Radon Management: Issues and options

Prepared For: Ministry of Health, Health Protection Branch
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Executive Summary

The Health Protection Branch of the Ministry of Health is interested in exploring the potential for developing a provincial radon program to reduce or eliminate indoor radon exposure. M. McBride & Associates Management Consulting Inc. was contracted for a two month period to gather information on existing national and regional radon programs that may serve as models for a BC program, determine best practices in current programming (addressing the issues of communication, testing, analysis and remediation), and provide options and recommendations for introducing a radon program for the province.

Radon is a naturally occurring colourless, odourless and tasteless radioactive gas, formed by the breakdown of uranium in soil, rock and groundwater. Radon gas becomes a health risk if it accumulates to unacceptably high levels in enclosed spaces with inadequate ventilation (such as basements) in homes or buildings where people spend a significant amount of time. Recently, Health Canada lowered the national guideline level for radon in homes and some public buildings from 800 Becquerels per cubic meter (Bq/m3) to 200 Bq/m3. Long-term radon exposure is the leading cause of lung cancer among non-smokers, and dramatically increases the chance of lung cancer in smokers. Many homeowners do not recognize the health risk associated with radon exposure.

In B.C., the highest levels of radon concentrations are found in the interior and northern regions of the province. The B.C. Centre for Disease Control has completed some analysis and mapping of the data, and there has been testing of schools and mitigation activities undertaken in the interior of the province. Radon awareness programs have for the most part been undertaken by non-profit organizations with funding support from Health Canada. Other provinces and territories have taken similar actions in the past; no Canadian jurisdictions have a comprehensive radon program. Since 2009, Health Canada has been developing and implementing a radon program. Several concurrent strategies are being implemented, including improving public awareness, mapping, testing of homes, testing and mitigation of federal buildings, and providing expert advice to other agencies. Other countries are further ahead and more active in radon programming, including the U.S. and several European countries.

In 2005, the World Health Organization (WHO) launched the International Radon Project (IRP) to develop evidence-based public health guidance to assist member states to formulate policy and advocacy strategy; guidance on methods for radon measurements and mitigation; and develop approaches for radon risk communication. A handbook was published in 2009 (WHO Handbook On Indoor Radon: A Public Health Perspective) which focuses on residential radon exposure from a public health point of view and provides detailed recommendations on reducing health risks from radon and sound policy options for preventing and mitigating radon exposure.

Some more recent evaluations of radon programs have concluded that public awareness efforts are successful at improving public awareness and encouraging testing. However, it is still difficult to get homeowners to take mitigation action.
The scope of a comprehensive strategy and the specific activities undertaken would depend on funding and could include the following components:

- Public education and awareness campaigns (including test kit distribution)
- Testing and mapping of private homes located in high risk areas
  - Test kit subsidies
- Testing and remediation in government buildings located in high risk areas
- Support for building remediation through capacity building
  - Work with building industry to raise awareness and develop skills in radon remediation
  - Cost-shared remediation subsidies for private homes
- Other activities/strategies support, e.g., research grants
1. Introduction and Background

1.1 Purpose of Project

The Health Protection Branch of the Ministry of Health would like to explore the development of a provincial radon program to reduce or eliminate indoor radon exposure. The long term goal of this program is to reduce lung cancer illness and deaths in BC which in turn may decrease overall health care costs, as well as support the public health principles of primary prevention and sustained wellness.

M. McBride & Associates Management Consulting Inc. was engaged to gather information on existing national and regional radon programs that may serve as models for a BC program, determine best practices in current programming (addressing the issues of communication, testing, analysis and remediation), and provide options and recommendations for introducing a radon program for the province.

1.2 Scope and Overall Approach to Project

The scope for the project included both a jurisdictional review of radon management activities and programming, and a review of specific issues associated with radon testing, mitigation and awareness campaigns. Specifically, the project included:

• a review of activities in BC, with a particular emphasis on the BCCDC, health authorities and other government agencies and non-profit organizations;
• a review of activities in other provinces and territories, and Health Canada activities in this area;
• a review of international efforts in radon management;
• a review of research with respect to best practices in terms of radon awareness programs; and,
• interviews with experts and others actively involved in radon management, particularly in BC.

Since the purpose of the project was to inform the development of a radon management program, emphasis was placed on identifying issues and options that would support an effective program, as opposed to addressