economic effects felt thousands of miles beyond the area where the earthquake occurs.

Communications will certainly be subject to disruption. Telephone lines may be down, and public communications such as television and radio may be out of service. The resulting uncertainty is likely to add to the distress and anxiety of those who are waiting for help, as well as those who are wanting to provide assistance and support.

It may be some days before relief efforts reach much of the population. Merely identifying those areas most affected will take time, even before help is mobilized. For this reason, it is important that people be able to look after their own needs for at least 72 hours after the earthquake.

Even when emergency relief has been delivered to those in need, the process of getting back to normal may take many years, even extending beyond the lifetime of many of the population. And, restoring business confidence, reviving the economy and rebuilding the infrastructure (both public and private) could be a slow and expensive process.

Even knowing all this, however, many people still view earthquakes as "low probability, high consequence" events. This makes it difficult to encourage a high level of personal awareness and preparedness; people tend to believe that an earthquake will never happen—and if it does, the effects will be such that nothing they can do individually will change the outcome. This attitude encourages the belief that governments will step in to provide immediate help, and will protect the public from financial loss arising from the destruction of private property.

None of these views is realistic.

In the immediate term, mobilizing a response to a major earthquake takes time: priorities must be established, emergency centres must be set up, and resources must be moved to where they are most needed. The size and geography of British Columbia are not advantages in this regard. For example, moving emergency relief equipment from the Lower Mainland to southern Vancouver Island will take time. Clearly, the extent to which individuals are able to look after themselves and their families can make the difference between surviving the aftermath of a major earthquake or not, particularly during the critical 72 hours immediately following the event.

In the longer term, it may be impossible for governments to compensate the public in any significant way for the value of property losses arising from a catastrophic earthquake, even if they wish to. Such losses could run to many billions of dollars, and may exceed by far the current total annual budget of the Province. In such circumstances, it is not reasonable for private citizens to expect anything beyond token financial assistance—if that. Individuals should be expected to take all reasonable steps to mitigate losses of their own property.

Given this situation, what we are prepared to spend on earthquake preparedness should not be considered a cost, but an investment to protect our communities during and beyond our own lifetimes. It may be the best legacy we can leave to future generations of British Columbians.

Investing in earthquake preparedness is not always cheap, but viewing the risk on the long-term continuum supports a long-term, affordable strategy for addressing it. An adequate state of preparedness cannot be accomplished overnight. However, by developing an effective, long-term strategy, that state can be achieved over time at a cost that the community can afford.

How Earthquakes Happen

In compiling this information and that which follows relating to seismic hazard, we would like to acknowledge the invaluable assistance of the Geological Survey of Canada at the Pacific Geoscience Centre in Sidney, British Columbia.

An earthquake is the rapid shaking of the earth's surface that follows the sudden release of energy within the earth. The energy is released by a sudden fracture between large blocks of material. This movement, or "snapping" into new position, creates vibrations—seismic waves—that are felt as they reach the earth's surface. The point at which energy is released is the "focus" of the earthquake and may be many kilometres below

the earth's surface. The point on the earth's surface directly above the focus is called the epicenter. The seismic waves can be felt over a wide area, up to several hundred kilometres from the fault. As the distance from the epicentre increases, energy is dissipated and the amplitude of shaking decreases.

Measuring the Strength of Earthquakes – the Mercalli and Richter Scales

The Richter scale measures the magnitude or energy release of an earthquake. Values calculated by different seismological agencies will all be similar. The Mercalli scale estimates the intensity of ground shaking and thus the values get smaller further away from the epicentre.

The development of the Richter scale allowed for a consistent measure of magnitude, making it easier to compare earthquakes regardless of location. The scale, designed in 1935 by Charles F. Richter, a seismologist then living and working in California, expresses the magnitude of an earthquake calculated from motion of the ground. The scale is logarithmic, in that an increase of one unit on the scale represents a 10-fold increase in the amplitude of the seismic waves that shake the ground. For example, a magnitude 6 earthquake is 10 times greater than a magnitude 5, and 100 times greater than a magnitude 4.

The Modified Mercalli scale measures the intensity of an earthquake by reference to effects of the earthquake actually observed and experienced. The original scale was developed in 1902 by Guiseppi Mercalli, an Italian geologist, and was adapted to North American conditions in 1931. The scale has 12 levels, from level I (instrumental – detected only by seismographs) to level XII (catastrophic – total destruction; objects thrown into air, much heaving, shaking and distortion of ground).

The use of the Mercalli scale has some disadvantages. While it can estimate the strength of earthquakes in inhabited areas, it is less useful for measuring earthquakes in remote and unpopulated areas.

There is an upper limit in terms of shaking. When an earthquake approaches a magnitude of 7.25, the energy developed breaches or fractures the earth's crust. At that point, the shaking reaches a threshold and does not become more violent. What does happen, however, is that the shaking spreads over a larger geographical area. The duration of ground shaking also increases: higher magnitude earthquakes may produce many minutes of ground shaking.

Courtesy: Office of Emergency Services, State of California

Debris requires prompt removal from streets

Knowing that the ground shakes during an earthquake does not give emergency planners and others involved in seismic safety much information with which to work. There must be some means of identifying the areas that are most at risk so that an appropriate focus can be given to earthquake planning. The concept of seismic hazard "mapping" helps planners to make these geographical comparisons.

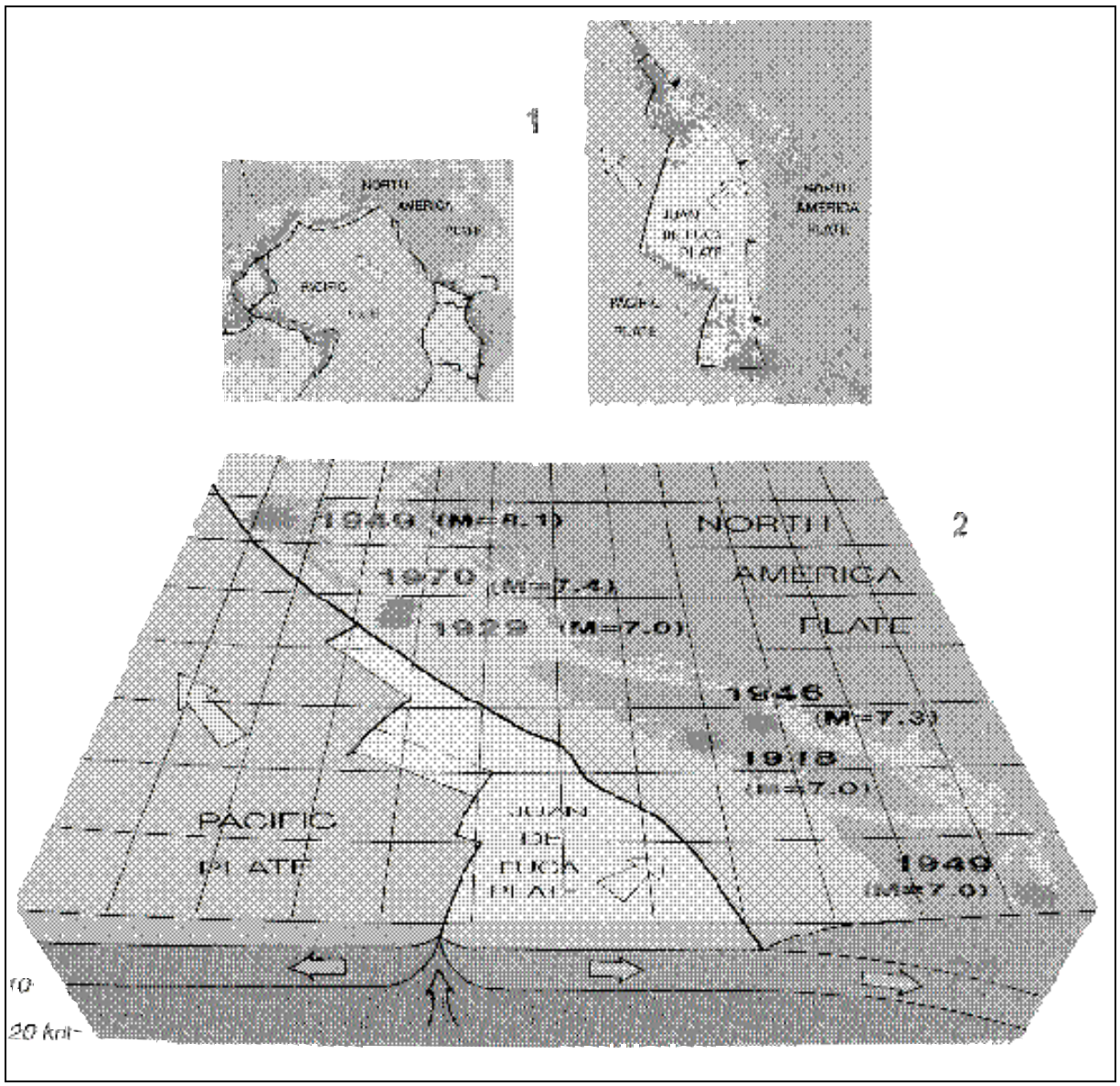
What Is the Seismic Hazard in British Columbia?

The risk of a major or even catastrophic earthquake occurring in British Columbia is high! Much of the Lower Mainland and Vancouver Island falls into zones of greater seismic hazard.

Southwestern British Columbia lies over the active Cascadia subduction zone in an earthquake environment comparable to that existing along the coasts of Japan, Alaska, and Central and South America. As Exhibit 2.1 shows, there is considerable earthquake activity along the faults separating the three plates lying to the west of the North American continent.

Exhibit 2.1

1. Subduction zones (barbed lines) around the Pacific are sites of large earthquakes
2. Large earthquakes have occurred in the coastal regions and the subduction zone setting has potential for even larger events.



Source: Geological Survey of Canada

The stresses that arise between the North American and Juan de Fuca plates are considerable. Vancouver lies at the north end of a zone of high seismic activity, which extends to the south end of Puget Sound. Locations in this area are exposed to shaking from crustal earthquakes, subcrustal earthquakes arising from within the Juan de Fuca plate and large subduction earthquakes. Records show that major damaging earthquakes

Types of earthquake exposure in southwest British Columbia

Two plates parallel the North American coast: the North American plate, on which both Vancouver and Victoria are located; and the Juan de Fuca plate, which abuts the North American plate at the surface approximately 30 kilometres offshore.

Crustal earthquakes originate in the North American plate at depths ranging to 30 kilometres.

Subcrustal earthquakes, on the other hand, develop in the Juan de Fuca plate (a plate that slides under the North American plate) and extend to depths of 90 kilometres.

Subduction earthquakes form at the boundary between the North American plate and the Juan de Fuca plate. These earthquakes are rare in that there is relatively little movement between the edges over time; the plates are often described as "being stuck." However, when internal stresses and forces exceed certain limits, the plates suddenly move, and the resulting rupture and release of energy are even greater than with crustal and subcrustal earthquakes. This may occur once every 300 to 800 years.

have occurred over this zone in 8 of the last 125 years and that a great earthquake is likely once every 300 to 800 years. The last great earthquake in Canada occurred off the Queen Charlotte Islands in 1949 and was magnitude 8.1. In recent years, earthquakes exceeding 7 on the Richter scale have been recorded in British Columbia, (as illustrated in Exhibit 2.1).

Scientists with the Geological Survey of Canada indicate that because subduction earthquakes are among the world's largest, those along the west coast of Vancouver Island are likely to exceed magnitude 8 on the Richter scale and to have effects comparable to those caused by the 9.2 magnitude earthquake that occurred in Alaska in 1964. Scientists believe a massive subduction earthquake—estimated to be 9 on the Richter scale—occurred offshore from Vancouver Island, Washington and Oregon in 1700.

A subduction earthquake can rupture a geographical area and have a significant impact over an area as large as 1,000 kilometres long and hundreds of kilometres wide. The earthquake can occur at any point at which the plates converge or along the whole length of the convergence. (Since the boundary between the North American and Juan de Fuca plates is approximately 70 kilometres from the city of Victoria and 150 kilometres from the city of Vancouver, this puts the two areas well within potential reach of strong shaking from a subduction earthquake.) As the distance from the earthquake fault increases, energy is dissipated and the amplitude of the shaking decreases. Nevertheless, it is the location of the fault in relation to the high risk/heavily populated areas that determines the degree of damage. For example, both the Loma Prieta earthquake in San Francisco (1989) and the Kobe

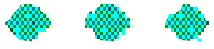
earthquake in Japan (1995) registered magnitude of 6.9, yet damage in the former exceeded $10 billion, while damage in the latter exceeded $200 billion. In the case of San Francisco, the epicenter of the earthquake was approximately 100 kilometres away. In the case of Kobe, the epicenter was directly beneath the city.

Crustal earthquakes are the greatest hazard to the Lower Mainland and Vancouver Island. Forty years of earthquake monitoring in southwest British Columbia has revealed persistent crustal earthquake activity. In fact, there are between 200 and 300 such earthquakes each year in southwest British Columbia, and about 90% of small earthquakes in the Lower Mainland occur in the continental crust of the North American plate.

In this geographical region, there have been three significant crustal earthquakes in the past century. In 1872, an earthquake of magnitude 7.4 occurred in northern Washington State. And in 1918 and 1946, earthquakes of magnitude 7 and 7.3, respectively, occurred on Vancouver Island.

While most of these earthquakes tend to originate at depths of approximately 20 kilometres, there is a subset of small earthquakes that occur in the upper 10 kilometres of the earth's crust. The larger of these shallow events, though rare, have long after-shock sequences typical of California earthquakes. Because the distribution and maximum magnitude of these earthquakes are difficult to assess, they represent the greatest source of uncertainty for scientists trying to assign seismic hazard to a region.

Also important to recognize is that areas of the Province other than the southwest are earthquake-prone. Numerous earthquakes occur along the entire coastline. As well, there have been significant occurrences near the Rocky Mountains.



part 3 the stage for earthquake preparedness in British Columbia: legal authorities and key players

Both provincial and local governments have the power to declare states of emergency. In such cases, normal day-to-day operations are suspended and governments assume additional powers to deploy resources and take what actions are needed to protect the public.

Earthquake Preparedness—Who Has What Powers

In this part, we summarize the legislative framework that governs the approach to earthquake planning in the Province, and we describe the key agencies responsible for planning and coordinating earthquake preparedness activities.

The Legislative Framework

To authorize the implementation of emergency management programs, each level of government must put in place appropriate statutes, regulations and bylaws.

In British Columbia, these include:

- by the provincial government:
  - the Emergency Program Act
  - the Emergency Program Management Regulation
  - the Local Authority Emergency Management Regulation
  - the Compensation and Disaster Financial Assistance Regulation
- by local governments:
  - Municipal/regional district bylaws
  - the Municipal Act

As well, the federal government has established:

- the Emergencies Act
- the Emergency Preparedness Act

The Emergency Program Act in British Columbia, with its supporting regulations, assigns roles and responsibilities to the Provincial Emergency Program (an agency within the Ministry of Attorney General) provincial government ministries and local governments, and allows the provincial government to compensate to some degree individuals, businesses and governments for losses resulting from major disasters. The

framework also enables local and provincial governments to declare states of emergency when a major disaster occurs, whereby normal day-to-day operations are suspended, and governments assume additional powers to deploy resources and take what actions are needed to protect the public.

Local governments, as first responders in the event of a disaster, are required to develop plans for preparing for, responding to, and recovering from emergencies. Provincial ministries and government corporations also are required to develop emergency and business continuation plans for key functions covered by their business operations. These plans enable the provincial government to assist local governments, where needed, in providing food, clothing, transportation, medical services and other assistance for afflicted communities.

The Provincial Emergency Program (PEP) has two major roles to play. It provides support and advice to the minister responsible (currently the Attorney General), other provincial government ministries, Crown corporations and local governments about developing emergency plans and programs. And it also is made responsible for coordinating, or assisting in coordinating, the provincial government's response to a major disaster.

Federal legislation calls on the Government of Canada to identify civil emergency contingencies, develop emergency plans, conduct training and exercises, and test national plans for all hazards, including earthquakes, in conjunction with provincial authorities. It allows the federal government to provide help to provincial governments where requested, and to declare a state of emergency in circumstances where this is needed to provide such assistance.

The following is a more detailed summary of the main aspects of the legislation and regulations.

Provincial Legislation and Regulations

The Emergency Program Act was enacted in 1993 to replace earlier legislation from the Cold War era which focused mainly on war-related concerns. The Act:

outlines the responsibilities and authority of the minister, PEP, and local governments. Specifically, it requires the minister to prepare emergency plans pertaining to the preparation for, response to and recovery from emergencies and disasters. It also allows the minister to:

– conduct public information programs;

  - recommend preventative measures to alleviate the effects of emergencies or disasters;
  - enter into agreements;
  - make payments and pay grants to local authorities to assist in emergency prevention, preparation and response;
  - establish training programs;
  - provide support to volunteers;
  - review and recommend modification of local emergency plans of local authorities; and
  - delegate to the director of PEP all of the powers given to the minister under the Act, except those relating to provincial and local states of emergency;

- establishes that a local authority is at all times responsible for the direction and control of the local authority's emergency response; and
- enables the Province to provide disaster financial assistance to persons who suffer loss as the result of a disaster.

Under the Emergency Program Act, both provincial and local governments have the power to declare states of emergency. These will usually only be declared where immediate and dramatic action is needed to neutralize a threat to public safety. In such cases, normal day-to-day operations are suspended, and governments assume additional powers to deploy resources and take what actions are needed to protect the public.

The powers include the ability of the minister or head of local government to:

- acquire or use any land or personal property considered necessary to deal with the effects of an emergency;
- authorize or require any person to render assistance if that person is qualified to do so;
- evacuate people; and
- acquire, set prices for and ration food, clothing, fuel, equipment and medical supplies.

The Emergency Program Management Regulation, which came into effect in 1994, describes in greater detail the responsibilities of PEP. Among other things, the agency is required to:

- carry out a hazard, risk and vulnerability study to identify potential emergencies that could affect any part of the Province, and to assess the impact of these studies on people and property;

- make recommendations to the minister about legislation and policy, and about creating and maintaining an emergency management program;
- provide advice to other ministers regarding the development of multiministry or multiagency emergency plans and procedures;
- provide advice and assistance to local authorities in development of local emergency management organizations and local emergency programs; and
- coordinate, or assist in coordinating, the government's response to emergencies and disasters.

And, at the minister's request, PEP must:

- prepare, or assist in preparing, provincial emergency plans; and
- assist local authorities in responding to and recovering from emergencies, and in developing emergency plans in which a number of governments may participate.

PEP is also given some discretionary powers under the regulation. These include:

- providing advice to other ministers, business and industry on emergency management issues;
- conducting training; and
- assisting local governments in coordinating their emergency plans with those of the provincial government, its ministries and corporations.

The regulation assigns responsibilities to ministers in the government and to government corporations. Each minister must develop emergency plans and procedures, including those intended to assist local authorities where those authorities are overwhelmed in a disaster. The regulation also imposes a specific requirement for business continuation planning to enable the government to continue to provide essential services.

The regulation also establishes an Inter-Agency Emergency Preparedness Council, and states that every minister referred to in a schedule attached to the regulation must appoint one representative to the Council.

The responsibilities that the Province has assigned to local governments are set out in the Local Authority Emergency Management Regulation. Under this piece of legislation, each local authority must:

- develop local emergency plans for preparing for, responding to and recovering from emergencies and disasters;
- establish and maintain an emergency management organization; and
- provide a program of emergency response exercises and a training program.

The plans must specifically address the coordination of food, clothing, shelter, transportation and medical services, and must also set priorities for restoring essential services, both by the government and the private sector.

The Compensation and Disaster Financial Assistance Regulation identifies who is eligible to receive financial assistance for property and other losses arising from disasters, including earthquakes, and the amounts that may be involved. The regulation:

- requires governments to compensate property owners for loss or damage to property that is used by governments in an emergency; and
- allows, but does not compel, the government to provide financial assistance for property losses resulting from disasters, as long as certain criteria stated in the regulation are met.

The program is available to property owners, individuals, farms, small businesses, charitable or volunteer organizations and local governments. For claimants other than local governments, the maximum payable for an accepted claim is $100,000.

Municipal/Regional District Bylaws

To establish an emergency management organization and to set up an emergency management program, local governments must pass bylaws that authorize these activities. The bylaws enable the local governments to carry out the responsibilities charged to them in the Local Authority Emergency Management Regulation, described above.

Regional districts are not required to have emergency plans under current legislation (except for unincorporated areas of the Province). However, if the member jurisdictions of a regional district so decide, the regional district can apply under the Municipal Act for the additional powers needed for it to assume responsibility for emergency planning for all or part of the entire district.

Federal Legislation

The Emergency Program Act for British Columbia is complemented by two pieces of federal legislation: the Emergencies Act and the Emergency Preparedness Act.

The Emergencies Act defines four types of national emergencies, two of which affect British Columbia earthquake preparedness:

Public welfare emergency – an emergency, such as a natural disaster, epidemic, accident or pollution, that may be declared for an initial period of 90 days by the federal Cabinet, after consultation with the provincial governments of all affected provinces. If the emergency is confined to one province, the declaration can only be made when the Lieutenant Governor in Council of the province has indicated that the emergency exceeds its capacity or authority to deal with it.

Public order emergency – an emergency that arises from threats to the security of Canada and that is so serious as to be a national emergency. It may be declared for an initial period of only 30 days by the federal Cabinet, after prior consultation with the provincial government, in the event the province's capacity or authority to deal with the emergency has been exceeded.

Under the Act, a national emergency may not be declared unless whatever is requested of the federal government cannot be done under any other federal legislation.

The Emergency Preparedness Act established Emergency Preparedness Canada as the federal coordinating agency for civil emergency planning. The Act requires that federal ministers identify and plan for civil emergency contingencies related to their normal areas of accountability. The plans developed should include provision for assistance and advice, as appropriate, to provincial governments and, through them, to local authorities. The plans must be tested and adequate training provided.

The Act also authorizes the federal government:

- to make regulations regarding the provision of assistance (including financial assistance) to a province, when a provincial emergency is deemed of concern to the federal government and the province has requested assistance; and
- to enter into agreements with provinces regarding emergency planning and response.

The Canada-British Columbia Memorandum of Understanding on Emergency Preparedness, signed in April 1988, is one such

Courtesy: Office of Emergency Services, State of California

Building codes aim to prevent structural collapse

agreement. It sets out the responsibilities of the two levels of government during emergencies, and establishes the tasks that should be carried out by each party.

In 1995, the federal government updated and confirmed a Federal Policy for Emergencies, originally adopted in 1980. The policy indicates that individuals, municipalities, provinces and the federal government—in that order—are responsible for preparing for, and responding to, emergencies and disasters according to their level of competence.

It is expected that any federal support to the provincial response effort will be conducted under the overall direction and control of the responsible provincial government, or in the event of a primary federal or national emergency, in close collaboration with provincial responders. Because provincial governments are largely responsible for handling public welfare or public order type emergencies contained within their borders, federal government planning concentrates on supporting them in that role. The federal government is largely responsible for the response to international and war emergencies, and for the coordination, at the request of the province, of national and international support to public welfare and public order type emergencies.

Key Agencies and Programs

Provincial

The Lead Agency: the Provincial Emergency Program

Implementing an earthquake program in the public sector involves many government organizations. A lead agency must therefore be established to ensure that what needs to be done gets done—and it must be accountable for results. This agency should also provide political decision-makers with assessments of how policy and funding decisions across government are likely to affect the government's overall ability to respond adequately to an earthquake.

The lead agency in British Columbia for promoting sound management of emergencies and disasters is the Provincial Emergency Program (PEP). As the lead agency, PEP sets specific functions for the agencies, including ministries of the provincial government, that support its activities.

PEP administers the Emergency Program Act of 1993. The Act makes PEP responsible for "carrying out the powers and duties vested in it by the act, the regulations and the minister." It also makes provision for "a director and any officers and employees required to enable the Provincial Emergency Program to perform its duties and exercise its powers."

PEP is part of the Public Safety and Regulatory Branch of the Ministry of Attorney General (Exhibit 3.1). Its mandate is to maintain and enhance the development and coordination of provincial emergency planning, preparedness, response and recovery to prevent or mitigate the effects of natural or other disasters. It is directly responsible for emergency response operations in the Stikine region of British Columbia, where there is no local government structure, but it may assume direction and control of response operations in organized areas of the Province where local governments have requested that the provincial government assume that responsibility. This might occur, for example, as a result of a catastrophic event in which the local government has been rendered incapable of providing direction and control.

PEP is intended to provide leadership in emergency planning for the provincial government, its ministries and Crown corporations, and municipalities and agencies. This includes:

- coordinating the provincial response to emergencies (notification, needs assessment, logistical support, communications and public information);

Exhibit 3.1

Positioning of the Provincial Emergency Program in the Ministry of Attorney General

Source: Ministry of Attorney General

- providing emergency planning advice and assistance to regional and municipal governments, and assistance to industry;
- maintaining and operating the government's Emergency Operations Centre for major emergencies;

- directing operations for those emergencies not assigned to another ministry of government;
- developing plan standards and specifications, and reviewing the status of plans and their content;
- creating public awareness of the need for emergency preparedness;
- providing support to mandated search-and-rescue agencies and emergency service volunteers;
- administering provincial/federal disaster financial assistance arrangements; and
- providing training for provincial government staff, municipal officials, volunteers and the public.

PEP has an operations budget of $2.1 million (1997/98 voted expenditure) with an additional $12 million (1997/98 Estimates) for preparedness, response and recovery costs related to emergencies or disasters. The program employs 38.5 full time employees, augmented by 7 contract personnel at the Justice Institute. There are about 17,000 volunteers involved in air service, search and rescue, communications, emergency social services and other activities.

The resources expended by PEP for emergency planning over the past four years, with the comparable projection for 1997/98, are shown in Exhibit 3.2.

The Inter-Agency Emergency Preparedness Council

The Inter-Agency Emergency Preparedness Council was created under the *Emergency Program Management Regulation.* Its membership consists primarily of government employees

Exhibit 3.2

Resources of the Provincial Emergency Program

	1993/94	1994/95	1995/96	1996/97	1997/98
Total funds ($millions)	$3.440	$3.435	$3.753	$3.361	$3.217
Staff	35	36	40	42	38.5

The 1997/98 projection includes anticipated resource allocations from the ministry's general funds.

Source: Ministry of Attorney General

who are responsible for emergency planning in their ministries, Crown corporations or other agencies. The purpose of the Council is to recommend to the provincial government what coordinated emergency prevention, preparedness, response and recovery measures it should adopt for British Columbia.

The scope of its operations includes developing and promoting policies and procedures for a government-wide emergency management system. As well, it is expected to promote emergency management principles to other levels of government, non-governmental agencies, industry and the general public.

Federal

The Lead Agency: Emergency Preparedness Canada

The federal role is to identify civil emergency contingencies, develop emergency plans, conduct training and exercises, and test national plans for all hazards, including earthquakes, in conjunction with provincial authorities. The principal federal agency for emergency planning and coordination is Emergency Preparedness Canada. This agency—that has a regional office in Victoria, British Columbia—is charged with advancing civil preparedness in Canada of all types, including the four types of national emergencies set out in the Emergencies Act. This is accomplished by facilitating and coordinating, among government institutions and in cooperation with provincial governments, foreign governments and international organizations, the development of civil emergency plans and assisting, when required, in their implementation.

Emergency plans and preparations undertaken by the federal government focus on operations that:

- save lives and mitigate suffering;
- preserve peace, order and good government;
- respond to large scale disasters;
- assist provinces unable or less able to respond;
- relate to emergencies of a transborder or international concern; and
- promote risk analysis, warning and communication.

Federal government departments are assigned lead planning responsibility for emergency response functions in which they are considered most likely or most appropriate to play the predominant federal role. For example, while provinces are directly responsible for programs for emergency

health and social services, Health Canada is responsible for coordinating, and facilitating the eradication of, pandemics and foreign sourced diseases.

Regional Government Committees

Individual local governments are the first responders when an earthquake happens, and each develops its own programs to best meet the specific needs of its own community. As well as individual municipalities, there are also regional districts that look after regional issues such as the provision of water. Being able to provide these services after an emergency is a critical responsibility for the regional districts, and therefore many of them set up groups to carry out research and other work on emergency planning.

Such groups exist throughout the high hazard, high risk area that we focused on in our audit. Three committees that cover a substantial part of the population in the areas covered by this audit are the Regional Emergency Planning Committee, the Joint Emergency Liaison Committee and the Greater Victoria Emergency Coordination Committee.

The Regional Emergency Planning Committee

The Regional Emergency Planning Committee is a committee that includes emergency planners of municipalities in the Greater Vancouver Regional District (GVRD), representatives of PEP, and associate members from federal government departments and provincial government ministries and Crown corporations. The committee has existed since 1980, and has provided a valuable forum for discussing emergency planning issues for the Lower Mainland.

The Joint Emergency Liaison Committee

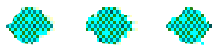
The Joint Emergency Liaison Committee was created by agreement between the government of British Columbia and municipalities within the GVRD to achieve improved emergency coordination among the municipalities and between the municipalities and provincial ministries.

It recommends to municipalities (through the GVRD's Regional Administrators Advisory Committee) and to the provincial government (through the Inter-Agency Emergency Preparedness Council) coordinated strategies for emergency preparedness, response and recovery in the GVRD area.

The goals of the Committee cover a wide range of emergency issues, including communications, plan testing and the prioritization of emergency management issues that require coordination among the members of the GVRD and with the provincial government. The Committee has been focusing on issues that, though identified as high priority, have no "owner" due to their being regional in nature. These issues include: provision of water; communications; resource management; urban search and rescue; structural assessment; and seismic upgrading of emergency routes.

The Greater Victoria Emergency Coordination Committee

The membership of the Greater Victoria Emergency Coordination Committee comprises the emergency program coordinators of the municipalities in the Greater Victoria area, as well as provincial government ministries and representatives from some Crown corporations. It has no specific financial resources, and decisions must be approved by the affected jurisdictions. The Committee is currently reviewing emergency coordination matters in the Greater Victoria area in an effort to standardize planning and coordination. It is examining such issues as emergency broadcasting, resource inventories and emergency transportation routes.



part 4 the audit assessment: how well prepared governments are in British Columbia

It is unlikely that all key aspects of the response efforts for a major earthquake will work as intended.

Overall Conclusion

We have concluded that governments in British Columbia are not adequately prepared for a major earthquake. However, we were impressed by the amount of earthquake planning that has taken place in recent years. The federal government, agencies such as the Provincial Emergency Program, and emergency planning officials in many local government organizations have been working hard to further the preparedness of the Province for such an event.

The provincial government and local governments are, in a general sense, aware of the hazards, risks and vulnerabilities associated with a major earthquake. However, they are likely to experience difficulty (albeit to varying degrees) in planning mitigation, response and recovery programs effectively because they have not yet developed specific, comprehensive scenarios for all high hazard, high risk areas of the Province. Through these scenarios, governments would be able to assess the likely impacts of a major earthquake on citizens, critical facilities, lifelines and economies—information that would better focus planning and public awareness programs.

Governments also have a general understanding of the importance of mitigation. However, it is unclear whether resources invested by provincial and municipal governments to upgrade infrastructure (such as bridges and dams) are being targeted to the highest priorities because a coordinated approach and a long-term strategy have not been developed. Furthermore, there is no assurance that all critical response facilities (such as fire and ambulance halls, and police stations) will remain operational after an earthquake, or that damage to hazardous buildings will not cause avoidable injury or death. Public apathy towards preparing for an earthquake remains high, despite a number of public awareness programs having been implemented.

It is unlikely that all key aspects of the provincial government's response efforts for a major earthquake will work as intended. The Provincial Emergency Program and most provincial government organizations have developed response plans that deal with key response functions, and some testing of those plans has been carried out. However, the overall provincial response plan, while sound in concept, is still in interim form after five years, and needs updating and finalizing. Some provincial government response functions, such as emergency social services, appear well prepared; others, such as the medical and heavy urban search and rescue functions, do not.

We believe that local governments are not yet adequately prepared to respond. The quality of local government earthquake planning varies widely. Some jurisdictions have taken the earthquake threat very seriously and are continuing to improve their response plans. Other jurisdictions have given less attention to developing sound plans. Nearly 20% of the local governments who answered our survey reported that there was no earthquake preparedness plan in their jurisdiction.

At all levels, testing of response plans is insufficient, and there are indications that more training is required. The ability of responders to communicate with each other and with different levels of government continues to be a concern, although steps are being taken to improve the situation.

Neither the provincial nor local governments are prepared to manage the recovery that will be necessary after a major earthquake. Business continuation planning—critical to effective short-term recovery—is almost non-existent at the provincial level. It is also generally lacking at the local level, although some municipalities are currently developing such plans. Procedures for inspecting and posting unsafe buildings do not exist, and little thought has been given to how the debris resulting from a major earthquake would be dealt with. Also, few governments have plans for expediting the repairs and rebuilding that would be necessary, and none has analyzed the financial options for funding a rebuilding program.

Understanding the Hazards, Risks and Vulnerabilities Associated With a Major Earthquake

Why Is This Element of Preparedness Important?

A good understanding of hazards, risks and vulnerabilities is of fundamental importance to all aspects of earthquake preparedness. Elected officials need to visualize the threat so that they can commit themselves to leadership in mitigating the hazards and planning for response. Provincial and local government officials need to reflect these factors in their decision-making for emergency planning. Private sector managers must understand the scope of the hazards so they can consider them in their business decisions process. Educators and journalists must use their understanding to ensure that the public is correctly informed about the character of the threat and the importance of being prepared to mitigate its effects. And the general public needs to appreciate the extent of their vulnerability if they are to be convinced to support public mitigation efforts and develop personal strategies for earthquake preparedness.

What Did We Expect to Find?

We expected to find that the provincial government and local governments were aware of all the hazards, risks and vulnerabilities associated with major earthquakes in British Columbia. This awareness would be based on scientific identification of the hazards, and on a comprehensive analysis, undertaken by qualified individuals, of the risks and vulnerabilities.

Also, we expected that the hazard identification and risk analysis would reflect the latest thinking from other earthquake-prone jurisdictions, and would be communicated to concerned parties.

Conclusion

The provincial government and local governments are, in a general sense, aware of the hazards, risks and vulnerabilities associated with a major earthquake. What they have not yet done comprehensively, however, is develop specific scenarios for all high hazard, high risk areas of the Province to assess the likely impacts of a major earthquake on their citizens, critical facilities, lifelines and economies—information that would better focus planning and public awareness programs.

Courtesy: Office of Emergency Services, State of California

Highway infrastructure is especially vulnerable

Some worthwhile scenario work has been undertaken for Lower Mainland communities within the last five years, but it was not intended to cover all of the critical components that scenarios generally include, such as potential damage to hospitals and schools. Overall, therefore, local governments and government organizations are likely to experience difficulty, albeit to varying degrees, in planning mitigation, response and recovery programs effectively.

Findings

Credible Information Available

The Pacific Geoscience Centre in Sidney, British Columbia, a facility of the Geological Survey of Canada (GSC), provides scientific verification of the earthquake hazard in the Province. As well as conducting geological surveys on- and offshore, the GSC evaluates seismic hazard, examines seismic processes and monitors earthquakes. It locates earthquake epicentres, calculates their depths, magnitudes and the mechanisms of fault motion, and makes estimates of seismic hazard for use in formulating the National Building Code and other purposes.

The GSC receives many requests for information, yet there are only three seismologists at the Pacific Geoscience Centre who deal with these matters. The Inter-Agency Emergency Preparedness Council, in its analysis of the state of emergency preparedness in British Columbia, concluded that "although federal government seismologists have clearly identified (mainly within scientific circles) the earthquake risk to British Columbia, additional scientific research is needed to improve earthquake scenarios used to improve preparedness activities."

In addition to the work of the Geological Survey of Canada, there is a lot more in the way of broader-based research on seismic hazard being carried out internationally. We believe much of this information could be of practical use to emergency planners at all levels of government. The acquisition, evaluation, adaptation and dissemination of this information is a role that the Provincial Emergency Program (PEP) could play, but one that it has not been able to do to date.

Planning Scenarios Required

PEP is required by the *Emergency Program Management Regulation* to prepare and maintain a hazard, risk and vulnerability study that identifies potential emergencies and disasters that could affect all or any part of British Columbia. In response to this obligation, PEP commissioned a "British Columbia Hazard, Risk and Vulnerability Analysis" in 1993 from the Disaster Preparedness Resources Centre at the University of British Columbia. The analysis identified those areas that are highly vulnerable to significant hazards, and so served as a starting point for developing a planning strategy to allocate resources effectively. We understand that PEP recently commissioned the Disaster Preparedness Resources Centre to update the original study, and to rank the priority of the hazards.

The next step after the preparation of the hazard analysis is translating the general earthquake hazard into a more area-specific planning tool—one that would explain in detail the hazards, risks, and potential impacts on citizens, critical facilities, lifelines and economies. The planning scenarios should, from the identified hazards, project the potential impact a major earthquake is likely to have on such structures as hospitals, schools, highways and electric power, natural gas, water supply and sewerage systems. In this way, emergency plans would offer a comprehensive range of planning considerations. This information could then be used to better

decide the nature and extent of mitigation necessary, the specific risks that need to be planned for, and the extent of recovery planning that is appropriate. And, perhaps most importantly, the information would bring to life for elected officials the real risks faced by those living in their constituencies.

Developing a specific scenario for each community is important because each may have unique exposures to risk. For example, differences in soil and geological conditions can affect the severity of an earthquake's impact.

Comprehensive scenario development has been incomplete and inconsistent. In 1993, the Regional Emergency Planning Committee commissioned the development of an assessment of potential damage that a major earthquake might cause to transportation and utilities lifelines in the Greater Vancouver area. While the study was also intended to be of use to planners for individual municipalities, its main focus appeared to be on stimulating cooperative planning efforts for dealing with issues of regional concern—and subsequent events indicate that it achieved some success. Because of its focus on regional issues, the study did not include by design an assessment of the damage to hospitals, schools and other municipal infrastructure, and therefore was not intended to be of itself a complete scenario.

We believe that a consistent and comprehensive level of scenario development is an important next step in improving the state of earthquake preparedness in British Columbia. While commendable work has been carried out by some, momentum needs to be maintained to develop earthquake scenarios that both are comprehensive and cover the high hazard, high risk areas of the Province. We see PEP as having a key role in being a catalyst for this future development.

Mitigation

What Is Mitigation?

Mitigation activities are those actions aimed at reducing the impacts on people and property of natural hazards and their effects. The basic concept behind earthquake mitigation is that, to the extent that the effects of a major earthquake can be anticipated, steps can be taken to minimize those effects.

Mitigation may be viewed as being both future-oriented and past-oriented. In looking to the future, mitigation is concerned with ensuring that: new buildings are built to a standard that will withstand a major earthquake and are not built on high-risk land areas; the private sector and general

Courtesy: Office of Emergency Services, State of California

Building codes aim to prevent structural collapse

public are aware of the hazards and risks associated with a major earthquake, and the steps they need to take to mitigate the potential impacts; and the use and potential benefits of insurance are maximized.

In addressing the past, mitigation is concerned with bringing existing buildings and other parts of the urban infrastructure up to a standard that reflects current knowledge—a process known as "retrofitting."

Building Codes

For many earthquake-prone jurisdictions, the use of building codes has been one of the main ways of reducing the damaging effects of earthquakes. The actual effects of earthquakes on buildings depend on a number of factors, including: the strength and location of the earthquake; ground response according to soil types; building code provisions in force at the time of building; the type and quality of construction; and the nature and extent of subsequent structural changes.

To address the seismic hazard (currently mapped as the level of horizontal ground shaking that has a 10% probability

of being exceeded over a 50 year period), building codes set out certain construction requirements that are intended to reduce the risk of a building collapsing during a major earthquake. Seismic hazard is important to know because the building code specifications are designed to endure a certain level of ground shaking—they are not tied directly to a magnitude of earthquake. For example, the level of ground shaking may be the same for a moderate earthquake close to the community as for a larger one farther away.

The seismic safety component of building codes goes a long way to saving lives and reducing the extent of injuries. However, it cannot (nor is it intended to) prevent significant structural damage to buildings. It is only aimed at minimizing the risk of collapse. Codes cannot assure that buildings can continue to be used for business after an earthquake. There are also often restrictions on the types of buildings to which certain provisions of a code apply. For example, buildings of less than a certain area or with fewer than a certain number of floors are sometimes exempt from a code's seismic considerations, because the nature of their construction is deemed to make them inherently seismically safe.

Land Use

In many jurisdictions around the world, earthquakes have killed and maimed people partly because buildings were erected in predictably unsafe sites where the seismic hazard was high. No-one had identified hazardous areas or determined safe uses for them.

Ideally, zoning and land-use decisions should reflect the susceptibility of buildings and other infrastructure components to damage, based on the soil conditions where they are built. For example, restrictions on land use may be imposed in areas close to oceans, which may be subject to liquefaction when a major earthquake happens.

Public Awareness

Educating and informing the public about earthquake hazards, risks and vulnerabilities in a way that causes them to change their perceptions and behaviour is a significant challenge for emergency coordinators everywhere.

Public awareness is important for a number of reasons. First, the more aware the public is of the earthquake risk and what precautions they should take, the more they have the opportunity to become better prepared. This should reduce the

consumption of resources during the response effort, and make prioritizing of needs less difficult.

Second, knowledge of the likely aftermath of an earthquake can also help the public form reasonable expectations of how the response effort might unfold. If people know that help is unlikely to arrive for at least 72 hours and even up to a week, the public and emergency responders can plan their activities rationally.

And third, public awareness can help the public develop an informed opinion of what it believes the role of government should be in earthquake planning and management. In this way, the public can convey its expectations to governments, and governments can promote a better community understanding of the issues and options involved.

Insurance

Insurance has an important role to play in mitigation, too. It will not dramatically reduce the total immediate cost of recovering from an earthquake, but it can significantly alter the way in which that cost is borne, by distributing it among a broader spectrum of risk bearers, both in Canada and overseas. It can also reduce the length of the recovery period, and thereby reduce the downstream costs to the community of financing recovery. Essentially, the higher the level of earthquake insurance, the less the financial burden that governments and individuals in the affected areas will need to bear.

Retrofitting

Information about the earthquake hazards and associated risks is always increasing. As a result, the seismic content of the National Building Code is revised from time to time to reflect the current state of knowledge about earthquakes. However, there is no requirement for the seismic robustness of buildings and other elements of the infrastructure to be upgraded as the seismic code changes (as long as there are no structural alterations made after the original construction). Thus, as more seismic knowledge is gained, the soundness of some structures may be in doubt even though they were built in accordance with the seismic provisions of the building code that were current at the time of building. In addition, some structures may, for a variety of reasons, not have been built in accordance with seismic safety standards. Retrofitting is a process of upgrading these structures to current standards. A program of retrofitting can be justified not only on the

Courtesy: Office of Emergency Services, State of California

High occupancy buildings such as theatres are a concern

grounds of ensuring public safety, but also on the grounds of minimizing the potential economic impact of major damage caused by an earthquake.

There are also many components of the provincial infrastructure that could result in large economic and personal deprivation if damaged. For example, an earthquake is likely to inflict some cracking, heaving, blockage and possible displacement on many roads—and those in areas susceptible to liquefaction are likely to sustain even greater damage as a result of soil instability. Bridges are at risk of collapse, both from substructure failure and from subsidence of the surrounding soil.

The seismic safety of dams is particularly critical. There are 43 major hydro dams in British Columbia (most of which are not in areas of major seismic risk), and many are located where, if they were to fail, considerable loss of life and damage would result in surrounding areas.

The water supply system is one of the most critical lifelines for effective post-earthquake response and recovery. A major earthquake is likely to cause at least temporary loss or contamination of the domestic water supply. The maintenance of drinking water is therefore an immediate priority for

emergency response management at all levels of government. Water for other purposes, including fire suppression, sewerage and personal use, must also be available.

Other important lifelines include electrical power and natural gas systems. Experience in California has shown that large earthquakes generally disrupt electric power service and often result in some damage to gas supply systems, especially to older components of transmission and distribution systems.

Certain types of buildings—referred to in some jurisdictions as "hazardous buildings"—have a greater risk of damage. Generally, hazardous buildings include unreinforced masonry buildings, older wood frame houses, tilt-up buildings, older concrete frame buildings and mobile homes. The extent of the risk for any of these buildings depends on the quality of construction, the degree to which seismic safety provisions for the type of building have been included in the building code, and soil conditions at the building's location.

Of particular importance are those buildings that would be critical in the post-earthquake response phase, such as fire and ambulance halls and police stations. If they were to fail, response would clearly be much more difficult. Of similar concern are high occupancy buildings such as theatres, group homes, office towers, and apartment buildings. The collapse of these could kill or injure many people. These buildings need to be identified, assessed and, if necessary, strengthened.

What We Expected to Find

We expected to find that the National Building Code had been modified by the provincial and local governments to take into account the hazards associated with a major earthquake; and we expected that governments would be enforcing their codes.

We also expected to find a coordinated approach to raising the level of public awareness of the earthquake hazards and risks and of the steps that the public should be taking to mitigate those risks. As well, we expected to see insurance against earthquake risks widely purchased.

Finally, we looked for a process in place to upgrade provincial and municipal infrastructures to current seismic standards. We anticipated this process would include identification and assessment of seismically suspicious structures, the estimation of the costs of required upgrade, and the establishment of a long-term program to carry out the upgrades.

Conclusion

Governments have a general understanding of the importance of mitigation, and some government organizations have in recent years devoted considerable effort to the topic. However, there is no overall long-term strategy that identifies the goals to be achieved, establishes priorities, and allocates funding over a multi-year period. As a result, it is unclear whether resources are being invested in mitigation activities in a way that reflects the highest priorities. We believe there needs to be a more comprehensive and coordinated approach in order to better mitigate the potential impacts of a major earthquake.

The Provincial Building Code—which forms the basis of codes adopted by regional jurisdictions—appears to be reasonably current in that it is regularly updated to reflect new seismic safety research and experience. And the majority of local governments responding to our survey believe the code is being enforced. However, local governments would benefit from having more information about how to interpret and apply the code to the hazards and risks in their own areas.

The consistent view of those to whom we spoke was that the public is generally apathetic about the risks of a major earthquake and is therefore not well prepared, despite the myriad public awareness programs delivered by all levels of government and several private sector organizations. This suggests the need for a new communications strategy.

The government has not clearly defined the role that insurance can and should play as a means of mitigating the impacts of an earthquake. Further, the government has not evaluated the most desirable balance of public and private sector involvement in offering affordable earthquake insurance to the public. And although discussions are taking place with representatives of the insurance industry on matters such as its capacity to meet all potential earthquake-related claims, there is still some way to go before these issues are resolved.

In recent years, work has been undertaken at significant cost to upgrade the provincial and municipal infrastructure (such as bridges and dams). But there has not been a coordinated approach to the effort, either at the provincial or municipal government level. Furthermore, it is unclear whether all critical response facilities (fire and ambulance halls, police stations, etc.) will remain operational after an earthquake, or that damage to hazardous buildings will not cause avoidable injury or death, because there has not been

an organized approach to assessing these structures and, where appropriate, strengthening them.

Clearly, to upgrade everything at once would be cost-prohibitive; a longer-term approach makes expenditures more palatable. If retrofitting is to be done effectively, there needs to be goals established and a long-term plan for achieving the goals developed.

Ultimately, it is up to the provincial and local governments to determine the level of resources that should be applied to mitigation, and the proportions of the resources that should be provided from different sectors of the community, including governments themselves. Both levels of government are generally aware of main types of mitigation activities, but neither has estimated the amount of resources which, if applied to mitigation, would represent a prudent and supportable investment against future loss, nor identified how these resources should be acquired.

Findings

Building Codes Current

The Provincial Building Code appears to be reasonably current in that it is based on the National Building Code of Canada and so reflects the latest knowledge of the seismic hazard. And, the majority of local governments believe the code is being enforced. Still, we think that local governments would benefit from having more information about how they should interpret the code with respect to the hazards and risks in their own areas.

In Canada, the National Building Code forms the basis of the building codes of provincial and local jurisdictions. In British Columbia, the *Municipal Act* empowers the Minister of Municipal Affairs to make regulations that establish a provincial building code governing standards for the construction and demolition of buildings.

The national code is published every five years, but significant changes to the seismic safety component tend to be made every 10 to 15 years. Ongoing analysis of seismic hazard is done by the Geological Survey of Canada to make sure that the code contains the best estimate. In British Columbia, each new national code is, after review, approved and becomes the official provincial building code. For example, the 1990 national code was adopted by the Province in 1992. The 1995 version of the national code has not yet been adopted provincially.

Courtesy: Office of Emergency Services, State of California

Fire following an earthquake is a major risk

The code has included provisions for earthquake-resistant design and construction of buildings since its first edition in 1941. The seismic provisions of the code's early editions were based on the United States building code. The seismic zoning map in the 1970 edition was the first to present probability estimates of seismic ground motion for the whole of Canada.

The 1995 and previous codes do not consider a subduction earthquake. We understand, however, that the impact of subduction earthquakes is likely to be recognized in changes to the seismic content of the National Building Code for the year 2000.

Theoretically, communities that are near the epicentre of such an earthquake could suffer considerable collapse and damage to infrastructure, even if that infrastructure was built to the most recent seismic code. However, current calculations for the year 2000 code suggest that the design level of ground motion included in the present code is equal to, or greater than, the ground motion that most British Columbian communities in the high hazard areas would experience in a subduction earthquake. Although there are a relatively small number of communities at risk, it seems appropriate for the provincial government to ensure that these communities have

access to whatever advice and technical support they may seek for making local modifications to the national code.

Another important point is that the seismic safety component contained in Part 4 of the provincial code does not apply to all structures. Bridges, roads, water and gas pipelines and transmission towers are not within the scope of the code. Moreover, the construction of buildings of fewer than three stories and of an area less than 600 square metres (which includes many fire halls, ambulance and police stations) are governed by Part 9 of the provincial code which does not contain a seismic safety component. However, in some cases, such as bridges, other standards govern how they are built. But in cases where no specific standards apply, it is up to the owners or developers of these infrastructures to set the design criteria. Many do design to a similar seismic standard as outlined in the national code, but it seems to be at their discretion.

It should also be pointed out that, under the *Interpretation Act*, the provincial government is not bound by any enactment that would bind or affect it in constructing improvements on lands that it owns. Improvements for this purpose include buildings and structures. Notwithstanding this exemption, we have been advised (by the British Columbia Buildings Corporation) that the policy of the provincial government is to observe the intent of the building code requirements for new buildings, major alterations and structural restoration to existing buildings. We encourage the provincial government to continue to ensure that the seismic elements of the building code are applied to provincial buildings. Further, we recommend that local governments take steps to ensure that the same approach is taken, especially for all new critical response facilities.

The Provincial Building Code is a minimum standard only. Each community is responsible for ensuring that the code is amended where necessary to reflect conditions within its boundaries. Most of the local governments responding to our survey felt that the Provincial Building Code is current and adequately addresses the hazards associated with a major earthquake. A majority confirmed that the code is adequately enforced, although about 10% of respondents felt it was not. (It was not practical in this audit for us to check the extent of enforcement ourselves.)

Only about one-third of the survey respondents reported having modified the code to take into account the local conditions. This information, together with the views of those we interviewed, suggests that, while many local governments

appear to have access to the expertise needed to review and amend their building codes, there are a number that do not. The latter will need guidance and support from the provincial government to help them do so. However, the Building Standards Branch of the Ministry of Municipal Affairs and Housing was closed as of the beginning of 1997. The branch had been responsible for the development of guidelines and interpretation of building codes. We recommend that the provincial government, possibly through PEP, should maintain an advisory capability to help these communities work with the Provincial Building Code.

Microzonation May Help Land Use Planning

Some local governments do not have the information or expertise to be able to evaluate the earthquake hazards of a particular site. For example, because the National Building Code is based on firm soil conditions only, a factor must be applied to the design criteria when structures are built on other than firm soils. Unfortunately, not all buildings constructed are subject to soil sampling, so the necessary amendments to the code do not always get done. Some communities are aware of this issue and do require more stringent soil sampling to ensure buildings meet the code requirements, but some do not.

Local governments need both soil and geologic information to properly assess the earthquake hazards. We believe a role for PEP is to inform local governments of the methodologies available and provide the necessary technical advice. Earthquake hazard mapping (or microzonation) is one of the tools that appears to be helpful in this regard. It involves identification of the location of active faults, areas susceptible to liquefaction or landsliding or soft soil conditions that could intensify the violence or extent the duration of ground shaking during an earthquake. Its main use is as a predictive tool for land-use decisions and emergency planning. Earthquake hazard maps are generally used for the identification of vulnerable lifeline systems (for example, water, hydro and gas); planning of transportation and utility corridors; setting of priorities for seismic upgrading or retrofitting on schools, hospitals, fire halls and other important structures; identification of good sites for new essential facilities; and establishment of more stringent design requirements where needed.

Microzonation studies have been done for Chilliwack and Coquitlam, and are underway for Greater Victoria. We also understand mapping is planned to start for the Greater Vancouver area soon. Clearly, then, the capability to produce such maps exists in British Columbia. What is less certain is

how projects of this kind are to be funded, and whether governments are prepared to support continuing research and refinement in this technique.

We believe that the estimated costs and related benefits of microzonation should be investigated to ascertain if microzonation should be extended to all parts of the high hazard areas.

Public Apathy a Continuing Problem

The consistent view of those to whom we spoke was that the public is generally apathetic about the risks of a major earthquake and is therefore not well prepared. (We were not able to measure the extent of public preparedness ourselves in this audit, or to assess whether this level of preparedness is increasing as a result of the various programs.) This apparent situation is despite the fact that the provincial government (through PEP), many local governments, the federal government (through Emergency Preparedness Canada) and several private sector organizations have developed a range of programs aimed at increasing public preparedness and thus helping to mitigate potential loss and damage during and after an earthquake. This suggests the need for a new communications strategy.

At the provincial level, PEP has been involved in a number of awareness activities. It has designed and distributed pamphlets and brochures, and participates in conferences and an annual Emergency Preparedness Week. As well, it has set up an Internet web site and has provided material on earthquake planning for inclusion in telephone directories distributed to every home with telephones. The Ministry of Human Resources also develops displays and brochures, and provides volunteer instructors for training and education about Emergency Social Services.

At the federal level, Emergency Preparedness Canada provides public presentations and brochures.

At the local government level, about two-thirds of those jurisdictions that responded to our survey indicated they have a public awareness program. Those local governments we interviewed confirmed they carry out numerous activities related to public awareness programs.

And organizations such as the Emergency Preparedness for Industry and Commerce Council (EPICC) are trying to raise awareness and increase preparedness in the business sector.

Despite all these public awareness programs, however, the great majority of people we spoke to felt that the public is not well prepared. Although PEP itself has not measured the degree of public preparedness, this view was confirmed by a 1995 survey we examined (Environics Research Group Ltd., *Emergency Preparedness: Canadian Attitudes and Behaviour).* It found that 52% of British Columbians said they did not have enough information on how to prepare for emergencies, and 62% thought they did not have enough information on the natural and human-made risks to their own communities. A 1994/95 study done by students at the University of Victoria found that the majority of respondents were aware of the earthquake hazard, but less than a third had made any preparations above having a flashlight and water in the house. The Chair of EPICC has estimated that only about 10% of businesses in British Columbia have any emergency plans. And, the Insurance Bureau of Canada—a voluntary industry trade association representing about 75% of private property and casualty insurance companies operating in Canada—informed us that only about one-third of British Columbians have insured against the risk of earthquake.

Many local governments we spoke with would like to see the provincial government deliver a strong public message about the limitations of what government can do in the event of an earthquake. Most important is convincing people to accept that, for the first 72 hours at least, they must be able to survive as a result of their own foresight and efforts. We believe that PEP should play a greater role in supporting a coordinated, consistent approach to public awareness programs across the Province. We recommend that PEP should:

- measure the extent of public preparedness (this should be done now, to help decide how and where to focus public awareness activities and to provide a baseline for future measurement, and at regular intervals in the future, to help assess the effectiveness of the initiatives); and
- work with key stakeholders (such as Emergency Preparedness Canada, provincial government agencies, local governments, utilities and private sector organizations) to develop and implement a coordinated public awareness communication strategy.

The Role of Insurance Is Not Clear, and There Are Questions About Insurance Capacity

The government has not developed an overall strategy for mitigation, and therefore has not clearly defined the role that insurance can and should play as a means of mitigating the financial impacts of an earthquake. Further, the government

has not evaluated the most desirable balance of public and private sector involvement in offering affordable earthquake insurance to the public. And although discussions are taking place with representatives of the insurance industry on matters such as its capacity to meet all potential earthquake-related claims, there is still some way to go before these issues are resolved.

The potential benefits of insurance can only be realized if the right environment is created for an insurance program. The provincial government has a key role in defining what this environment should be. However, the government has not looked at mitigation from a strategic perspective. As a result, it has not clarified the role that insurance can play in arriving at an appropriate distribution of risk.

First, the government has to reach a policy decision as to what the role of insurance should be, by identifying the appropriate distribution of financial risk among individuals, businesses, governments and insurance. This involves putting the potential benefits resulting from various levels of insurance coverage in the context of an overall mitigation strategy.

Second, having determined the role for insurance in mitigation, the government needs to decide on the type of insurance regime that will best fit this role. For example, should earthquake insurance be provided by the private sector, the public sector or a blend of both? The result of this will affect the extent of government encouragement and incentives for individuals and businesses to arrange for earthquake coverage, and with whom.

Currently, the insurance regime involves delivery of earthquake insurance through the private sector. Unlike automobile insurance, the government does not offer earthquake insurance to the public, either directly or through its agencies. Nor does it offer fiscal incentives either to the insurance companies or to the public to move the level of insured earthquake risk to the level it feels appropriate. Whether or not this is the best regime through which to offer insurance to the public should be confirmed by the government once it has defined the role that earthquake insurance should play in mitigation.

And third, the insurance companies must have the ability to meet potential claims for the earthquake risk that they assume. Encouraging an expansion of coverage is futile if the insurance industry does not have this ability. However, governments can, through regulatory and fiscal policy, help insurance companies build an adequate level of capacity to cover these risks.

According to the Insurance Bureau of Canada, the ability of the insurance industry to meet all potential claims were a catastrophic earthquake to occur in British Columbia is questionable. The bureau estimates that such claims could mount to as much as $10 billion, but the total value of reserves allowed by the federal regulator for the payment of claims is only $6.5 billion. However, the industry estimates that it has sufficient reserves to meet potential claims from a major earthquake.

The industry's perceived undercapacity was an important observation drawn from the CANATEX 2 test of the federal and provincial earthquake response plans (discussed later in this report). The rough estimates included in the CANATEX 2 evaluation suggested that casualty and damage claims arising against the insurance industry as a result of a major earthquake would far exceed the ability of the industry to pay. Any inability by insurance companies to meet claims for insured losses would put additional public pressure on governments already expected by many to compensate uninsured or underinsured losses.

The exposure of the insurance industry is largely determined by projections of probable loss arising from the event, the extent to which those losses are insured and the value of capital and reserves from which earthquake claims can be paid.

Financial projections of any kind have inherent limitations in their accuracy, and in predicting losses from earthquake damage, particularly so. There are currently a number of probable loss projection models. Great strides are being made in refining their accuracy but even so, the values they produce from the same base data can cover a significant range. There may also be differences of opinion on the magnitude of the event that should be anticipated for assessing industry capacity: should it be based on a catastrophic event of rare occurrence or one of a lesser magnitude but more likely to happen? And insurance companies and other parties may have differing views on the extent to which existing reserves are available to meet earthquake claims.

The issues surrounding the ideal insurance regime for earthquake mitigation are complex. The goal is to provide the public with affordable insurance without creating significant exposure for the insurance industry.

Discussions between the insurance industry and governments have been taking place. The industry has made a number of presentations to governments and other interested

Courtesy: Office of Emergency Services, State of California

photo eight

groups concerning legislative, regulatory and other reforms it believes will better enable it to cover earthquake claims. There are, however, some issues on which the insurance companies and governments have yet to reach agreement as to the appropriate action, if any, required.

We recommend that the provincial government determine the role that insurance should play in mitigation, and define the most appropriate regime through which it can be offered to the public. We also recommend that the government continue discussions with the insurance industry and, where appropriate, the federal government with a view to creating the environment for an affordable insurance regime within the industry's capacity.

Retrofitting Not Well Coordinated

In recent years, work has been undertaken at significant cost to upgrade the provincial and municipal infrastructure (such as bridges and dams). We view this effort positively, but note that there has not been a coordinated approach to the effort. Also, almost half of the local governments responding to our survey indicated they did not have an organized approach to identifying and assessing seismically suspicious

structures. As a result, it is unclear whether resources are being invested in a way that reflects the highest priorities. Furthermore, it is unclear whether all critical response facilities will remain operational after an earthquake, or that damage to hazardous buildings will not cause avoidable injury or death, because there has not been an organized approach to assessing these structures and, where appropriate, strengthening them.

Infrastructure

What follows in this section is intended not to be a complete analysis of the state of the provincial infrastruture but, rather, an indication of some of the issues and concerns regarding the upgrading of the infrastructure to current seismic standards.

Some existing bridges in the Province's infrastructure have been seismically upgraded, and we understand that new bridges and roads are being built to current seismic standards. The Joint Emergency Liaison Committee (JELC) task force studying the seismic upgrade of emergency routes has identified and designated emergency routes in the Greater Vancouver Regional District. A similar exercise is being undertaken by the Greater Victoria Emergency Coordination Committee.

The JELC's approach has been to choose routes that include a minimum of susceptible bridges. It is hoped that as the retrofit program matures, better routes will become available. The exercise has identified those roads and bridges needing upgrade, and the JELC has, in an interim report, recommended evaluation, cost estimates, design and retrofit as a priority. The Ministry of Transportation and Highways, however, has recently reduced the staffing it devotes to the seismic assessment of provincial bridges. Furthermore, the budget to carry out its 10 year plan for retrofitting all major bridges was reduced after the first year. The result is that little work is currently being done. This concerns us, since bridge failures, aside from possibly causing death and injury during an earthquake, could severely hinder response efforts, disrupting transportation routes and making it very difficult for emergency workers to reach their assigned posts.

The British Columbia Power and Hydro Authority (B.C. Hydro) has a rigorous program of dam inspections and has spent many millions of dollars retrofitting dams. According to B.C. Hydro, 17 of 30 high or significant hazard dams meet all safety standards, and three other dams have safety improvements either in progress or planned. Studies to investigate potential deficiencies continue on the other 10 high or significant hazard dams.

Both the Greater Vancouver Water District and the Greater Victoria Water District have conducted vulnerability studies. The Vancouver study showed that for a major earthquake the system could be "severely impacted." Greater Vancouver municipalities depend on the regional water distribution system, and so need to reflect the results of the study in their own emergency planning. The JELC has concluded that "a great deal of activity must take place on the municipal level to achieve a basic emergency continuation plan to address the performance of the water distribution system." Some retrofitting of water facilities still needs to be done. For example, in the Greater Vancouver Regional District, anchoring and supporting equipment and pipe in chlorinating facilities and in pump stations has not been started.

Most of the distribution network for gas is relatively new. Nevertheless, gas utilities carry out seismic studies to identify the parts of the system that are most susceptible to earthquake damage. Retrofitting programs are in place for reconfiguring older, steel-based segments of the systems, which are mainly in urban cores, with newer polyethylene pipes that can withstand a higher level of groundshaking as they are more flexible.

BC Hydro has a program for assessing the seismic safety of its buildings, substations, etc. and has established guidelines for building upgrades to improve seismic resistance. The guidelines involve a three-category assessment of threat to safety for the purpose of prioritizing retrofitting projects.

The design and construction of the third runway at Vancouver International Airport reflects current assessments of seismic hazard, and specifically the risk of liquefaction. The Airport Authority also participates in seismic improvement projects and emergency planning with the City of Richmond.

In 1992, the Vancouver Port Corporation carried out a seismic assessment of its facilities. Most facilities are built on concrete cribs that sit on a mattress of rock and are filled with rubble. However, in a major earthquake, some cribs are likely to move, with possible damage to cranes and wharves. There has been no retrofitting of the cribs due to the logistical difficulties in emptying, floating and repositioning the cribs, and to the high direct and indirect costs involved.

In 1992, a seismic risk study was carried out for hospitals and schools in use at that time. The study assessed the condition of the facilities and prioritized those that required the most immediate attention for seismic upgrading. Retrofitting on hospitals and schools has continued since that date, although

in recent years, seismic upgrading has only been done in conjunction with major renovations otherwise planned to the facilities concerned.

We recommend that, in conjunction with the development of earthquake planning scenarios recommended in the previous section of this report, the provincial and local governments develop inventories of key infrastructure for which they are responsible. Based on the detailed vulnerability analysis the planning scenarios would provide, options for dealing with areas of vulnerability should be considered, cost estimates of upgrading made, and programs designed to carry out the upgrades on a priority basis over, for example, the next 20 years.

Hazardous Buildings

There are no consistent or comprehensive approaches to identifying and inventorying hazardous buildings and, consequently, there are no complete estimates of the costs of upgrading. More than half the local governments responding to our survey reported that they did not have an organized approach to assessing the state of unreinforced masonry construction. And most indicated that they have no programs in place for the retrofitting of structures that do not meet existing building codes. This has the potential for earthquake damage to hazardous buildings causing more injury or death than need be the case.

We recommend that local governments develop programs to identify and inventory hazardous buildings and to upgrade the seismic robustness of buildings based on the relative magnitude of risk to the public. Determining this magnitude would call for a composite evaluation of such factors as the age of the buildings, the code requirements at the time these were built, and the level and frequency of occupation of the buildings.

Critical Response Facilities

It appears that some critical response facilities such as fire and ambulance halls and police stations are in premises that may not be up to current code seismic standards. If such facilities fail during an earthquake, response efforts would obviously be hindered.

Many fire and ambulance halls and police stations are under 600 square metres and so are not covered by the seismic provisions of the building codes. Consequently, it is possible that many such buildings were built without any seismic enhancement. The Joint Emergency Liaison Committee (JELC),

in an interim 1997 report regarding structural assessment, stated that, "many fire halls are not up to code." It recommended that all such response facilities be assessed and a costing exercise carried out to establish how much it would cost to upgrade them to a standard that would ensure their operability in a post-earthquake situation. Some municipalities have recognized the problem and have started to upgrade their facilities. We think this is an important aspect of earthquake preparedness, and recommend that all municipalities assess their critical response facilities as soon as possible, and then establish priorities for upgrading.

Planning for Response

What Is Planning for Response?

Planning for response involves activities that governments, organizations and individuals develop to save lives and minimize damage once an earthquake has occurred. They include such measures as emergency plans, mutual aid agreements, resource inventories, warning procedures, training exercises, and emergency communications systems.

Emergency plans should exist at all levels of the response effort. Federal, provincial and local governments should develop plans (integrating them where appropriate) that will provide for an effective response to an earthquake. The plans should identify what functions will have to be carried out, how and by whom they will be carried out, and how the response effort should be controlled and delivered.

Mutual aid agreements between jurisdictions allow for the resources of one to be made available to another should the need exist. This pooling allows relief efforts to be focused on those areas with the greatest need. Most frequently, these agreements exist between organizations that deal with emergencies as part of their day-to-day business, such as fire departments.

A very important aspect of planning is the inclusion of a rigorous regime of plan testing to ensure that all parts of the plan will work effectively when needed. Testing is the only way of getting some assurance that everything will operate as effectively as possible when a real emergency occurs. Since the response to an earthquake will usually involve different levels of jurisdiction, plan testing should involve all of the potential participants.

Resource inventories should also be maintained so that needed help can be speedily identified and mobilized.

Resources do not just mean equipment; they also include human skills and abilities. For example, lists of construction engineers should be maintained so that these individuals can be deployed for assessing damage to buildings. There are many private sector agencies with specific expertise in caring for people—a valuable resource in supporting relief efforts.

Adequate training of emergency responders is another important component of planning for response. Planning activities should identify what different levels of responders need to know to carry out their work effectively, and should provide an appropriate way for this training to be delivered to them.

Good communications are essential as well. Many agencies are involved in relief efforts, and coordinating their activities well requires effective communications between and among emergency operations centres, fire departments, police, medical specialists, engineers and care providers. Sufficient functional and back-up systems should also be in place, with appropriately skilled operators.

Finally, planning for earthquakes also involves ensuring there are means by which the public can be warned of impending hazards and kept informed after a disaster about what is happening and what to do. The purpose of a public information function is to provide timely, consistent and accurate information and advice to the media and public as soon as possible after a disaster, and during the response and early recovery phases. An effective system reduces uncertainty, confusion and suffering, shows the government has authority for response and recovery, and helps to expedite the emergency response plan.

If the emergency plans have been well designed—incorporating all of the above elements—and adequately tested, the response effort should be more efficient and effective.

What We Expected to Find

We expected that the provincial government would have a detailed plan that would identify what needs to be done in the event of a major earthquake, and what the roles and responsibilities would be of provincial government organizations and local governments. The plan would have been communicated to, and understood by, key stakeholders.

Similarly, we expected to find that local governments would have prepared plans that would enable an analysis of the situation and facilitate decisions about how to respond

quickly, appropriately and effectively. The plans would allow for coordination with, and support of, the response efforts of other jurisdictions.

We also expected that:

- the nature and extent of federal government support would be clear, as would the mechanisms for requiring and engaging such support;
- an on-going process of testing the plans would be in place at all levels, and the test results would be actively followed up and, where appropriate, plans amended;
- government organizations would have trained their emergency personnel;
- the provincial government and local governments would have established integrated and effective radio communication and information systems, and all jurisdictions would be testing and evaluating their systems on a regular basis;
- local governments would be able to activate enough qualified personnel to accurately assess the extent of damage caused by an earthquake; and
- governments would have established coordinated emergency warning and public information plans and systems.

Conclusion

It is unlikely that all key aspects of government response efforts for a major earthquake will work as intended.

At the provincial government level, while the British Columbia Earthquake Response Plan appears sound in concept, it is still in interim form five years after its issue, and needs updating to reflect subsequent changes in government organization. Some of the plan's underlying assumptions may not be valid, and some of the supporting ministry plans are incomplete or have not been adequately tested. While some response functions appear likely to be handled well, such as the provision of emergency social services through the Ministry of Human Resources and municipal personnel, other do not.

One particular area of concern to us is the medical function—the responsibility assigned to the Ministry of Health. There is not a system-wide plan for emergency preparation and response. This is particularly worrisome, as those hospital representatives who responded to our survey expressed a pessimistic view of their ability to provide adequate out-patient and care services after an earthquake.

We believe that local governments are not yet adequately prepared to respond. (This view was supported by our survey respondents, the majority of whom concluded that their respective local governments had not made adequate preparations for a major earthquake. And almost 50% believe that their local government does not have the capacity to respond effectively to such an event.) The quality of local government earthquake planning varies widely. Some jurisdictions have taken the earthquake threat very seriously and are continuing to improve their response plans. Other jurisdictions have given less attention to developing sound plans. Nearly 20% of the local governments that answered our survey reported that there was no earthquake preparedness plan in their jurisdiction.

Given the varied ability of governments to respond, we were pleased to learn that the British Columbia Emergency Response Management System—which incorporates the Incident Command System, a commonly understood command structure for dealing with emergency situations—is being implemented across the Province as part of emergency response planning.

We found British Columbia's arrangements with the federal government and the government of Alberta in support the Province's response efforts during a catastrophic earthquake to be comprehensive and practical. (As we did not have any authority to examine the completeness or currency of federal departmental plans, however, we must qualify this conclusion somewhat.)

Testing in recent years of the Province's response plans and their interface with the federal government's plans has shown that the plans appear viable. However, few of the recommendations following the exercises have been acted on. At the individual local government level, we found plan testing to be inadequate to provide assurance that a response to a major earthquake will be effective. To be beneficial, testing at all levels needs to be carried out more frequently than has been the case.

The nature of training offered both provincially and federally is good, but we have concerns about its extent. The major exercises held since 1993 have identified as a problem the insufficient training of ministry personnel who would be called upon to staff Provincial Field Response Centres and make decisions about ministry plans and resource use in the event of an earthquake. The need for similar staff at the local government level to be adequately trained is self-evident, yet

there are indications that not all front-line staff are receiving the required training.

The ability of responders to communicate with each other and with different levels of government continues to be of concern. Past testing has concluded that the current emergency radio communications resources available across the Province cannot effectively support a coordinated response effort to a major earthquake or, indeed, any other serious emergency that causes telephone service to be disrupted for a significant time. There are, however, some significant steps being taken by governments to deal with the situation.

Finally, we found that plans for issuing warnings to the public and for keeping the public informed after an earthquake are not well developed. As a result, the potential for uncertainty and confusion during an emergency is greatly increased. (One of the key lessons learned from the "Blizzard of '96" was that the lack of a public information plan at both the provincial and local levels was a problem.)

Findings

The Provincial Response Plan Needs Updating and Finalizing

The British Columbia Earthquake Response Plan appears sound in concept. However, five years after its issue, the plan is still in interim form and does not reflect more recent reassignments of government programs and emergency management responsibilities. Moreover, the assumptions on which it is based may not be realistic.

Concept of Operations

The provincial Earthquake Response Plan provides a general operational concept for what needs to be done to respond to a major earthquake. The plan:

- provides a general assessment of hazards and risks under different magnitudes of earthquake;
- describes the responsibilities, organization and concept of operations necessary for emergency response to a major earthquake in British Columbia; and
- identifies the critical emergency response functions and assigns each function to the relevant supporting ministry (the ministry that has the most authorities, resources, capabilities or expertise in that area).

Each supporting ministry is responsible for the detailed planning for the function (and for its management during

response). Details of functions and primary supporting ministries included in the interim plan are set out in Exhibit 4.1.

The plan recognizes that three levels of government—local governments, the provincial government and the federal government—may be involved in responding to earthquakes, depending on their severity. Although many other public and private agencies will be involved, their activities will usually be coordinated through one of the three government levels of response.

Local governments are assigned the role of first responder. They must plan and organize themselves to provide immediate relief for their citizens in the aftermath of an earthquake. Among other things, this would involve activating Emergency Operations Centres to direct the response locally. For minor

Exhibit 4.1

Critical Functions and Primary Supporting Agencies

Function	Primary Supporting Ministry
Medical	Health
Emergency Social Services	Social Services (now Human Resources)
Law and Order	Attorney General
Urban Search and Heavy Rescue	Attorney General
Communications	Attorney General
Damage Assessment	Attorney General
Firefighting/Rescue	Municipal Affairs and Housing
Transportation	Transportation and Highways
Engineering and Construction	Transportation and Highways
Human Resources	Attorney General
Resource Support	Government Services (now Finance)
Coroner/Mortuary	Attorney General
Hazardous materials	Environment, Lands and Parks
Public Information	Government Services (now Finance)
Food and Agriculture	Agriculture, Fisheries and Food
Finance and Claims	Finance and Corporate Relations
Utilities	no primary supporting ministry required

earthquakes, this level of response may be enough to adequately protect the public and address its immediate needs.

However, if a more severe earthquake happens, local governments would likely find that their resources are insufficient to deal with all the matters requiring immediate attention. In this case, the local government would request the assistance of the provincial government. This it would do by communicating with the Provincial Emergency Coordination Centre, which, unless circumstances dictate otherwise, would be activated in Victoria by the Provincial Emergency Program (PEP). The provincial government therefore has a role of secondary responder.

To coordinate the provincial response, one or more Provincial Field Response Centres would be set up. The centres would receive requests for provincial government assistance, and would coordinate the delivery of that assistance in the local area. All ministries and agencies involved in the response effort would be represented at the centres. Each ministry would carry out the response functions that are set out in its own earthquake plan.

In the event of a major earthquake that exhausts the emergency resources of both local and provincial governments, the federal government would be requested by the Province to assist in relief efforts.

Where a catastrophic earthquake is considered to have occurred, the National Earthquake Support Plan provides for mobilization of the necessary coordination structure, pending a request from the Province to the federal government to implement the plan.

Declaring a State of Emergency

Both local and provincial governments have the power to declare states of emergency. These will usually only be declared where immediate and dramatic action is needed to deal with a threat to public safety. In such cases, normal day-to-day operations are suspended, and governments assume additional powers to deploy resources and take what actions are needed to protect the public.

The Provincial Response Plan Is Not Current

The provincial response plan has not been updated since it was issued in interim form in 1992, and so some aspects are not current. It needs updating to reflect current government structure (for example, many responsibilities that formerly belonged to the Ministry of Health now belong to regional

health boards) and to ensure functions assigned to ministries are appropriate and accepted. (The *Emergency Program Management Regulation* also needs updating on a regular basis.) This was recommended after testing of the provincial and federal plans, but has not yet been done. We recommend that PEP update the provincial plan to reflect the current situation, and take steps to have the *Emergency Program Management Regulation* amended as necessary.

Communicating the Plan

The provincial response plan was mailed to mayors and councils of every local government in all areas at risk. It is also on PEP's Internet site. According to PEP, over 3,000 copies of the plan have been distributed since 1992. However, our survey results show that there is little awareness or understanding of the plan. We recommend that PEP develop a new communication strategy to ensure that the provincial response plan is known and understood by local authorities and response agencies.

Key Plan Assumptions

The plan is based on some assumptions that, as a result of government reorganizations and changes in funding levels, may not be realistic. Examples of some questionable assumptions are:

- provincial ministries will be able to implement their emergency response functions and have internal plans that are in accordance with the requirements of this plan. In fact, as described below, some plans are not current or have not been tested adequately.
- PEP can activate, on short notice, one or more Provincial Field Response Centres. In fact, sufficient potential locations of these centres have not yet been identified or tested in any formal manner, although such an exercise is currently in progress.
- PEP can activate, on short notice, a Provincial Emergency Coordination Centre with the capability to communicate with other response management components required for effective earthquake response. In fact, an alternative site for the centre has not been identified.

Functional Support Plans

Supporting ministries identified in the British Columbia Earthquake Response Plan have, to varying degrees, prepared plans to enable their responsibilities to be carried out. (We reviewed the latest versions of these plans to see whether

Courtesy: Office of Emergency Services, State of California

Many evacuees may require shelter

they addressed the function assigned to each ministry, and interviewed ministry representatives; we did not carry out detailed assessments of the extent to which each ministry would be able to carry out its assigned responsibilities effectively.)

In most cases, we found the plans do address the issues set out in the provincial plan and are reasonably current. A good example of this is the planning for emergency social services (ESS) done by the Ministry of Human Resources. The ESS function is designed to handle a wide range of personal services after an emergency, such as counselling, greeting evacuees and providing support to dependent individuals, as well as providing clothing, shelter and food to responders and evacuees. It provides support and advice to municipalities on matters such as setting up emergency reception centres, and it trains and assists municipal ESS personnel. Overall, we believe the ESS plans adequately address assigned responsibilities, and are tested to an appropriate degree.

Some other plans, however, are out of date or have not been adequately tested. Because ministries generally have not regarded emergency planning as a high priority, keeping plans current is difficult. We recommend that all ministries assigned key support functions complete, without delay, plans detailing how they will carry out their assigned responsibilities after

a major earthquake. And we recommend that PEP take a stronger, more proactive role than it is now doing to ensure that supporting ministries keep their earthquake preparedness plans up to date.

There are some response functions that warrant further discussion in this report: medical; heavy urban search and rescue; resource support; and hazardous materials.

Medical

Of the key support functions described in the provincial earthquake plan, medical is the one of most concern to us. The medical function involves the delivery of medical and hospital services to the injured, access to required prescription drugs, the containment of communicable diseases and other issues related to water, sewage and food. Primary responsibility for planning for the delivery of medical and hospital services, previously done by the Ministry of Health and Ministry Responsible for Seniors, has been transferred recently to the health authorities, as part of the government's regionalization of health care. There is not a system-wide plan for emergency preparation and response. This is particularly worrisome, as those hospitals that responded to our survey expressed a pessimistic view of their ability to provide adequate out-patient and care services after an earthquake. The ministry is determining what its new secondary role should be regarding emergency planning for the medical function, and the extent of the coordinating support that it may be called upon to provide to hospitals and local governments should a major earthquake happen.

A major earthquake will place considerable demands on the health system. Not only will the system be expected to ensure the safety and well-being of patients and other clients, many of whom may be in hospital at the time of the earthquake, but it must accommodate and treat the possibly large numbers of people injured. This calls for establishing temporary emergency hospitals, appropriately staffed, and a logistics system that can deliver the injured to them without excessive delay. To achieve this needs a lot of up-front planning and preparation, good coordination with local governments and a good understanding by medical, ambulance and administrative staff of how to bring it all together.

The Ministry of Health's current plan is known as the Disaster Response Plan. It is intended to have four elements: policy, response, recovery and continuation. In developing the plan, the ministry has progressed only as far as the response phase, largely because of changes in the ministry structure that began in 1994. Among other things, this involved the

transfer of emergency planning responsibilities described above. However, the Disaster Response Plan continues to have direct relevance both within the Ministry and for integration with the planning assumed by the health authorities. Although the administrative structures have changed, many of the roles and responsibilities, such as those of the Medical Health Officer, remain unchanged.

Prior to the major restructuring referred to above, the ministry conducted an internal evaluation of its disaster response plan under exercise ORACLE. The overall evaluation of the exercise and various other assessment activities was that the ministry could at best be said to be moderately prepared. The evaluation notes that the emergency plan is "stand alone" (that is, it is not integrated into other aspects of ministry disaster planning), thereby reducing its effectiveness. Another concern is that its communication system is land-based. This means that if the system fails, it will be difficult to implement the disaster plan because the command centre will be cut off. Ministry emergency planning staff expressed concern that the overall situation has not significantly improved since this assessment was done.

CANATEX 2 was intended to be the last whole ministry test, although both Health (less ambulance) and Environment withdrew their immediate pre-exercise planning support for the test despite "repeated prompting." CANATEX 2 concluded that many health services functions, notably hospitals, could not be effectively coordinated because the Ministry of Health has fallen behind in implementing disaster plans.

There have been no table-top exercises, and, according to the ministry's evaluation of its own plan, the fact that the plan is tested less frequently than annually is a deficiency.

Thunderbird 2 was the most recent test, but there was only limited involvement on the part of the ministry. The evaluation of Thunderbird 2 noted that the ability of provincial agencies to conduct a major medical evacuation has been a matter of concern since earthquake response planning began in 1988. Recently changed responsibilities in the health jurisdiction have not helped matters. We think this scenario should be the subject of a discussion or exercise involving the BC Ambulance Service, other Health and Social Services planners and senior operations personnel and PEP.

Two of the matters that the discussions should address are the ability of health authorities to activate sufficient emergency hospitals to handle a mass casualty incident of earthquake magnitude, and the ability of ambulance and other means of transportation to deliver casualties to them.

About 15 emergency hospitals in strategic locations around the province can be activated if needed. Each can be configured to treat up to 200 patients. The hospitals are old, but we are informed that they require little ongoing maintenance. Each requires a medical staff of about 100 to operate. Although the Province no longer stockpiles medical supplies, arrangements are in place with private sector suppliers for one week's estimated consumption of medical supplies to be on hand for emergencies.

Despite the availability of emergency hospitals, there appear to be no plans in place to identify and mobilize the staff needed to activate them. This includes both medical personnel and those who would be responsible for transporting the hospital facilities to the locations where they were most needed. As well, the ability of the ambulance service to respond effectively to a mass casualty incident covering a wide area is questionable.

The BC Ambulance Service is a component of the Emergency Health Service Commission of the Ministry of Health. The view of those to whom we spoke within the Ambulance Service is that it effectively does not have a comprehensive plan and it is not well prepared for an earthquake. The BC Ambulance Service has a core policy document on disaster that the Ministry of Health believes has resulted in good community plans in some areas. However, the integration of ambulance and municipal planning is inconsistent and the service lacks adequate supplies to deal with a major casualty incident. It has no mobile command post or operations centres, nor does it have back up dispatch centres (although the lack of these facilities is due more to a lack of funding than a lack of recognition of their importance). These matters raise concerns that not all of the injured would reach hospital in time, and that those who did might not receive treatment promptly if existing facilities were overwhelmed.

The ministry has indicated its commitment over the next few years to improving and updating its Disaster Response Plan. We believe, however, that the ministry and PEP should also consider how best the ministry can continue to support hospitals and local governments for the medical function, both in terms of ongoing preparedness and of response capacity. We therefore recommend that the Ministry of Health and PEP give immediate attention to reviewing and, where appropriate, strengthening the ability of the overall health system to respond to a major earthquake.

Heavy Urban Search and Rescue

Heavy urban search and rescue (HUSAR) is an element of emergency response that most of the public is familiar with, having seen newsreel coverage of sophisticated search and debris removal equipment in operation at disaster sites around the world. In British Columbia, and across Canada, HUSAR capability has been largely lacking. If a major earthquake happened, local jurisdictions in most areas would have to rely on locally available professional and volunteer first responders who lack specialized heavy rescue training and experience. Given the hazardous nature of HUSAR operations, this can place both rescuers and the injured at further risk. A 1996 national workshop on the subject of HUSAR concluded that the implications of such a shortcoming are potentially devastating, both to the possible victims and to governments that must address such a capability gap when a catastrophic event happens.

The workshop also concluded that it was possible to produce a viable capability for HUSAR for relatively little expense, using existing resources and expertise. What will be needed, however, is an unprecedented level of cooperation among all three levels of government. An initiative in Vancouver provides some evidence of this cooperation taking place.

With the assistance of funding from the federal government's Joint Emergency Preparedness Program, the City of Vancouver—through the Vancouver Fire and Rescue service—has substantially completed the development of a HUSAR capability. The team, comprising some 72 members, is currently able to respond to emergencies in Greater Vancouver and there are plans to establish in the near future protocols enabling it to deploy in other parts of the Province. Members of the Vancouver team have been training emergency responders from other provincial jurisdictions in HUSAR techniques. We believe that the progress made in Vancouver on HUSAR development is a significant accomplishment.

This is not to suggest that this HUSAR capability will solve all problems. A major earthquake will probably cause considerable devastation over a wide area. There are unlikely to be sufficient HUSAR resources to meet immediate needs, even with out-of-province help, or to reach all locations. However, we believe that it is essential for some HUSAR capability to exist to support emergency response efforts. We support the initiatives being taken in Vancouver, and recommend that PEP should continue to work with Emergency Preparedness Canada at the national level to develop further HUSAR capability.

Resource Support

The provincial response plan takes the position that no provincial ministry is dedicated to overall supply procurement on a routine basis: organizations have to obtain specialized supplies themselves. The logistics section of the Provincial Field Response Centres includes representatives from the Purchasing Services Branch of the Purchasing Commission to provide assistance for this, if needed.

Plan testing shows that resource support needs to be improved. The evaluation of Thunderbird 2 noted that more efficient resource databases and lists are needed within ministries and other government agencies. Also, a task force of the Joint Emergency Liaison Committee, in an interim report issued in January 1997, indicated that most local governments in the Greater Vancouver Regional District had no real predetermined idea what resources and critical supplies they would need for emergency responses. Further, there is no comprehensive system in any of the municipalities for keeping their resource information current.

The Joint Emergency Liaison Committee made a number of recommendations including that a provincial agency be responsible for the development of systems standards, protocols, guidelines and coordination for resource management throughout the Province. We agree that resource management needs some uniformity and recommend that PEP take a leadership role in this regard.

Hazardous Materials

The Ministry of Environment, Lands and Parks has a draft emergency plan and approved policies and procedures for hazardous material spills, an approved strategy and emergency plan for marine oil spills and a draft emergency plan for water-related events. These plans set out how the ministry believes it fulfills its responsibilities under the *Emergency Program Act* for its primary and supporting roles for seismic and flooding events.

The ministry's plans have not been tested for major events or in support of earthquake preparedness.

In December 1995, the ministry performed an evaluation of its emergency program for oil and hazardous material spills, dam failures and other threats for which it is designated as a key response agency.

The review revealed that the environmental emergency program was strong on plans and strategies, but weak on delivery, and that the ministry needed more trained and

committed staff who can work as a team in an emergency. The program is overshadowed by other ministry priorities and there is little ability to foster or support regional preparedness. Finally, progress on interagency coordination was rated as fair, as the ministry believes that there is still a need to reach unequivocal interpretation of the *Emergency Program Management Regulation* in defining key ministry roles.

We recommend that the Ministry of Environment, Lands and Parks develop a response plan, test it, and train staff accordingly, in order to be able to meet its assigned responsibilities under the provincial earthquake response plan.

Provincial Field Response Centres

Provincial Field Response Centres are activated when one or a number of local governments request assistance from the Province to respond to an emergency. The centres allow the ministries that have a role in the response to coordinate their efforts and those of other responders.

The potential effectiveness of the centres is limited by certain weaknesses. Training of participants is a concern, in that plan testing has shown that not all players are fully aware of what they are meant to do. Even identifying the individual ministry positions and officers that should be present has not always been done well by the ministries concerned.

The sites of the centres are also not always known in advance. It is true that the exact location of a future earthquake cannot be predicted, or which buildings are likely to survive the event. However, the lack of a tentative location throws a greater burden on the ability of the communications systems to ensure that all Field Response Centre officers are informed after the earthquake of the centre's location. This could be a major problem unless the communications systems are fully functional.

While some sites have been identified, we recommend that PEP identify a number of potential Field Response Centre sites at strategic locations throughout the Province, test them for suitability, and communicate the details to those agencies likely to be involved in the response efforts.

Provincial Emergency Coordination Centre

The Provincial Emergency Coordination Centre has a dedicated location in Saanich, in the Greater Victoria area. However, should this location be made inoperative by an earthquake, there is currently no identified alternative location in the Capital Region that could be activated. We

recommend that PEP take steps to identify, suitably equip, and test an alternative site for the Provincial Emergency Coordination Centre.

Local Government Plans Provide Inadequate Guidance

The quality of local government earthquake planning varies widely. Some jurisdictions have taken the earthquake threat very seriously and are continuing to improve their response plans. Other jurisdictions have given less attention to developing sound, viable plans. Nearly 20% of local government respondents reported that there was no earthquake preparedness plan in their jurisdiction. We think this should be a matter of concern to the provincial government.

Our survey results indicated that nearly three-quarters of local governments have earthquake preparedness plans, most of which are based on guidelines issued by PEP. About two-thirds of the respondents confirmed that their plans were based on a hazards and risks assessment, but fewer than half felt that their plans had been adequately communicated to staff at all levels. Furthermore, although more than half of the respondents felt that their emergency plans identified the resources that would be required to respond to a major earthquake, and the location of these resources, only half felt that their plans clearly identified the role of key private sector agencies.

The plans we examined varied considerably in their format and content. Some had clearly evolved from a sound emergency management process; these reflected a high degree of commitment and professionalism on the part of those who prepared them. Other plans were superficial, their content sketchy or incomplete and showing little evidence of updating or review. One third of the local government survey respondents felt that their own municipality did not take earthquake preparedness seriously.

Most plans had appropriate material for direction and control, and included listings of resources owned or available from other agencies and the private sector. Only a minority of the plans we examined had any reference to mutual aid agreements and, even where such reference was made, details were sparse. Evacuation situations were dealt with in only about one-third of the plans we looked at.

We recommend that all local governments within the high hazard areas ensure they have current, complete earthquake preparedness plans, prepared in accordance with guidelines issued by PEP. And, we recommend that PEP play a stronger

role in providing to local governments advice and assistance regarding response planning, and in monitoring to ensure that all municipalities plan to a certain standard.

The British Columbia Emergency Response Management System Is Being Implemented

We strongly support the initiative of the Inter-Agency Emergency Preparedness Council (IEPC) to implement the British Columbia Emergency Response Management System for use in earthquake preparedness (as well as for other emergencies). The system has the potential to provide the many different response agencies with a commonly understood command structure. This should minimize confusion and duplication of effort.

The complexity of incident management, coupled with the growing need for multi-agency and multi-functional involvement on incidents, has increased the need for a single standard incident management system that can be used by all emergency response disciplines.

The standardized approach adopted by the Province, through the IEPC, incorporates the Incident Command System. This flexible structure, used in many parts of the United States, is designed to be used in the handling of both minor accidents and major emergencies involving multiple jurisdictions and agencies. The Province is encouraging local governments and the private sector to endorse and use the Incident Command System outlined by the British Columbia Emergency Response Management System.

National Support Plans Are Generally Comprehensive and Practical

There are comprehensive and practical arrangements with the federal government and the government of Alberta to support the Province's response efforts in the event of a catastrophic earthquake. (We must qualify this conclusion somewhat, however, because we did not have any authority to examine the completeness or currency of detailed federal departmental plans that are key to the effectiveness of the overall national plan.)

The Plans

There exists the necessary enabling emergencies legislation (the *Emergencies Act* and the *Emergency Preparedness Act)* and a solid base of departmental and program legislation and regulations to ensure support to the Province during and after a major or catastrophic earthquake. As well, the 1988 *Canada-British Columbia Memorandum of Understanding on*

Emergency Preparedness provides an appropriate framework for interaction between Emergency Preparedness Canada and PEP, and forms an effective basis for planning for, and responding to, a major emergency.

There is also an agreement between the Government of Canada and the Government of the United States on *Cooperation in Comprehensive Civil Emergency Planning and Management*. This agreement facilitates such actions as the quick movement of goods across the international border (for example, it has been used successfully on a couple of occasions to bring sandbags over the border in flood situations).

The federal government's National Earthquake Support Plan is aimed at providing a coordinated national response in support of the government of British Columbia following a catastrophic earthquake. It describes national activities to be undertaken during the response phase to support provincial and local government efforts to save and sustain lives and protect property. The plan envisages an extensive amount of joint operations between federal and provincial authorities and the exchange of liaison groups with self-sufficient communications and support. British Columbia retains responsibility for allocating federal and national support from distribution points within the Province to the disaster area. The plan is updated regularly; the latest version was issued in June 1997.

Because the plan identifies which federal departments would be involved and how, its effectiveness depends on the more detailed departmental plans (which we did not review). In light of downsizing going on in federal government departments, we recommend that PEP review on a regular basis with Emergency Preparedness Canada the status of the federal support plan. And the *Canada-British Columbia Memorandum of Understanding on Emergency Preparedness* should be reviewed and, where appropriate, updated.

There is also an Alberta Support Plan. That plan is based on the assumption that a major earthquake in British Columbia will require a significant response initiative from Alberta. It recognizes the need to coordinate and mobilize public and private sector support. The plan is written in the context of Alberta's responsibility to support the federal government and it concludes that Alberta must be prepared to either directly respond to requests for support or serve as a forward logistical base for the national response effort.

We think it is commendable that a neighboring province has taken it upon itself to identify a hazard and develop a

basic response plan for a time of need. We recommend that PEP should continue to work with its counterparts in Alberta to ensure that the plan is in fact operational for a real event.

The National Earthquake Support Plan, the Alberta Support Plan and their coordination with the British Columbia plan were tested in 1994 in CANATEX 2. The final report of CANATEX 2 contained recommendations to further enhance the interface between the three plans. However, they were generally found to be viable at that time.

The only federal government department that we had detailed discussion with was the Department of National Defence. There we focused on the role of the Canadian Forces, a potentially important player in response efforts given its presence in British Columbia.

Canadian Forces

Notwithstanding the fact that Canadian Army resources stationed in British Columbia have been reduced significantly in recent years, the other branches of the Canadian Forces continue to offer many resources to the Province for civil assistance. Also, Canadian Forces resources could be made available from across Canada through the "Area System" in the event of a catastrophic earthquake, but time and means of deployment could be very long if transportation links and related infrastructure sustain major damage.

Under the *National Defence Act*, the Canadian Forces may be called upon by a provincial government to render civil assistance. In general, civil assistance may involve humanitarian and life-saving assistance, search and rescue, damage assessment, road-clearing, sand-bagging and internal security. If the Canadian Forces are sent to deal with a provincial disaster at the request of the provincial Attorney General, the Province may be called upon to pay the expenses of the Forces.

However, although there is a high probability that many of the operational and training units will be at or near their base/port locations, municipal, provincial and federal response plans must stand alone since they cannot rely on Canadian Forces units being available to respond in an emergency. The earliest that any unit could be made available in the Greater Vancouver Area is 36 hours by land, and some 12 hours, without equipment, by air.

At present there are about 5,000 sailors, 1,400 air personnel, and 100 land force soldiers in British Columbia, the latter dispersed throughout the Province primarily in support of

reserve units. According to Canadian Forces representatives, about 50% of reservists would be expected to report for duty after a major earthquake. Local militia have been given pre-assigned tasks to perform in the event of an emergency.

The primary linkage between British Columbia and Canadian Forces is through the British Columbia Domestic Operations Detachment to the Land Forces Western Area base in Edmonton, Alberta. But Department of National Defence policy allows regional commanders, on their own authority, to respond to an immediate emergency with the resources at hand.

In the National Earthquake Support Plan the Canadian Forces are assigned responsibility for operating the Logistics Operations Management System—the means by which required resources will actually be delivered to British Columbia. "Operation Agile" is the name given by the National Defence Headquarters to the plan to provide logistic support to British Columbia. Both it and "Operation Paladin," its subordinate plan for Land Forces Western Area, are currently being rewritten to reflect recent changes, such as the closure of the base at Chilliwack.

Canadian Forces' Resources Available

CFB Comox

The infrastructure at CFB Comox is largely of 1950s/60s vintage, and this includes the major command centre for the airfield. On the other hand, the base is located on a solid platform and boasts the second longest runway in the Province, which could prove invaluable in supplying Vancouver Island.

The aircraft of the maritime surveillance squadron would be a natural resource for damage survey, and the base has access to a world-wide communications network. The search-and-rescue squadron can provide short take-off and landing aircraft and helicopters for search and rescue as well as other transport missions.

The fire department does extensive training on urban extrication of casualties and, combined with the expertise of the search-and-rescue squadron, could form the basis, locally or as needed elsewhere, for a light urban search and rescue capability.

CFB Esquimalt

At CFB Esquimalt, facilities vary from pre-war to a modern new Headquarters. The latter, and some of the more sturdy shipyard buildings, meet or exceed present building code standards. Others do not and there is a move to place the more critical resources in those that are.

Any of the modern ships and the Headquarters possess state of the art command and control capabilities and could potentially provide contingency resources for government or any key department. The base can provide food and emergency accommodation (including modular tenting) and medical facilities. It also has the capability to conduct light rescue, and to coordinate air/sea search and reconnaissance.

CFB Chilliwack

The closure of CFB Chilliwack announced in the 1995 Federal Budget will take full effect in 1998. A permanent, regular presence of over 1,200 in 1995 will, by the fall of 1998, shrink to a reserve support unit of approximately 49 regulars and reserves. There will be a major change in the availability of resources, particularly heavy engineering equipment, which will now have to be brought in from Edmonton or Gagetown, New Brunswick (this would take from between three and seven days). To get skilled operators to use available civilian equipment, however, would take much less time than that. There has always been only a limited amount of equipment at Chilliwack, and some, such as the bridge building equipment, has often been overseas for extended periods of time.

Of greater significance will be the loss of medical supplies, tents, clothing, communications equipment, command and control capability on site, general stores and vehicles. These would have to be brought in from Edmonton or obtained from the limited supplies of reserve units throughout the Province.

One of the findings of the CANATEX 2 exercise (referred to below) was the tendency of those involved to look only to the military's capabilities without investigating the availability of civilian assets. The closure of CFB Chilliwack emphasizes the importance of having inventories of civilian and military resources available in the Province.

We recommend that PEP remain in contact with the Canadian Forces to ensure that it has current information about the resources and capabilities available. PEP should also disseminate this information to local governments.

More Testing and Follow-up of Tests Is Needed

PEP has arranged and participated in a number of plan testing exercises in recent years. The testing has shown that the federal and provincial plans appear viable. It has also demonstrated the benefit of such tests by identifying a number of issues that need resolving. However, many of the resulting recommendations have not yet been acted on. At the individual local government level, we found plan testing to be inadequate to provide assurance that a response to a major earthquake will be effective. Priority should be given at all levels to more frequent testing.

Plan testing and exercising is a critical element of earthquake preparedness. Even an apparently well-designed plan may prove to be ineffective due to either unrealistic underlying assumptions or defects in such matters as resources and communications. Plan testing shows how well the plan functions in practice, and enables modifications to be made. As well, testing is valuable from a training viewpoint—although this value diminishes rapidly if the tests are not conducted frequently.

Major Tests Carried Out

Federal/Provincial

At the senior government level, three major tests of emergency plans have been carried out in recent years: CANATEX 2, an exercise involving federal and provincial governments, and Thunderbird 1 and Thunderbird 2, both provincial exercises.

CANATEX 2 was a 12-day exercise conducted May 2–13, 1994. The exercise was intended to test the British Columbia Earthquake Response Plan (interim), the National Earthquake Support Plan and the Alberta Support Plan. The scenario for the exercise was a catastrophic magnitude 8.5 earthquake caused by a 400-600 kilometre long rupture of the Cascadia subduction zone approximately 150 kilometres off the west coasts of British Columbia, Washington and Oregon. This scenario was intended to create a situation beyond the ability of British Columbia to manage without national support.

The Province participated actively for three days, and for the balance of time provided a small “simulation cell.” Most ministries, Crown corporations and utilities were included, as well as 14 Lower Mainland municipalities, the Vancouver Port Corporation and the Vancouver International Airport Authority. Also involved were 21 departments and agencies of the federal

government, the Government of Alberta and non-governmental organizations such as the Red Cross and the Salvation Army.

The two primary players in the exercise, British Columbia and the federal government, completed exercise evaluations and offered many recommendations. Those of the Province were made in three main areas: plans, procedures and training. They focused on the need for: the government to finalize the interim British Columbia Earthquake Response Plan; ministries to complete their supporting functional plans; and for more specific communications, logistics and emergency management system planning. By and large, these recommendations have not yet been implemented.

Thunderbird 1 was held in November 1993. Its primary objective was to test the ability of the provincial plan to provide a coordinated response to a major earthquake affecting the Lower Mainland. The exercise lasted three days, and simulated an earthquake of 7.3 magnitude with an epicentre some 90 kilometres north of Vancouver. The exercise was designed to test implementation of provincial resources. As well, it was intended help provincial participants prepare for CANATEX 2, which followed six months later.

Most provincial response-involved ministries and Crown corporations participated in Thunderbird 1, as did a number of regional districts in the Lower Mainland. The major recommendations resulting from the exercise focused on the need for improved communications systems within the Provincial Field Response Centre, more pre-exercise training, and establishment of dedicated radio nets for emergency management.

The objective of Thunderbird 2, held in November 1996, was to use an earthquake scenario to test the ability of the Provincial Field Response Centre and ministry / agency / municipal Emergency Operations Centres to provide a coordinated response to a major earthquake affecting the Greater Victoria area. The scope was limited to a size of earthquake that could be managed using provincial resources only.

Most provincial response-involved ministries, Crown corporations and agencies, as well as key private sector companies, participated fully or partially in Thunderbird 2, but only five municipalities elected to join the exercise. According to the evaluation, activation of more ministry / municipal emergency operations centres would have improved the practice and information flows. The evaluation for this exercise also produced a number of recommendations, most of which

again have not been implemented (although the final report was only issued in June 1997).

When interpreting the results of these exercises, it should be noted that:

- all were paper exercises only; no physical resources were moved;
- the exercises began with the response centres already in place; and
- in the case of CANATEX 2, the exercise was limited to the Lower Mainland area, despite the fact that the simulated earthquake would have had devastating effects on Vancouver Island and the neighbouring Pacific Northwest States.

Nevertheless, these ongoing training and exercise programs are invaluable. They serve to familiarize participants with plans and procedures, as well as to test the plans and serve as the basis for their refinement. The conduct of these exercises is the next best thing to a real event to identify shortfalls in training and plans. But, the value of the exercises has been reduced by the absence of an effective follow-up mechanism. The consensus of opinion of those involved in the Thunderbird 2 exercise was that such exercises must be made a priority and conducted on a regular basis.

Local Governments

Our survey results showed that about half of the local government respondents periodically test their plans and evaluate the results. Our interviews confirmed that local governments with the largest population concentrations tend to test their plans more extensively and more often than do those with smaller populations. Approximately one-half of local government respondents reported that their earthquake preparedness plans had been modified as the result of plan testing. This suggests that where local governments do test their plans, they are using the results to correct plan weaknesses.

What Testing Is Required

We recommend that PEP develop provincial initiatives to encourage municipalities to test key components of their individual plans sufficiently; and, to provide more exercises at the province-wide and regional levels to ensure that the liaison between the emergency response efforts of different levels of government works effectively. We also recommend local governments develop schedules for testing their plans and ensuring that recommendations arising from the testing are dealt with.

And, we recommend that PEP discuss with Emergency Preparedness Canada the possibility of conducting regular exercises around the National Earthquake Support Plan and its relationship to British Columbia's plans.

The Extent of Training Is Inadequate

The nature of training offered both provincially and federally is good, but we have concerns about its extent. The training infrastructure in British Columbia needs strengthening.

The major tests held since 1993 have identified as a problem the insufficient training of ministry personnel who would be called upon to staff Provincial Field Response Centres and make decisions about ministry plans and resource use in the event of an earthquake. The need for similar personnel at the local government level to be adequately trained is self-evident, yet there are indications that not all these staff may be receiving required training.

Training for Emergencies Is a Complex Issue

Training is a complex aspect of emergency management. It must cater to a multitude of functions, a wide range of organizations, and a diverse array of individual needs and circumstances of potential participants. And even where training needs are identified, designing and delivering training can be constrained by the levels of funding provided by stakeholders. As well, for many individuals, earthquake planning is only one of many responsibilities that they have in their ministry or local government function. Thus, even where training is available, people's ability to participate in it might be limited by the demands of their other duties.

What Training is Offered

Training for earthquake planners and responders is provided at a number of levels, and ranges from formal courses to on-the-job training.

At the federal level, Emergency Preparedness Canada offers training and education programs through the Canadian Emergency Preparedness College at Arnprior, Ontario. The courses offered include Basic Emergency Preparedness, Emergency Operations Centre Management, Managing Emergency Telecommunications, Exercise Design, and Mayors and Elected Municipal Officials. A number of offerings in the health/social services field are also available, including emergency planning for hospitals and for emergency social services. Courses tend to be of one week's duration.

At the provincial level, training in emergency preparedness is provided through the PEP Academy at the Justice Institute and through local regional offices. The PEP Academy offers workshops and courses for volunteers, municipal officials and various government ministry staff. Core training is offered and funded for volunteers and municipal officials, whereas specialized courses and workshops are offered on a fee-for-service basis to government ministries and agencies. To address the widest possible audience, training manuals have been produced and a strong emphasis is placed on train-the-trainer projects and distance education. Since 1990, more than 700 programs have been delivered and about 17,000 people trained. In addition to the Academy courses, the Justice Institute offers courses on the Incident Command System and on Emergency Social Services.

We examined the core curriculum offered at the Justice Institute and found it is based on identified hazards and the principles of emergency management. Our survey replies indicated a high degree of satisfaction with the training offered at Arnprior and the PEP Academy.

Funding for Training

As well as providing financial support for the PEP Academy, the provincial government has traditionally given local governments financial assistance to help them defray the costs of course attendance. This assistance used to apply not only to course fees, but also to the costs for accommodation and meals for participants. However, the provincial government no longer provides assistance for the out-of-pocket expenses of local government attendees.

Regional managers of PEP have traditionally provided training on a less formal basis at the local level. However, with reductions in funding for PEP, managers are less able to travel throughout the Province to provide this training.

Where the Gaps Are

The two most recent major tests of earthquake plans at the provincial level indicated that more training is needed for ministry staff assigned to the Provincial Field Response Centres. The tests illustrated the difficulties that can arise where response coordination is assigned to an ad hoc body that is only activated when a disaster occurs. As well, it was evident that training programs had not kept pace with the reassignment of responsibility for earthquake planning among ministry staff.

Courtesy: Office of Emergency Services, State of California

Rescue teams need good training

In PEP, regional managers play a key role in assisting local governments in their earthquake programs. However, not all the regional managers have been trained to the same level and, as a result, the program may not be able to offer a consistent level of support across the Province.

In 1993, PEP carried out a survey of municipal administrators to assess the types of training programs that would be required in the future, the numbers of people that might be involved, and the types of training that key emergency personnel had taken at that time. However, no determination has yet been made of the minimum training levels that should exist, nor is there any on-going monitoring of the overall state of training in the Province.

Most local governments have identified those positions for which earthquake preparedness training is required. While about two-thirds of them indicated in our survey that they believed their organization provided and supported opportunities for external training, only about half felt that sufficient funds were provided for this purpose and that front-line personnel were being adequately trained. Fire departments, police departments and hospitals were more pessimistic. Most expressed concerns about the adequacy of funding for

earthquake training and the extent to which training was provided to front-line personnel.

The Training Infrastructure Needs Improvement

The assignment of earthquake planning responsibilities among governments makes it unrealistic to assign a single agency responsibility for a global training program for everyone involved. On the other hand, it is important that training needs for different levels of involvement be assessed accurately and consistently. It is equally important that there be some evaluation of how well personnel are being trained overall, as modification to public policy may be required to address inadequacies in training over a long term.

This state of affairs, in our opinion, suggests a broader role for PEP. We recommend that, first, PEP should prepare a matrix of emergency planning and response positions at both the provincial and local government levels, and should identify the appropriate training regime needed for each position. This is particularly important with respect to the Incident Command System that the Province would like to see adopted by all local governments. And, second, provincial government agencies and local governments should be required, at least annually, to provide PEP with information about the training they have provided to emergency planning and response personnel. The latter information will assist PEP management in making policy recommendations, and is also essential information for an annual report on the state of earthquake preparedness in the Province.

Processes for Damage Assessment Are Inadequate

There is currently a lack of clarity about how initial damage assessment will be carried out and by whom. As a result, were a major earthquake to occur tomorrow, damage assessment would likely be slow and uncoordinated in the early stages after the earthquake, and inconsistently carried out by the local and provincial authorities.

To respond to an earthquake effectively, a local government's Emergency Operations Centre needs accurate reporting from the field as soon as possible after the earthquake. If provincial help has been requested, this information must be sent on to the Provincial Field Response Centre. From this information, the Province needs to establish priorities. What those priorities are will depend on the extent of damage and destruction and how key and non-key facilities are affected.

In 1994, the government of British Columbia prepared a draft Damage Assessment Emergency Response Function Plan. Under this draft plan, damage assessment would be the responsibility of the response management structure itself. At both the Provincial Field Response Centres and Provincial Emergency Coordination Centre there would be a damage assessment manager reporting to the planning chief. The Ministry of Forests would be responsible for providing the field centres with a damage assessment manager and assistants; the provincial Government Communications Office would be responsible for coordinating media gathered information and observations.

The plan also assigned damage assessment functions to local governments for their communities, to the school, hospital, sewerage and water districts for their functional jurisdictions, and to the provincial ministries for their responsibilities.

The plan's usefulness as a working document is limited, however. The plan has remained in draft form, is not generally regarded as a "live" document, and refers to an emergency-planning concept that has since been abandoned by PEP. Furthermore, the plan is vague on how private sector resources and volunteer resources are to be marshalled.

In general, the ability of local governments to activate an effective damage assessment program is limited. Only a small majority of local governments reported having the expertise to properly assess damage to public and private facilities.

We recommend that PEP complete a clear and practical plan for carrying out initial damage assessment immediately following a major earthquake. The plan should set out who is responsible, how it should be carried out, and the process for communicating the assessments to different levels of government. And the plan must be communicated to all who will have a role in damage assessment. Local governments should develop their own plans, which should be consistent with the provincial plan.

Communications Systems Need More Coordination

The ability of responders to communicate with each other and with different levels of government is a concern. The CANATEX 2 evaluation concluded that "the current emergency radio communications resources available to the province cannot effectively support a coordinated response effort to a major earthquake or, indeed, any other serious emergency situation which causes telephone service to be disrupted for significant periods of time." The evaluation went

on to state that "what is required is a province-wide satellite-based telecommunications system." Thunderbird 2 showed that there continues to be a problem with communications, although the test did show a marked improvement over previous exercises. Governments are aware of these problems and some significant steps are being taken to deal with them, in particular the building of a regional communications centre in Vancouver to serve southwestern British Columbia.

At the provincial government level, PEP and various provincial government ministries are beginning to acquire satellite telephones, but there is no coordinated government-wide plan for upgrading all communications systems. At the local government level, the adequacy of communications also remains a problem. The Regional Emergency Communication Centre being built in Vancouver should improve the ability of the municipalities in the Greater Vancouver Regional District to communicate among themselves, with PEP, and with others. However, for other local governments (and key agencies such as fire and police departments), similar improvements are required to allow effective communication.

In 1995, the provincial government started work on a British Columbia Emergency Communication Plan, setting out the emergency communication requirements and capabilities of the Province. The draft plan describes the expected performance of ministries, other provincial agencies, local authorities, and the private sector in building a comprehensive communication system to support response management. Of particular note, it also gives local authorities responsibility for providing their own emergency communications.

Although the draft plan assumes a realistic scenario in which all telephones are "down," the plan has not been completed and thus is of little or no operational use.

Most local governments and fire departments responding to our survey reported that they tested and evaluated their emergency radio communications systems, but nearly half the police departments and hospitals said that they did not. Nearly three-quarters of local governments, fire departments and hospitals reported that they had back-up emergency radio systems.

Communication problems—such as fire departments in neighbouring communities being unable to communicate with each other—have occurred in past emergency situations (and tests) because of lack of common radio frequencies. These situations put additional stress on communications by telephone.

Testing of radio communications systems under duress was not extensive. Testing to ensure systems compatibility with other jurisdictions was also weak, but most local governments and fire departments said that testing was done for compatibility with municipal Emergency Operations Centres. Somewhat disturbing to us, however, was the response from over half the police departments and hospitals that they did not do any compatibility testing. And most respondents overall stated that no testing was done to confirm that radio communications systems were compatible with commercial radio stations.

Partnerships with amateur radio groups are relatively common among local governments. While emergency planners spoke highly of the competence and enthusiasm of such groups, there are concerns about the speed with which the operators could be mobilized.

We recommend that PEP develop a coordinated plan for upgrading the province's communication equipment to a more reliable system. Also, it should update, finalize and distribute its communications plan. And, local governments should continue to test their ability to communicate with each other and, where significant problems are identified, take steps to correct the problems.

Public Information and Warning Systems Are Not Well Developed

We found that plans for issuing warnings to the public and for keeping the public informed after an earthquake are not well developed. This could result in uncertainty and confusion in the minds of the public. (One of the key lessons learned from the "Blizzard of '96" was that the lack of a public information plan at both the provincial and local levels proved to be a problem.)

An interim British Columbia Emergency Public Information Plan was prepared in 1994, but it has not been finalized, or updated to reflect current circumstances. And, only a minority of local governments and police forces felt that they had the capacity to provide accurate, timely and useful information during an emergency period. Prerecorded messages are rarely developed and multilingual messages for use after an earthquake are virtually non-existent. Given the ethnic diversity of the province's population, the latter is a serious limitation.

Most police forces in our survey said they were aware of the provincial procedures for warning local governments about the effects of a major earthquake—but fewer than one-

Courtesy: Office of Emergency Services, State of California

Good signage is an important element of public information

half of local governments confirmed that they were aware of these procedures. About one-half of the local governments and police forces also confirmed that procedures were in place to warn public officials about aftershocks, landslides, tsunamis and other critical hazards to life, but fewer than half of our survey respondents had procedures to provide citizens with similar warnings.

The extent of testing and evaluation of emergency public information systems is also unsatisfactory. Only a quarter of responding local governments and police forces indicated that their emergency warning systems were tested and evaluated.

We recommend that PEP develop and issue a current emergency public information plan as soon as possible, and that local governments develop their own emergency public information plans, which should be consistent with the provincial plan. All of these plans should be tested on a regular basis.

Planning for Recovery

What Is Recovery?

Recovery is the phase of earthquake management that aims to restore communities affected by disasters to a normal regime of social and economic activity. It involves not only repairing or replacing physical infrastructure that has been damaged during an earthquake, but also rebuilding the economic strength and social stability of a community through appropriate financial and regulatory programs.

Planning for recovery has a number of components.

Planning for Business Continuation

Business continuation planning is aimed at allowing an organization to resume its regular business activities as quickly as possible after a disaster. In the case of governments, this means being able to continue to provide essential services to the public with as little disruption as possible. This is not just a matter of marshalling physical resources; it also involves providing the appropriate authorities to functions and individuals to enable government business to continue under extreme conditions.

Business continuation doesn't just happen. As with other aspects of emergency preparedness, it should be an ongoing program from which an organization develops and modifies its continuation plans. And to be fully effective, it should involve all members of the organization.

The organization must identify the business functions to be restored and the priority in which they will be restored. It must analyze what personnel, equipment, information and office facilities are needed to successfully restore the operating capability of the functions. And it must assess how it can reduce the impact of a disaster such as an earthquake on its business functions.

The business continuation program generates the development of the continuation plan. The plan should deal with establishing the succession list of responsibilities, alerting key personnel and external contacts, performing a disaster assessment, and obtaining the resources such as personnel and facilities needed to restore services. In the same way that the business continuation program should involve the whole organization, so the plan should be the work of more than one author.

Dealing With Building Damage

Repairing and rebuilding damaged buildings is one element that covers the entire recovery cycle. Initially, the concern is to prevent further loss of life or injury, particularly from aftershocks following the initial seismic activity. Damage to structures must be assessed and buildings posted to indicate which buildings are safe to use. A system of inspecting and posting key buildings is therefore essential if injury and loss of life are to be minimized.

Inspections often take the form of two main evaluations: one rapid and one detailed.

A rapid evaluation is carried out to identify and post apparently safe and obviously unsafe structures, and to designate buildings whose strength and safety cannot be determined without a more thorough examination. These evaluations are usually done by local building inspectors, assisted by volunteer civil/structural engineers, architects, building contractors and other individuals.

A detailed evaluation is carried out to evaluate and post buildings of questionable safety, usually those that have already been posted as "Limited Entry." Detailed evaluations are designed to be performed by volunteer engineers within a few hours or days after the rapid evaluation phase, and are intended to provide reasonable assurance about whether a building can be returned to or not.

The effectiveness of any post-earthquake structural assessment program depends on effective protocols for the assessment. As well, it depends on a trained and accessible core of volunteer engineers with the necessary authority, supplies and equipment to perform their function.

Removing Debris

A major earthquake is likely to cause a significant amount of damage, so debris removal is a key element of recovery (as well as of response). Initially, streets must be cleared quickly to allow emergency vehicles access to help the injured and extinguish fires. Subsequently, removing what is left of destroyed buildings allows reconstruction to begin earlier. The personnel and equipment of governments and private sector companies will likely be needed to remove debris. Suitable places to dump earthquake rubble will also have to be identified so that environmental problems and higher future costs for cleanup can be avoided. It is therefore important for governments to identify potential disposal sites in advance,

Courtesy: Office of Emergency Services, State of California

Debris removal can be a formidable task

and to plan for the logistics of moving debris to them. As well, the authority to make decisions about the disposition of debris should be assigned before the event, since such decisions will have to be made quickly once the emergency has occurred.

Rebuilding

Building regulations need to be established to enable the rebuilding process to proceed as quickly as possible.

In the meantime, temporary housing has to be found for the homeless after the earthquake. As well, health and safety information must be distributed among the population to minimize the risk of a disease outbreak resulting, for example, from drinking contaminated water.

Economic Recovery

To find out how best to revive the economy, impact studies usually have to be carried out to identify how damaged the various elements are, what needs repair and how the repairs can be done. Only then can appropriate financial assistance programs be put into place.

Recovery activities are related to mitigation. Effective mitigation can have a significant effect on a community's ability to recover swiftly from an earthquake. For example, a high level of earthquake insurance lessens the financial burden on individuals and governments to replace damaged property, and frees up resources that can be applied to other aspects of the recovery effort.

The magnitude of recovery from a major earthquake transcends jurisdictional boundaries. Reconstruction usually needs to be planned and carried out by groupings of jurisdictions at least at the regional level. Plans should be made ahead of time for rebuilding the infrastructure. This initially entails developing an appropriate way for expediting the review of applications for rebuilding immediately after an earthquake. But beyond this, governments should have some sense, based on a realistic earthquake scenario, of the likely effect that a major earthquake would have on the infrastructure. They should know which facilities would survive and which would not, and plan accordingly.

An effective rebuilding program would also need to be supervised by a reconstruction authority. Such an agency may act for a number of governments, and the creation of one should be contemplated as part of a long-term recovery plan.

Financial assistance programs typically involve some degree of cooperation between the provincial and the federal governments, particularly those delivered through the fiscal system.

What We Expected to Find

We expected to find that governments had identified recovery as an important component of being prepared for a major earthquake. We looked for written, tested business continuation plans that would enable governments to continue to provide essential services to their citizens after an earthquake.

We also expected governments to have established procedures for inspecting and posting unsafe buildings, and local governments to have considered how they would deal with debris removal.

Finally, we anticipated that governments would have given some consideration to the rebuilding and reconstruction process, and to how that process might be funded.

Conclusion

The provincial and the local governments are not prepared for recovering from the social and economic effects of a major earthquake. Recovery plans generally do not exist, and little attention has been given to making sure that key elements of recovery are likely to function in an effective and coordinated way. Although the *Emergency Program Act* requires the minister to prepare emergency plans for recovery from disasters, this requirement has not yet been met.

There is still much work to be done on key recovery issues, especially business continuation planning, something that is important to governments' ability to continue to provide essential services in the aftermath of a major earthquake. It is almost non-existent at the provincial government level—a serious concern. It is also generally lacking at the local government level, although some municipalities are in the process of developing such plans. Established procedures for inspecting and posting unsafe buildings do not exist, and little thought has been given to how to deal with debris that would undoubtedly result from a major earthquake. Few governments have plans for expediting the repairs and rebuilding that would be necessary. None has analyzed the financial options for funding a rebuilding program.

Failure to plan for recovery can mean that the recovery process may take much longer than otherwise might be required. Prolonged economic instability makes it difficult for the community to regain its former competitive advantages, and can hold back the rate at which the economy is rebuilt. As well, the lack of recovery planning weakens a community's ability to plan for effective mitigation, as the potential costs of economic and social restoration will not be known with any accuracy. While it is difficult to assign a value to human life, communities will want to know the cost-benefit implications of different ways to mitigate purely economic risks.

Many of the decisions associated with recovery are ones of government policy. How quickly recovery can or should take place and how the costs of recovery will be distributed within the community are largely determined by government decisions. It is therefore important that governments give considerable thought to the types of decisions they will have to make and how they will carry them out.

Findings

Priority Has Not Been Given to Recovery Planning

Recovery planning has been given very little profile in the context of overall earthquake planning, either at the provincial or local government levels. This is despite the fact that PEP has a legislated role in recovery. The *Emergency Program Management Regulation* requires it to make recommendations to the minister about all aspects of emergency management, including recovery. These recommendations are to cover legislation, regulation and policy, as well as the creation and maintenance of an emergency management program. The regulation also allows PEP to advise and assist business and industry on recovery matters. The same regulation also requires the Inter-Agency Emergency Preparedness Council to make recommendations to each minister on, among other things, recovery.

There Is Very Little Business Continuation Planning for Governments

Business continuation planning, which is important to governments' ability to continue to provide essential services in the aftermath of a major earthquake, is almost non-existent at the provincial government level—a serious concern. It is also generally lacking at the local government level, although some municipalities are in the process of developing such plans.

In British Columbia, regulations require governments to prepare plans for business continuation. Each minister of the provincial government must set out in business continuation plans and procedures the manner and means by which that minister will continue to provide essential services despite an emergency or disaster. As well, the *Local Authority Emergency Planning Regulation* requires each local authority to establish priorities for restoring the essential services it normally provides. These are to be reflected in the authority's emergency plan, as are the recommendations to service providers for restoring essential services that are not provided by the authority.

The Risk Management Branch of the Ministry of Finance and Corporate Relations is currently responsible for the effective management of the risks of loss to which the provincial government is exposed by virtue of its assets, programs and operations. In delivering its mandate, the branch has assumed three roles: central risk management agency within government, risk management consultant, and risk financing. As part of its central risk management function, the branch is responsible for business continuation planning within government, and coordinates the ministries' efforts in developing their own plans.

The branch has developed a methodology for preparing business continuation plans appropriate for government activities.

Despite the efforts of the Risk Management Branch, and despite the regulatory requirements, we found that many ministry officials generally feel that business continuation planning is largely lacking in their ministries. What plans do exist, tend to be outdated.

There are some exceptions. For example, the Provincial Treasury has a number of business continuation plans. As well, the Ministry of Human Resources has a draft plan developed by internal advisory groups and tested in two internal exercises. The ministry executive is considering the current version of the plan for formal approval.

The overall inadequacy of ministry preparation was confirmed in a report prepared by the Risk Management Branch in May 1997. The report concluded that, with few exceptions, business continuation planning in ministries is dormant or non-existent, and that most government organizations would only be able to respond to a disaster in a slow, uncoordinated manner. Problems identified as contributing to this situation included a lack of leadership and accountability, lack of resources, outdated planning, little training or exercises, and the absence of a coordination plan for restoring services. Recommendations included: assigning responsibility for maintaining a business continuation planning program and establishing accountability for success; monitoring the status of such planning; and auditing ministry planning programs. Also recommended was that the Risk Management Branch act in a training and coordinating role and provide status reports to the Deputy Ministers' Council. We concur with these recommendations. Further, we recommend that government give serious consideration to how best to coordinate the roles of the Risk Management Branch and PEP, as this area of emergency preparedness is closely related to the other aspects of preparedness for which the latter is responsible.

Since this assessment, the branch has continued to encourage better business continuation planning in ministries. Within the past year, it has produced a planning guide for the completion of business continuation plans, and has highlighted in its newsletter proven examples of good business continuation planning in the provincial government.

Crown corporations and similar agencies are in the process of developing business continuation plans; few have been

completed. Where there is competitive pressure to retain business that might otherwise go elsewhere, business continuation programs tend to be better defined.

Local governments are generally left very much to themselves as far as business continuation planning is concerned. Most recognize its importance, but few (only 1 in 10 according to our survey) have included a business continuation component in their emergency plans. A number of the local governments we interviewed indicated they were at various stages of developing such plans, however. And, only about one-third of our survey respondents felt that individual municipal departments were clear on the role they would need to play in restoration of essential services. PEP has not been actively working with local governments in this area.

We recommend that ministries, Crown corporations and local governments give immediate attention to completing and testing business continuation plans. PEP should establish and provide to local governments guidelines for the development of business continuation plans.

Ability to Inspect and Post Unsafe Buildings Is Inadequate

We found no organized, coordinated, province-wide approach to the inspection and posting of buildings in British Columbia. Few guidelines are in place and, particularly at the local government level, it seems unlikely that sufficient qualified personnel would be available to complete the task in a satisfactory way. This could result in unsafe buildings being accessed by the public after an earthquake, thereby possibly causing injury or loss of life.

The Province is in the early stages of developing a plan for the inspection and subsequent posting of its own office buildings.

At the local government level, only a minority of respondents to our survey reported that they had a priority list of buildings to be inspected immediately, about half indicating that they had procedures to post and restrict access to all damaged structures following inspection. Only a minority of local governments indicated that they had identified external structural engineers who would be available to assist them in assessing damage. As well, few local governments said they had set up processes for calling in suitably qualified volunteers to assist local government building inspectors.

In fact, we understand there are currently relatively few volunteers who would be available to perform the most basic

Courtesy: Office of Emergency Services, State of California

Search and rescue capability saves lives

level of evaluation. This skill is taught in a course (referred to as ATC 20 training) that the Association of Professional Engineers provides. The course is based on the approach to building inspection in the United States. Trainees learn to do a 10-minute rapid building assessment, resulting in red, yellow or green signs posted on the building to let others know its state. We understand that discussions about training engineers, inspectors and building officials in the use of post-earthquake structural assessment are in progress between the Joint Emergency Liaison Committee, the Justice Institute, the British Columbia Institute of Technology and the University of British Columbia.

In 1992, PEP recommended that all ministries, municipalities, regional districts and federal department offices in British Columbia adopt the ATC 20 building inspection process. PEP provided a set of forms and signs that could be reproduced locally and thus provide the necessary coordination in the post-earthquake scenario. However, the survey results described above suggest that many local governments have not adopted the recommended building inspection process.

More recently, in 1997, a working committee of the Joint Emergency Liaison Committee issued an interim report on structural assessment. The report's recommendations included:

- assignment of volunteer engineers to pre-designated fire halls;
- accessible storage of necessary equipment and supplies at pre-designated fire halls;
- pre-identification of volunteer engineers and registration of them with PEP;
- coordination by PEP of the registration of all types of volunteers prior to a disaster; and
- development by PEP of an education strategy for professionals and the public to inform them about building inspection and posting.

We think these recommendations have merit, and encourage PEP to pursue them. And we recommend that PEP should again advise local governments as to the steps they should take to develop sound plans to inspect and post buildings after an earthquake. Helpful in this regard—particularly in establishing priorities for post-earthquake inspections—will be the inventories of hazardous buildings and critical response facilities recommended in the mitigation section of this report. Also, we recommend that PEP, in conjunction with local governments, ensure that plans are developed to inspect all key infrastructure (whether it be owned provincially or locally).

Little Planning for Debris Removal

We found that very little thought has been given to the post-earthquake removal of debris. Most local governments do not have plans to coordinate debris removal. Even of those that do, few have identified potential sites to which to move debris. As a result, emergency vehicles could be impeded, and other recovery activities slowed down unnecessarily.

We recommend that all local governments develop plans for debris removal. And we recommend that PEP establish and provide to local governments guidelines for dealing with debris removal.

No Plans for Long-term Reconstruction

We found that most governments do not have plans for expediting the review of applications for repairs and rebuilding, or for identifying areas that are likely to need rebuilding after a major earthquake. And attention given to longer-term planning issues is virtually non-existent. Fewer than 10% of our local government survey respondents indicated that a reconstruction

authority existed in their jurisdiction, and none of them had prepared a reconstruction plan.

We recommend that local governments establish strategies for long-term reconstruction. And we recommend that PEP establish and provide to local governments guidelines for planning for reconstruction.

No Plans for Funding Recovery

Although some elements of a financial relief plan are in place, existing arrangements are not comprehensive and would likely be inadequate to facilitate a full recovery program after a major earthquake.

The provincial and local governments appear to have done little research into the potential economic costs associated with recovery. We were not made aware of any attempts to quantify the overall potential damage to the commercial and social infrastructure.

Generally, estimates of the costs associated with recovery from earthquakes tend to be performed by private sector organizations, for which such information is critical to the success of their business operations. For example, insurance companies develop projected scenarios of property damage so that they can assess risk exposure and set premiums. A study prepared in 1992 by the Munich Reinsurance Company of Canada estimated that an 8.5 magnitude earthquake occurring under the Strait of Georgia could inflict damage of between $19 billion and $30 billion in the Greater Vancouver area.

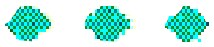
The government of British Columbia offers a disaster financial assistance program to property owners, individuals, farms, small businesses, charitable or volunteer organizations, and local governments. The program details are set out in the *Compensation and Disaster Financial Assistance Regulation* to the *Emergency Program Act*. The regulation seems to apply more to short-term assistance following relatively small disasters than to recovery from major disasters involving many millions of dollars. For claimants other than local governments, the maximum payable for an accepted claim is $100,000. The Government of Canada has established disaster financial assistance arrangements to help provinces meet the portion of the costs of disasters that exceeds what they might reasonably be expected to meet on their own.

Eligible costs for funding are those that arise on the loss of, or damage to, uninsurable assets as the result of a disaster. They cover needs in the immediate disaster period, as well as

those for individuals and the public sector after the disaster. The assistance is based on a scale of expenditures per capita of provincial population. Not included as eligible costs are those recoverable by law or from insurance, and those relating to non-essential properties and infrastructure.

After the CANATEX 2 test, it was recommended that a financial options paper be developed by the federal Department of Finance to consider possible options for dealing with the financial ramifications of a catastrophic disaster and for dealing with possible options. In the final status report (1996) regarding the CANATEX recommendations, no progress was reported on this issue.

We recommend that the provincial government discuss this matter with the federal government, but in addition it should develop its own options paper on ways of dealing with and mitigating its own financial liabilities in the event of a major earthquake. For example, one significant option is the role of insurance in distributing the cost of recovery among individuals, governments and the private sector.



part 5 recommendations: what should be done next

Preparedness for a major or catastrophic earthquake can never be absolute. Deaths, injuries and significant property damage are likely to be unavoidable. What preparedness can do, however, is reduce the scale of these impacts, help return life to normal sooner than would otherwise occur, and reduce the cost of recovery.

The purpose of our audit was to assess the degree to which governments in British Columbia are prepared for a major earthquake in high hazard areas of the Province, and to determine what actions, if any, are needed to raise the level of preparedness to an adequate standard. Our assessment, set out in Part 4, was that governments in British Columbia are not yet adequately prepared for a major earthquake. Throughout our assessment we noted specific actions on the part of the provincial government and local governments necessary to improve British Columbia's earthquake preparedness.

We have also considered the general environment in which earthquake preparedness activities are carried out, and have concluded that there are a number of factors that influence in a significant way the state of earthquake preparedness.

Factors Influencing the State of Earthquake Preparedness In British Columbia

- British Columbia has not yet experienced a major earthquake in a heavily populated area, such as those that have caused significant damage in other parts of the world. As a result, while there is clearly some political will to achieve an adequate level of preparedness—as shown by the Attorney General's call for this audit—the threat of an earthquake is generally not seen to be sufficiently real or imminent to make preparedness a matter of political priority. Public interest has a significant effect on political priorities, of course, but public interest in earthquake preparedness remains intermittent at best.

  This situation is not unique to British Columbia. In California, for example, experience has shown that earthquake preparedness receives strong political and public attention only after an earthquake has occurred, and then only for a short time. The same limited attention followed southwestern British Columbia's 1996 snow storms.

- British Columbia is relatively new to the field of earthquake preparedness. Although it has had various forms of civil defence planning over the last 40 years, it is really only since the 1980s—with the growing understanding of the vulnerabilities and risks—that serious consideration has been given to preparing for a major earthquake. Most of the effort to date has gone into planning for response; planning and establishing mitigation and recovery programs have been slower to develop.

- Strategic planning—setting long-term goals and objectives, and implementing a plan designed to achieve them—has not been carried out. In part, this reflects the lack of consistent interest and commitment shown by politicians and senior management in government. Lack of strategic direction reduces the likelihood of a consistent effort toward mitigation and recovery activities. Mitigation is costly—especially upgrading buildings and other structures to current standards—and can only be done over the long term. Similarly, preparing for recovery can seem a daunting task, one that is far removed from day-to-day reality.

  Those individuals involved in earthquake preparedness in the Province, though dedicated and enthusiastic, have had limited success in gaining the attention and support of senior management. We believe this is one of the reasons that some emergency plans are neither current nor tested, and that even when some tests are carried out, it has been difficult to get the involvement of those who would actually be called upon to make decisions in the event of a major earthquake.

  We believe that tangible progress in improving overall preparedness is only likely to be achieved if the efforts taken are in response to an explicit statement of what government wants to achieve. A long-term strategy is required—one that prioritizes the work necessary and provides for continuing but affordable expenditures to enhance the province's recovery capabilities.

- The absence of specific and comprehensive earthquake planning scenarios has reduced the incentive to plan effectively. Such scenarios can be powerful tools in: helping elected officials visualize the threat and commit themselves to leadership in mitigating the hazard and planning for response; helping provincial and local government officials focus their decision-making for emergency planning; helping private sector managers understand the scope of the hazard and consider them in their business decisions process; helping educators and journalists ensure that the public is

correctly informed about the character of the threat and the importance of being prepared to mitigate its effects; and helping the general public appreciate the extent of its vulnerability, and support public mitigation efforts and develop personal strategies for earthquake preparedness.

- The positioning of the Provincial Emergency Program (PEP) in government does not give it a sufficient profile to be effective. Many people we spoke with felt that PEP's relatively minor position within the Ministry of Attorney General signifies the degree of importance placed on the program by the provincial government. We agree that this issue does appear to have affected PEP's ability to influence others to do what needs to be done.

  In other jurisdictions, it does seem that emergency planning organizations that enjoy high visibility and demonstrated support from their senior government stakeholder do achieve more success than those that do not. We agree that the location of emergency planning agencies within government can send a powerful message concerning the government's support of the agency and the program. This in turn can significantly affect how other organizations respond to the agency's initiatives, and how important they regard its role.

- PEP has not had the resources to carry out many of the tasks its staff know should be done. In its headquarters in Victoria, it has two planners, one of whom spends a considerable part of his time on earthquake preparedness. Around the Province it has six regional offices, each staffed with just one professional and one administrative assistant (apart from the southwestern region, which has two full-time professionals and one full-time and one half-time administrative assistant) who must deal with all aspects of disaster management in the Province, not just earthquake preparedness. This means that much of staff's time is taken up handling day-to-day crises.

- No agency has been charged with the responsibility of monitoring for compliance with the *Emergency Program Act* and associated regulations. The legislation provides a good framework for emergency preparedness and is specific about responsibilities (stating, for example, "a local authority must prepare or cause to be prepared local emergency plans respecting preparation for, response to and recovery from emergencies and disasters," and "each minister must . . . set out, in business continuation plans and procedures, the manner in which . . . that minister will continue to provide essential services despite an emergency or a disaster").

Non-compliance with these and other requirements means that emergency preparedness is not as good as it should be (or as good as was intended when the legislation was passed in 1993). PEP does have the option of reviewing and recommending modifications to the emergency plans of local authorities, but to our knowledge it has never done this. We believe it essential that the provincial government, through PEP, takes a stronger leadership role to ascertain that what is contemplated in legislation is actually being done.

Beyond monitoring for compliance with the legislation, no agency has been given the responsibility of monitoring the overall state of earthquake preparedness in the Province. As a result, government may not have had full information to support its policy decisions regarding the direction and funding of emergency preparedness activities.

- The Inter-Agency Emergency Preparedness Council has not been as effective as it could have been. The *Emergency Program Act* gives the Council broad powers to look at a range of emergency management issues. While the Council does have some positive achievements to its credit (for example, introducing the British Columbia Emergency Response Management System), there are some issues, such as recovery, that the Council has not yet looked at in any detail.

  The Council comprises emergency planners from ministries, Crown corporations and other government agencies, and is chaired by the director of PEP. Its membership therefore represents an appropriate level of working expertise for its mandate. However, we believe there have been a number of limitations imposed on the Council, diminishing its effectiveness. The composition of the Council has changed frequently, attendance of some members has been inconsistent, and it is questionable whether some of the members have been sufficiently empowered to commit their organizations to actions approved by the Council.

  Also, there has been no body overseeing the activities of the Council, and thus no one to encourage participation and remove impediments to progress. The Council is only required to report to the minister responsible (the Attorney General) at the request of the minister or the Lieutenant Governor in Council. As a result, the Council has only issued one very general two-page report since 1993.

- The need for regional coordination has not been given sufficient emphasis. Lack of coordination between the road clearing services of neighbouring municipalities during

the 1996 snow storms demonstrated, in a small way, the consequences of this problem. Existing legislation enables regional districts to assume emergency planning responsibility for a region, but only where the member jurisdictions want this shift to take place. Where this has not happened, regional coordination depends on voluntary participation of municipalities.

The provincial government clearly has an interest in the overall success of regional planning initiatives, but this interest has not been articulated either in existing legislation or in any other formal way. Nor has a way been set out for the provincial government to ensure that lack of consensus and non-participation do not jeopardize a region's ability to deal with key emergency planning issues.

A number of regional committees and groups are currently trying to tackle emergency planning through a complex web of direct and functional relationships. Their thinking is that some broad emergency planning issues are best dealt with through a cooperative approach. This approach is not compelled by legislation, and there is no formal framework that requires certain results to be achieved. In these cases, a lack of consensus among the players on how to approach specific issues can jeopardize the group's ability to complete projects that could significantly improve public safety. Clearly, regional coordination is essential to improving the state of earthquake preparedness in the Province. But, unless its development becomes better coordinated and the provincial government establishes clear goals, its progress will be impaired.

The Recommendations

Here, we reiterate the specific recommendations made in Part 4 of this report, but also go a step further. Based on our analysis of the factors influencing the state of earthquake preparedness in British Columbia, we believe there are nine major—strategic—recommendations that transcend all the others. Implementing these high-level actions would, in our opinion, provide the leadership necessary to enable significant improvement in the state of preparedness.

In formulating all of our recommendations we have understood that preparedness for a major or catastrophic earthquake can never be absolute. Deaths, injuries and significant property damage are likely to be unavoidable. What preparedness can do, however, is reduce the scale of these impacts, help return life to normal sooner than would otherwise occur, and reduce the cost of recovery.

Our recommendations do, of course, require the commitment of certain resources. But, even in today's restraint atmosphere, we believe that what we are suggesting is affordable. We also believe that the investment of a relatively limited amount of additional resources would pay great dividends in improved preparedness.

Strategic Recommendations

The following recommendations describe the most important steps that we believe must be taken to address the problems described in the context above. Unless these issues are dealt with, we think there is little likelihood of significant improvement in the overall state of preparedness for earthquakes in British Columbia.

These strategic recommendations focus mostly on the provincial government's leadership role in providing a solid foundation for earthquake planning and management in the Province. Among other things, this role involves providing appropriate direction, creating and supporting the agencies needed to effect change, and monitoring and reporting progress made toward desired levels of preparedness. These initiatives, we believe, will create the environment needed to improve the current state of preparedness throughout the Province.

1. *The provincial government should establish a Seismic Safety Commission*

We believe that better coordination of scientific studies is required so that the information can be used to develop effective mitigation, response and recovery activities across the Province. This effort would require the cooperation of governments at all levels, scientists and engineers, the private sector, academics and the general public. The Inter-Agency Emergency Preparedness Council reached a similar conclusion recently, and recommended the establishment of a British Columbia Seismic Safety Commission to take on this coordinating role. We strongly endorse the idea.

Bringing together the experts scattered throughout the Province, the commission would provide the means of integrating disciplinary expertise into a comprehensive earthquake safety strategy for the Province. It would review relevant scientific and other information from British Columbia and elsewhere, provide advice to all stakeholders, and make specific policy recommendations to the minister responsible (the Attorney General) with respect to enhancing:

- earthquake planning scenarios;
- public awareness programs;

- mitigation programs;
- response capabilities; and
- strategies for recovery.

We believe that membership on the commission could be voluntary and unpaid, and should represent areas of expertise such as seismology, surficial geology, civil engineering, structural engineering, construction, business and industry, and insurance. The commission should be established under section 3 (1) of the *Emergency Program Act* which allows the minister to "appoint the committees the minister considers necessary to advise . . . the Lieutenant Governor in Council."

Many of the people we spoke with support the idea of having such a commission in place, although some felt it should be more than an advisory body. However, we believe such an agency should not be able to usurp government's public policy role. Giving the commission some legal basis and requiring it to report publicly to government would, we think, create a public expectation that government's policy would reflect the information provided in the commission's reports. (In recommendation 7 below we discuss the idea of an annual report on the state of earthquake preparedness. This might be a good vehicle for reporting government's response to the commission's recommendations.)

Such a body has been established with some success in some other jurisdictions. In California, for example, an earthquake advisory board to government was established in 1975 and has been instrumental in securing the support of legislators and others for increased earthquake preparedness efforts. Called the Seismic Safety Commission there, the multi-disciplinary panel is composed of volunteers with expertise in such fields as earth sciences, engineering, emergency services, local government, social services and public policy. These individuals are drawn from the private sector, academia and government.

The board's functions are to:

- identify seismic hazards;
- advise the legislature and administrative agencies;
- advocate earthquake programs;
- promote improvements to seismic safety and procedures;
- coordinate plans and actions of responsible agencies, programs and government levels;
- gather, integrate and transfer information from a wide range of sources; and

- plan for the long-term implementation, review and maintenance of seismic safety programs.

The State of Washington has a similar body: the Washington Seismic Safety Sub-committee. Its purpose is to:

- provide policy recommendations;
- act as an advocate for seismic safety issues; and
- provide an annual assessment of state-wide implementation of seismic safety improvements.

The subcommittee published a report in 1991 called *A Policy Plan for Improving Earthquake Safety in Washington.* This document formed the cornerstone for later improvements.

2. *The provincial government should develop long-term goals for earthquake preparedness*

Achieving an adequate state of preparedness for an earthquake is a long-term endeavour. While the provincial government is making progress, it is still only at a relatively early point on the continuum leading to an adequate state of preparation. Given that there is still much to do, the provincial government should have a clear sense of where it would like the Province to be in its earthquake preparedness state after the next 5, 10 and 15 years have elapsed, and even longer.

We believe the provincial government needs to establish specific and measurable long-term goals on which to focus its earthquake preparedness activities. To be of practical value, these goals should be established in the areas of mitigation, planning for response, and recovery. For each of these goals, substantive and measurable objectives must also be set.

Given that public sector resources are becoming increasingly scarce, some prioritization of these objectives will be needed. An appropriate balance must be struck between life saving, property protection and other qualitative objectives. Within a long-term planning process, such a balance can be reached without the risk that, over time, key aspects of the emergency program may be overlooked.

It is not enough that goals merely be set. There also has to be a plan to achieve the goals, a specific timetable for carrying out the plan, and an accurate process for measuring the extent to which progress is being made toward achieving the goals. Such a process would require more intensive monitoring by PEP of, for example, the adequacy of municipal plans and the extent to which important activities such as plan testing and exercising have been carried out. In doing this, the provincial government can move toward a situation in which

all citizens of the Province can enjoy at least comparable levels of preparedness.

3. *The provincial government should provide more focus to its earthquake preparedness program*

The earthquake preparedness program should provide an integrated and cohesive approach to earthquake preparedness that supersedes the assignment of specific jurisdictional responsibilities. Many key elements of such a program are currently being carried out to varying extents through the Provincial Emergency Program, though lack of resources has not allowed all the necessary activities to be carried out.

We believe that the provincial government needs to clarify the scope of its earthquake preparedness program if it is to reach the long-term goals for earthquake preparedness we have recommended be set.

Among the objectives of the earthquake program would be to:

- develop a provincial resource and information system to support preparedness activities;
- evaluate, adapt and disseminate existing information from the United States and other sources;
- develop and disseminate guidelines and methodologies for earthquake hazard mitigation and post-earthquake recovery and reconstruction planning;
- provide appropriate technical assistance to local officials to improve their preparedness, response, and recovery capabilities, as well as hazard mitigation efforts;
- participate in a broad spectrum of public education and information efforts to increase public awareness of earthquake hazards, and to improve public understanding of the need for preparedness and mitigation;
- promote programs to encourage individual, family, institutional and business preparedness and mitigation, coordinated with other governmental preparedness and mitigation efforts; and
- encourage the effective use of all resources available to the Province to develop comprehensive and integrated approaches to preparedness.

We believe that the earthquake program should continue to be under the direction and control of PEP, which would be responsible for its proper design and implementation, and be accountable for its results (but see recommendation 5).

This specific earthquake program would require PEP to employ specialized professionals to interact with their peers and interpret technical information not easily accessible by generic emergency planners. For example, an architect or engineer could interpret and explain building codes and lifelines (such as electric power, natural gas, water supply and sewerage); a geologist could work with and interpret the information coming from the Geological Survey of Canada; a social scientist could develop programs specific to community-based organizations, schools and nursing homes; and an information and public affairs specialist could ensure appropriate messages are conceived and effectively transmitted to targeted audiences.

4. *The Provincial Emergency Program, regional and local governments should extend the development of earthquake planning scenarios*

PEP should work with regional and local governments to refine the development of specific, regional earthquake planning scenarios and to extend their application to all communities within the high hazard, high risk areas of the Province. We believe the development of these scenarios is critical if the level of earthquake preparedness is to evolve beyond its present state would.

These scenarios would articulate in some detail the hazards, risks and the potential impacts of a major earthquake on citizens, critical facilities (such as hospitals, schools and highways), lifelines and economies. This information could then be used by local emergency planners to better decide the nature and extent of mitigation necessary, the specific risks that need to be planned for, and the extent of recovery planning that is appropriate. And, just as importantly, this information could be used to help elected officials focus on the real risks for those living in their constituencies.

If PEP is able to recruit the expertise described in recommendation 3, it would be able to provide the technical advice and assistance necessary for developing the scenarios.

5. *The provincial government should reposition the Provincial Emergency Program*

One of the factors we identified as having limited the state of earthquake preparedness in British Columbia is the low profile that PEP has had in government. Some people we spoke with felt that PEP should be given greater authority and, perhaps, even be established as a central agency of government.

In view of PEP's difficulty up to now in providing effective leadership for earthquake planning, we believe that the repositioning of the agency is a matter requiring the government's immediate attention. Dealing with this matter now rather than later will also be seen as a clear statement of the importance that government attaches to earthquake preparedness, and of its commitment to improving it.

6. *The provincial government should increase funding for the Provincial Emergency Program*

Many of the recommendations that we have made call for a more active role for PEP. The provincial government should provide PEP with a reasonable level of resources to meet the government's expectations for corrective actions. Specifically, we believe that resources should be made available to PEP to allow it to recruit the sort of expertise we identified in recommendation 3. We also believe that PEP should be provided with additional resources to allow it to work more closely with local governments.

7. *The Provincial Emergency Program should report annually on the state of earthquake preparedness in British Columbia*

We believe that PEP should publish an annual report on the state of earthquake preparedness in British Columbia. The report should be from PEP to the minister responsible (the Attorney General). There should be a requirement that the minister table the report in the Legislative Assembly shortly after receiving the report from PEP. We think the subject of earthquake preparedness is sufficiently important to warrant a separate annual report—we don't think it appropriate that it be incorporated into the Ministry of Attorney General's annual report.

The report, which should be required within 90 days of the end of the fiscal year, should include:

- an assessment of the overall state of earthquake preparedness of the Province (this could be expressed in terms of the extent to which the Province is moving toward the goals we are suggesting be established, explained in recommendation 3, above), and would cover ministries, Crown corporations, regional and local governments;
- the status of recommendations made by the Seismic Safety Commission (see recommendation 1, above);
- a report on the plans and achievements of the Inter-Agency Emergency Preparedness Council; and
- accountability information regarding PEP's own performance in relation to its annual objectives.

The *Emergency Program Act* should be amended to include the above requirements.

(Note: We have expressed this recommendation in terms of earthquake preparedness. We recognize, however, that it may be expedient to broaden this requirement to cover an "all-hazards" approach.)

8. *The provincial government should raise the profile of the Inter-Agency Emergency Preparedness Council*

Deputy ministers and Crown corporation chief executives should take steps to increase the profile and effectiveness of the Inter-Agency Emergency Preparedness Council. First, they should ensure that their representatives to the Council are empowered to commit their organization to supporting and acting on Council initiatives. Second, they should, through their own councils, monitor the operations of the Council and make sure that any lack of participation or consensus is not allowed to impede its work.

As well, we have recommended (recommendation 7, above) that PEP's annual report to the minister and to the Legislative Assembly include an update on the plans and achievements of the Council.

9. *The provincial government should strengthen regional emergency planning and coordination*

The provincial government should establish a framework that requires regional planning and coordination to occur, and should specify the results to be obtained. As well, the government's role and interest in regional planning and coordination should be formalized through amendments to legislation, allowing the minister to intervene in certain circumstances. This is not a new concept for the provincial government: in another piece of community-focused legislation—*the British Columbia Growth Strategies Act*—it has clearly indicated its willingness to intervene for the public good in cases where consensus cannot be found. An alternative approach is to define the minister's role through prior agreement with all parties.

Operational Recommendations

In Part 4 of this report, we made a number of specific recommendations, some directed to the provincial government and some to local governments. These recommendations are summarized here and classified according to which level of government is responsible for their implementation.

Recommendations to the Provincial Government

Mitigation

The provincial government should:

10. ensure that the seismic elements of the Provincial Building Code are applied to all provincial buildings (page 65);

11. maintain an advisory capability to help municipalities work with the Provincial Building Code (page 66);

12. determine the role that insurance should play in mitigation, and define the most appropriate regime through which it can be offered to the public (page 71); and

13. continue discussions with the insurance industry and, where appropriate, the federal government with a view to reaching agreement on how best to create an environment for an affordable insurance regime within the industry's capacity (page 71).

PEP should:

14. measure the extent of public preparedness (this should be done now, to help decide how and where to focus public awareness activities and to provide a baseline for future measurement and, at regular intervals in the future, to help assess the effectiveness of the initiatives) (page 68);

15. work with key stakeholders (such as Emergency Preparedness Canada, provincial government agencies, local governments, utilities and private sector organizations) to develop and implement a coordinated public awareness communication strategy (page 68); and

16. in conjunction with the development of earthquake planning scenarios (see strategic recommendation 2 above), develop an inventory of key provincial infrastructure. Based on the detailed vulnerability analysis the planning scenarios would provide, options for dealing with areas of vulnerability should be considered, the cost of upgrading estimated, and programs proposed to carry out the upgrades on a priority basis over, for example, the next 20 years (page 74).

Planning for Response

17. The Ministry of Health and PEP should give immediate attention to reviewing and, where appropriate, strengthening the ability of the health system to respond to a major earthquake (page 86).

18. All ministries assigned key support functions should complete, without delay, plans detailing how they will carry out their assigned responsibilities after a major earthquake (page 83).

19. The Ministry of Environment, Lands and Parks should develop a response plan, test it and train staff accordingly, in order to be able to meet its responsibilities under the provincial earthquake response plan (page 89).

PEP should:

20. update the British Columbia Earthquake Plan to reflect the current situation, and take steps to have the *Emergency Program Management Regulation* amended as necessary (page 82);

21. develop a new communication strategy to ensure that the provincial response plan is known and understood by local authorities and response agencies (page 82);

22. take a stronger, more proactive role than it is now doing, to ensure that supporting ministries keep their earthquake preparedness plans current (page 84);

23. continue to work with Emergency Preparedness Canada at the national level to develop further heavy urban search and rescue capability (page 87);

24. take a leadership role with respect to the development of systems standards, protocols, guidelines and coordination for resource management (page 88);

25. identify a number of potential Provincial Field Response Centre sites at strategic locations throughout the Province, test them for suitability, and communicate the details to those agencies likely to be involved in the response efforts (page 89);

26. take steps to identify, equip and test an alternative site for its Provincial Emergency Coordination Centre (page 90);

27. play a stronger role in providing to local governments advice and assistance regarding response planning, and in monitoring to ensure that all municipalities plan to a certain standard (page 90);

28. review on a regular basis with Emergency Preparedness Canada the status of the National Earthquake Support Plan. As well, the *Canada-British Columbia Memorandum of Understanding on Emergency Preparedness* should be reviewed and, where appropriate, updated (page 92);

29. continue to work with its counterparts in Alberta to ensure that the Alberta Support Plan is operational for a real event (page 93);

30. remain in contact with the Canadian Forces to ensure that it has current information about the resources and capabilities available, and disseminate this information to municipalities (page 95);

31. discuss with Emergency Preparedness Canada the possibility of conducting regular exercises around the National Earthquake Support Plan and its relationship to British Columbia's plans (page 99);

32. develop provincial initiatives to encourage municipalities to test key components of their individual plans sufficiently, and to provide more exercises at the province-wide and regional levels to ensure that the liaison between the emergency response efforts of different levels of government works effectively (page 98);

33. prepare a matrix of emergency planning and response positions at both provincial and local government levels, and identify the appropriate training regime needed for each position (page 102);

34. obtain from provincial and local government agencies, at least annually, information about the training they have provided to emergency planning and response personnel (page 102);

35. develop a clear and practical plan setting out roles, responsibilities and processes for carrying out initial damage assessment immediately following a major earthquake, and communicate the plan to all who will have a role in damage assessment (page 103);

36. develop a coordinated plan for upgrading the province's communication equipment to a more reliable system, and update, finalize and distribute its communications plan (page 105); and

37. develop and issue a current emergency public information plan as soon as possible, and test the plan on a regular basis (page 106).

Planning for Recovery

The provincial government should:

38. implement the recommendations made by the Risk Management Branch regarding business continuation planning. These recommendations include: assigning

responsibility for maintaining a business continuation planning program and establishing accountability for success; monitoring the status of such planning; and auditing ministry planning programs. Also recommended was that the Risk Management Branch act in a training and coordinating role and provide status reports to the Deputy Ministers' Council (page 113);

39. give serious consideration to how best to coordinate the roles of the Risk Management Branch and PEP, as this area of emergency preparedness is closely related to the other aspects of preparedness for which PEP is responsible (page 113); and

40. discuss with the federal government options for dealing with the financial ramifications of a catastrophic disaster. In addition, it should develop its own options paper on ways of dealing with and mitigating its own financial liabilities in the event of a major earthquake (page 118).

41. Ministries and Crown corporations should give immediate attention to completing business continuation plans (page 114).

PEP should:

42. establish and provide to local governments guidelines for the development of business continuation plans (page 114);

43. pursue the recommendations made in an interim report of the Joint Emergency Liaison Committee regarding structural assessment. These recommendations include:

- assigning volunteer engineers to pre-designated fire halls;
- providing accessible storage of necessary equipment and supplies at pre-designated fire halls;
- identifying volunteer engineers and registering them with PEP;
- having PEP coordinate the registration of all types of volunteers prior to a disaster; and
- having PEP develop an education strategy for professionals and the public to inform them about building inspection and posting (page 116).

44. advise local governments as to the steps they should take to develop sound plans to inspect and post buildings after an earthquake [helpful in this regard—particularly in establishing priorities for post-earthquake inspections—will be the inventories of hazardous

buildings and critical response facilities suggested in recommendations 50 and 51, on the next page (page 116)];

45. working in conjunction with local governments, ensure that plans are developed to inspect all key infrastructure (whether it be owned provincially or locally) (page 116);

46. establish and provide to local governments guidelines for dealing with debris removal (page 116); and

47. establish and provide to local governments guidelines for planning for reconstruction (page 117).

Recommendations to Local Governments

We recognize that not all of the recommendations set out below will be applicable to every local government, although we suggest that each such government use this list as a checklist to see where its own earthquake preparedness could be improved.

Some of the recommendations require local governments to seek assistance from PEP, if they are to be economically, efficiently and effectively implemented. Where this is the case, the relevant recommendation to PEP is included under "Recommendations to the provincial government," above.

Although the scope of our evidence gathering was limited to the areas in the Province where earthquakes were most likely to occur and to cause the most damage, we believe our recommendations are applicable to all local governments across British Columbia.

Mitigation

Local governments should:

48. take steps to apply the seismic elements of the building code to all new critical response facilities (page 65);

49. in conjunction with the development of earthquake planning scenarios (see strategic recommendation 4 above), develop an inventory of key infrastructure. Based on the detailed vulnerability analysis the planning scenarios would provide, options for dealing with areas of vulnerability should be considered, the cost of upgrading estimated, and programs proposed to carry out the upgrades on a priority basis over, for example, the next 20 years (page 74);

50. develop programs to identify and inventory hazardous buildings and to upgrade the seismic robustness of

buildings based on the relative magnitude of risk to the public (page 74); and

51. assess all critical response facilities, estimate the cost of upgrading them to a standard that would ensure their operability in a post-earthquake situation, and establish priorities for upgrading (page 75).

Planning for Response

Local governments should:

52. ensure they have current, complete earthquake preparedness plans, prepared in accordance with guidelines issued by PEP (page 90);

53. develop schedules for testing their plans and ensuring that recommendations arising from the tests are dealt with (page 98);

54. develop plans for carrying out initial damage assessment immediately following a major earthquake, and ensure the plans are consistent with the provincial plan (page 103);

55. continue to test their ability to communicate with each other and, where significant problems are identified, take steps to correct the problems (page 105); and

56. develop emergency public information plans, and test them on a regular basis (page 106).

Planning for Recovery

Local governments should:

57. give immediate attention to completing business continuation plans (page 114);

58. working in conjunction with PEP, ensure that plans are developed to inspect all key infrastructure (whether it be owned provincially or locally) (page 116);

59. develop plans for debris removal (page 116); and

60. establish strategies for long-term reconstruction (page 117).

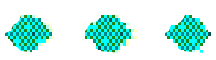
In What Order Should the Provincial Government Implement the Recommendations?

Our recommendations for the provincial government, although diverse, are all linked to some degree. Some are prerequisites of others. Some can be implemented within a short period of time, while others may require a number of years to bring about fully.

Our strategic recommendations provide an essential foundation for specific elements of earthquake planning and management. Because of this, we believe that these recommendations should receive the provincial government's immediate attention.

In particular, clarifying the government's **expectations for achievable states of medium and long-term preparedness** is needed to set up an framework for overall planning and management, and to establish the measures against which the government should be **publishing its report on the state of provincial preparedness. Establishing a seismic safety commission, developing an earthquake program, and providing the necessary resources** are key initial steps in translating these expectations into an action plan. At the same time, **preparing regional earthquake scenarios** allows the action plan to focus on the areas of most risk.

Most of the operational recommendations, particularly those for mitigation and recovery, logically follow the implementation of the above, particularly as policy issues may be involved. However, certain of the recommendations relating to response require immediate attention. The government's own **earthquake response plans should be updated, finalized and distributed** immediately. **Business continuation planning** needs to be given priority, and the provincial government should work with local governments to ensure that **critical response facilities are assessed** and, where necessary, **upgraded** to current standards. As well, the **ability of the health system to respond to a major disaster needs to be evaluated** in detail, and appropriate remedial actions taken. The **extent of earthquake plan testing province-wide** needs to be expanded, and steps should also be taken to **upgrade the training of government employees likely to staff the Provincial Field Response Centres** as soon as possible.



attorney general's response

November 20, 1997

George L. Morfitt, FCA
Auditor General
Office of the Auditor General
2nd Floor, 8 Bastion Square
Victoria, British Columbia
V8V 1X4

Dear George Morfitt:

In January, I requested an independent review of British Columbia's emergency preparedness. I am now pleased to receive the Office of the Auditor General's Performance Audit Report on the state of earthquake preparedness of British Columbia's provincial and local governments. The province's ability to cope with a major earthquake is a good indication of our ability to cope with any emergency situation that may occur.

The comprehensive report reflects the critical importance of this issue. It is my belief that this type of audit is essential to assess government's performance, identify areas that need improvement and, by way of its recommendations, outline action that needs to be taken at all levels of government to better prepare for, respond to, and recover from a major earthquake.

At the same time, your recommendations acknowledge that "achieving an adequate state of preparedness is a big task that will not be completed overnight."

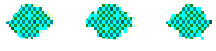
While it is clear that we must take more action, I am pleased by the recognition given to the Provincial Emergency Program for the progress made in the past few years, particularly in the areas of earthquake preparation and response planning.

The ministry looks forward to carefully reviewing the recommendations with other provincial ministries and municipalities to work out a detailed action plan.

The information contained in this report is invaluable, and will form the basis for discussion and the development of a coordinated approach and long-term strategy that reflects the commitment and continued support of all levels of government.

Yours sincerely,

Ujjal Dosanjh
Attorney General



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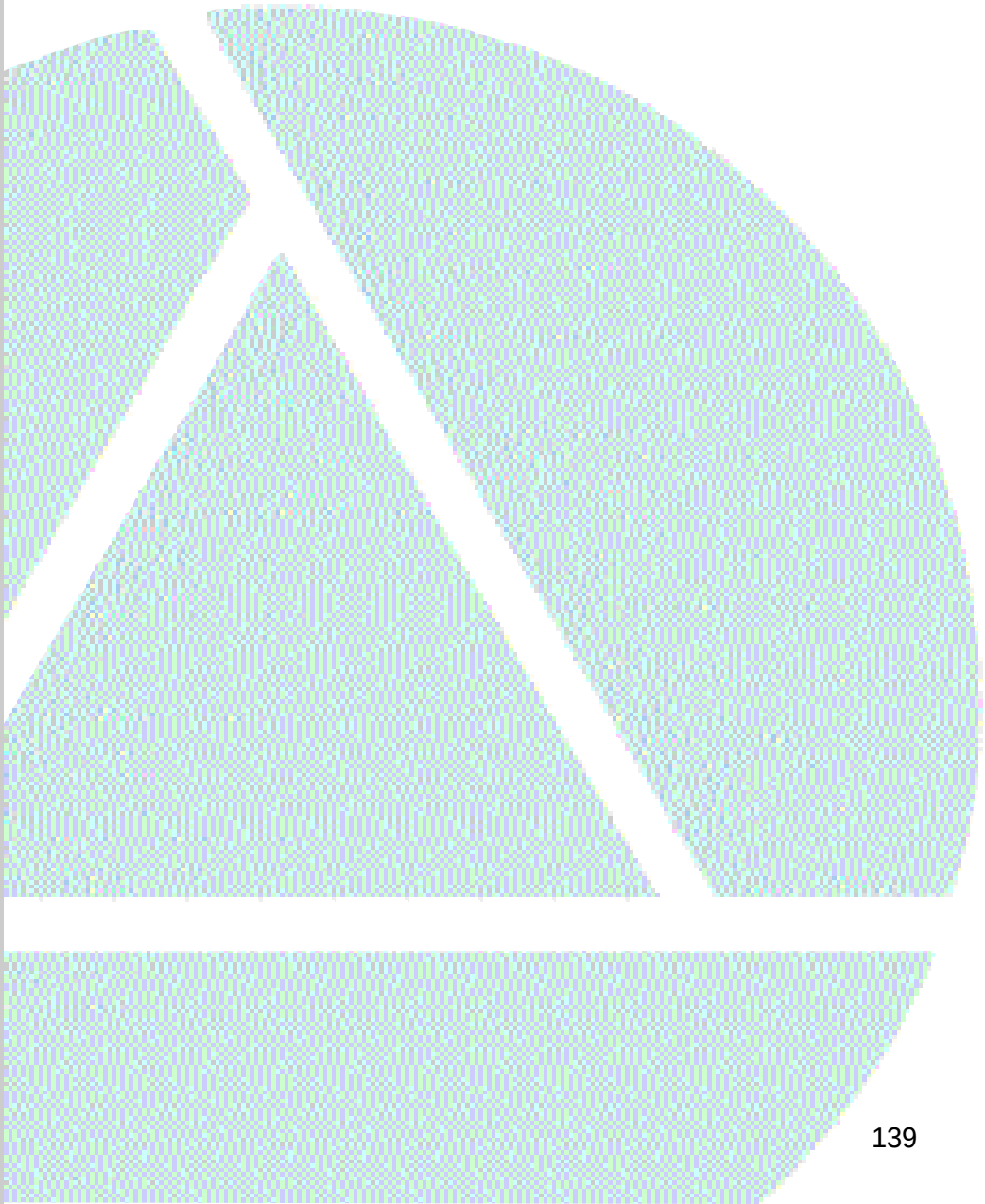

appendix a

The "Blizzard of '96" Do You Remember?

Courtesy: CHECK-TV

Boat houses in Sidney and North Saanich collapsed under the weight of snow

In a part of the province where the term "white Christmas" doesn't normally apply, more than a foot of snow on the ground at one time is almost unheard of. For most people living on Vancouver Island or the Lower Mainland, December of 1996 will be a month not soon forgotten.

It happened quite unexpectedly. There were traces of snow on the ground as early as December 23, but it wasn't until the 27th that the snow began to fall in earnest. Then, under the beautiful blue skies of the 28th, many people set to work clearing their driveways, sidewalks and even their roofs, thinking that this would be the last of the snowfall for a while.

But as evening settled in, the unthinkable was forming offshore. A final blast of winter weather was to hit the lower third of the province, leaving in its wake 30 to 80 centimetres of snow, some of which was in addition to an existing 50 centimetres already on the ground. Because of high winds, six to seven foot drifts were common and any snow-clearing efforts that were completed just one day earlier had all but disappeared.

The result was southern British Columbia's worst snowstorm in over 75 winters. In areas where the average snowfall for the entire month of December is under 20 centimetres, 124 centimetres fell in 24 hours. The "Blizzard of '96" may well be the storm of the century.

Courtesy: CHECK-TV

Industrial buildings at Victoria International airport

The Ensuing Days

Early Sunday morning, as emergency crews began the enormous task of clearing the snow from the arterial routes, people started to get out of bed and look outside. Little under a metre and a half remained uncovered. By this point, people had remained at home since the snowfall of the 27th, thinking it would not be too long before the snow disappeared. Now, two days later, these people were starting to wonder just how long it would be before they would be able to get to the store to replenish their dwindling supplies.

As the days moved on, people in their homes began to ask what was happening. Their streets had not yet been cleared and they had very little indication of when that would happen, and public information was scarce and uncoordinated. News media focused on the apparent lack of organization and coordination at both local and provincial government levels, and people were left feeling uncertain about how an event such as this would unfold. Mayors were trying to convince people that this was not an emergency but a transportation inconvenience and that they were doing everything they possibly could. Although no states of emergency had been declared, PEP did contact municipalities on Vancouver Island and the Lower Mainland to see if help was needed and, in the latter stages of the snowfall, a Provincial Field Response Centre was established on the Lower Mainland to assist relief efforts. PEP mobilized a number of information officers; however, not all of them were fully familiar with the public information plan. This, and difficulties in contacting radio stations, made it difficult for governments to get a regular flow of information to the public through the media.

To try and sort out the confusion, the Attorney General announced he would order an independent review of British Columbia's emergency preparedness, including measures used during the massive snowstorm that struck southwestern British Columbia. This appendix to the main report is intended to serve as an overview of the blizzard from an emergency management perspective.

As in all events where people are at risk and emergency personnel are working hard to save lives, minimize suffering and reduce economic hardship, lessons are learned. These

lessons are important to capture, reflect upon and incorporate into the emergency planning process so a greater level of preparedness will exist for the next emergency.

The primary purpose for including the blizzard in our review of earthquake preparedness was that it served as an indicator of what might happen in a catastrophic event. In a very mild sense this was a real-life test of how the current structure and systems in place operate—and might operate in a larger event such as an earthquake.

The scope of our analysis of the snowstorm focused on those same areas included in our audit, primarily Greater Vancouver and Greater Victoria. Our main emphasis here has been to describe the common problems encountered by local and provincial governments and private citizens, and to review what lessons were learned from the experience. Lastly, we have attempted to identify what steps have been taken to remedy the problems encountered.

How Did We Do?

A Local Government Perspective

In emergency management, local governments are usually the first level of response to a situation, whether it be a single accident or an event initiating a multitude of emergencies spanning a wide area. During the blizzard, it was the local governments' responsibility to clear their roads and deal with any emergencies that arose.

However, many emergencies are not localized, and may affect areas covered by different local governments. While minor emergencies of this kind can usually be handled by the individual governments concerned, major ones generally require coordinated regional effort to resolve without undue delay and disruption. This level of effort usually requires an ongoing regional planning process to work out ways of getting key lifelines of regional dimensions, such as power, water, sewerage and transportation routes, back into operation as quickly as possible after an emergency.

Another aspect of regional coordination is mutual aid. Before deciding on whether a state of emergency needs to be declared, a local government will usually consider whether invoking mutual aid agreements will allow it to access the resources it needs to deal with the emergency. This pooling of resources can often allow the emergency situation to be brought under control without recourse to the provincial government.

If this strategic approach to regional planning and response coordination is not there, problems are likely to arise—and in southern Vancouver Island, they did. The experience illustrated a couple of major areas for improvement in emergency management in that region, and these may be equally applicable to a number of other communities.

Regional Coordination Was Inadequate

In the case of the blizzard, none of the local governments affected declared a state of emergency—none felt that conditions warranted such a measure. Making such a declaration would have allowed local governments to assume certain additional powers that might have been useful in responding to the emergency, such as acquiring the use of resources like vehicles and equipment. However, it is possible that many local governments did not realize the extent of the challenges that needed to be met in responding to the blizzard.

Generally, municipalities felt they performed well. And on an individual basis, their work crews and volunteers put in long work hours and made significant efforts to get into work and to reach people in need. But clearly there were problems.

First, it was apparent during and after the blizzard that some municipalities had (relatively speaking) a lot of snow removal equipment available while others had little. As a result, some municipalities had their roads cleared much quicker than others, yet their snow-removing equipment sat idle while the other municipalities were still a long way from completing their tasks. We found no instances of mutual aid being used during the blizzard, although such agreements do exist. Likely this was the result of each municipality feeling that it was handling the situation adequately within its own border and of each jurisdiction being busy with its own efforts.

Second, there was no coordinated approach to clearing major transportation arteries. As a result, some major arteries were plowed up to the municipal border, but remained impassable beyond that. This posed many difficulties to emergency responders trying to travel across several municipal boundaries. This working in isolation from other neighboring jurisdictions raised a number of concerns, in that there is no one that currently oversees the “big picture” and who allocates resources and coordinates efforts based on this larger vision of the event.

Few Emergency Operation Centres (EOCs) Were Activated

Very few of the local governments we spoke with used and brought together their EOC staff to deal with the situation. In emergency management circles, it has been demonstrated that bringing emergency personnel together and working through an incident yields innumerable benefits.

In this situation, we believe that would have been beneficial to activate the local EOCs and to have them operate as they would expect to in an event such as an earthquake. The situation offered an invaluable "dry run."

The other benefit of activating the EOCs would have been the value in familiarizing staff with each local government's emergency plan and in giving staff an opportunity to see how effective and well-integrated their plan is with the various departments and external agencies that they must work with. Tests and exercises provide one level of assurance about the effectiveness of the emergency plan, but the best test of an emergency plan is to see how it works in real life, with real pressures and real people.

The Provincial Government

A number of government agencies were in operation during the blizzard, including the Provincial Emergency Program, Emergency Social Services, and Transportation and Highways. They worked behind the scenes to do what they could to assist local governments. As already noted, the current structure of the emergency management legislation designates local governments as first responders. In the absence of any local government declaring a state of local emergency, or of an obvious need for the provincial government to declare a state of emergency, the latter assumed that local authorities had the situation substantially under control, and that there was therefore no need for formal provincial involvement.

Courtesy: CHECK-TV

Fallen trees contributed to property damage

The Provincial Emergency Program, although available on a limited scale, was not technically required to do anything other than be available to take requests from the local government and other agencies. The fact that the

provincial government was not perceived as being an active participant in the blizzard did not seem to sit well with the media and the general public, even though both the local and provincial authorities understood how their relationship was meant to work.

Probably the single biggest oversight on the part of the provincial government was its inability to activate an effective public information plan. The provincial response agencies needed to be perceived as being in control of the situation. Instead, they were silent. What was needed was to have a public information plan in place, ready to collect, collate and communicate situation reports to those requiring the information, including the media and the general public.

In Washington State, for example, the activation of the public information plan is based on a number of assumptions, one of which is that an event has to have occurred, or public perception is such that people believe they have been placed in danger by a natural disaster. Whether the blizzard was an emergency or not, there was little doubt that many people affected by it had the perception that they had been placed in danger. A much more coordinated communication effort than occurred could have changed this perception by making people feel that the situation was under control. Currently the province does not have a completed public information plan.

The importance of communication during an emergency or a major event such as the blizzard cannot be overstated. Good communication requires that information be thorough, timely and accurate and that it be received by those who need it. Because, during the blizzard, the media had to receive their information from each municipality and each regional response agency, the information was often inconsistent, incomplete and confusing. The general public received their information from radio and, later, press, but it was at times inaccurate and out-dated. We believe that the lack of a public information plan in the province was a significant problem during the blizzard.

The Private Citizen

For many people stuck in their homes, the blizzard was a wake-up call. Some believed that they should have had their roads cleared in the first day of the storm or, at the very least, by the second day. When four and five days passed and their street still was impassable, people started to lose patience.

Society has come to expect a lot from government, and when normalcy is interrupted and service is not what we have

come to expect, we look for someone to blame. The following issues emerged from the public's experience of the blizzard:

Unrealistic Expectations of Government

Lack of access to snow removal equipment clearly limited municipalities' ability to cope with the situation. Each municipality chooses how it wants to spend the limited resources it has available to best meet the needs of its residents. Decisions related to policing levels and maintaining streets usually take precedence over those related to buying a snow blower or a snow plow which may or may not get used in the next year. In coastal areas of British Columbia, a decision by politicians to buy extra snow removal equipment might even be seen as wasteful by the taxpayers, during years of little or no snowfall.

The blizzard, therefore, seemed to highlight a common discrepancy between what the general public expects government to do and what in fact government can deliver. It is this discrepancy that must be addressed. No government can be all things to all people, and thus governments at all levels need to ensure that the general public's expectations are kept in check. If governments can provide information to the public about what to expect from them in a major catastrophic event, people can then make their own decisions about what steps they should be taking for themselves to mitigate the effects of an event.

Lack of Home Preparedness

The most common message emergency management personnel give to the public at earthquake seminars is to be prepared to survive on your own for at least 72 hours. This message was reinforced during the blizzard, as people could not easily get to a store to replenish food and supplies. Fortunately this lesson was on the gentle end of the scale, because people still had a roof over their head and electricity was still servicing most of their homes. What was obvious to emergency responders, however, was that many people did not have three days' worth of food at home. Had difficulties associated with an earthquake been added, the lack of necessary food, supplies and equipment would have added another order of magnitude to the problem. The 72-hour rule instructs the individual to be prepared for the worst possible case during that length of time. The worst case could mean living outside of your residence and having to sustain all family members for at least three days.

The events surrounding the blizzard only reinforced the fact that emergency personnel may be unavailable to get to people in need of assistance and that residents must take the necessary precautions to ensure that they and their families are adequately prepared. This message, although taught at each earthquake preparedness and home preparedness seminar, needs to be reinforced repeatedly so that people prepare themselves adequately.

What Did We Learn for the Future?

Our experience with the blizzard points to three main issues having implications for emergency preparedness in future:

First, regional emergency coordination on southern Vancouver Island was found wanting by a comparatively minor event. The lack of an adequate response to this key issue does not instill confidence of the ability of the Greater Victoria municipalities to respond to a major disruption of regional lifelines in the event of an earthquake. The blizzard will hopefully be a stimulus to local governments in the area to put high priority on the development of a coordinated regional approach for emergency planning. While emergency planners recognize its importance, considerable commitment and support from elected officials will be needed as a catalyst for future development of regional planning in the area.

Second, the lack of a public information plan at both the provincial and local government levels proved to be a problem. The difficulty experienced by the public in finding out what was happening was a great frustration to many, and magnified the effect of other problems. The value of effective public communication after a disaster is immense. An informed public can develop the morale and resourcefulness to overcome many hardships.

Third, because of the difficulties in communications and, in many remote areas, transportation, much greater demand was placed on local community support in responding to immediate needs. This outcome underscores the importance of ensuring that neighbourhood programs for emergency management are well-established and maintained.

The “Blizzard of ’96” was an inconvenience certainly but by no means a major emergency. For many, the main impact of the blizzard was that they could not leave their homes. A large earthquake, on the other hand, will result in thousands of people without homes. The blizzard did, however, emphasize that personal preparedness is the cornerstone of surviving a major disaster, and that no amount of expenditure on equipment and other resources can substitute for the willingness of the public to provide for its own needs during the critical 72-hour period following the event.

appendix b

Office of the Auditor General: Performance Auditing Objectives and Methodology

Audit work performed by the Office of the Auditor General falls into three broad categories:

- Financial auditing;
- Performance auditing; and
- Compliance auditing.

Each of these categories has certain objectives that are expected to be achieved, and each employs a particular methodology to reach those objectives. The following is a brief outline of the objectives and methodology applied by the Office for performance auditing.

Performance Auditing

Purpose of Performance Audits

Performance audits look at how organizations have given attention to economy, efficiency and effectiveness.

The concept of performance auditing, also known as value-for-money auditing, is based on two principles. The first is that public business should be conducted in a way that makes the best possible use of public funds. The second is that people who conduct public business should be held accountable for the prudent and effective management of the resources entrusted to them.

The Nature of Performance Audits

An audit has been defined as:

> *…the independent, objective assessment of the fairness of management's representations on performance, or the assessment of management systems and practices, against criteria, reported to a governing body or others with similar responsibilities.*

This definition recognizes that there are two primary forms of reporting used in performance auditing. The first—referred to as attestation reporting—is the provision of audit opinions on reports that contain representations by management on matters of economy, efficiency and effectiveness.

The second—referred to as direct reporting—is the provision of more than just auditor's opinions. In the absence of representations by management on matters of economy,

efficiency and effectiveness, auditors, to fulfill their mandates, gather essential information with respect to management's regard for value for money and include it in their own reports along with their opinions. In effect, the audit report becomes a partial substitute for information that might otherwise be provided by management on how they have discharged their essential value-for-money responsibilities.

The attestation reporting approach to performance auditing has not been used yet in British Columbia because the organizations we audit have not been providing comprehensive management representations on their performance. Indeed, until recently, the management representations approach to value for money was not practicable. The need to account for the prudent use of taxpayers' money had not been recognized as a significant issue and, consequently, there was neither legislation nor established tradition that required public sector managers to report on a systematic basis as to whether they had spent taxpayers' money wisely. In addition, there was no generally accepted way of reporting on the value-for-money aspects of performance.

Recently, however, considerable effort has been devoted to developing acceptable frameworks to underlie management reports on value-for- money performance, and public sector organizations have begun to explore ways of reporting on value-for-money performance through management representations. We believe that management representations and attestation reporting are the preferred way of meeting accountability responsibilities and are actively encouraging the use of this model in the British Columbia public sector.

Presently, though, all of our performance audits are conducted using the direct reporting model; therefore, the description that follows explains that model.

Our performance audits are not designed to question government policies. Nor do they assess program effectiveness. The *Auditor General Act* directs the Auditor General to assess whether the programs implemented to achieve government policies are being administered economically and efficiently. Our performance audits also evaluate whether members of the Legislative Assembly and the public are provided with appropriate accountability information about government programs.

When undertaking performance audits, auditors can look either at results, to determine whether value for money is actually achieved, or at management processes, to determine

whether those processes should ensure that value is received for money spent.

Neither approach alone can answer all the legitimate questions of legislators and the public, particularly if problems are found during the audit. If the auditor assesses results and finds value for money has not been achieved, the natural questions are "Why did this happen?" and "How can we prevent it from happening in future?" These are questions that can only be answered by looking at the process. On the other hand, if the auditor looks at the process and finds weaknesses, the question that arises is "Do these weaknesses result in less than best value being achieved?" This can only be answered by looking at results.

We try, therefore, to combine both approaches wherever we can. However, as acceptable results information and criteria are often not available, our performance audit work frequently concentrates on managements' processes for achieving value for money.

We seek to provide fair, independent assessments of the quality of government administration. We conduct our audits in a way that enables us to provide positive assessments where they are warranted. Where we cannot provide such assessments, we report the reasons for our reservations. Throughout our audits, we look for opportunities to improve government administration.

Audit Selection

We select for audit either programs or functions administered by a specific ministry or public body, or cross-government programs or functions that apply to many government entities. There are a large number of such programs and functions throughout government. We examine the larger and more significant ones on a cyclical basis.

We believe that performance audits conducted using the direct reporting approach should be undertaken on a five- to six-year cycle so that members of the Legislative Assembly and the public receive assessments of all significant government operations over a reasonable time period. Because of limited resources, we have not been able to achieve this schedule.

Our Audit Process

We carry out these audits in accordance with the value-for-money auditing standards established by the Canadian Institute of Chartered Accountants.

One of these standards requires that the "person or persons carrying out the examination possess the knowledge and competence necessary to fulfill the requirements of the particular audit." In order to meet this standard, we employ professionals with training and experience in a variety of fields. These professionals are engaged full-time in the conduct of performance audits. In addition, we often supplement the knowledge and competence of our own staff by engaging one or more consultants, who have expertise in the subject of that particular audit, to be part of the audit team.

As performance audits, like all audits, involve a comparison of actual performance against a standard of performance, the CICA prescribes standards as to the setting of appropriate performance standards or audit criteria. In establishing the criteria, we do not demand theoretical perfection from public sector managers. Rather, we seek to reflect what we believe to be the reasonable expectations of legislators and the public. The CICA standards also cover the nature and extent of evidence that should be obtained to support the content of the auditor's report, and, as well, address the reporting of the results of the audit.

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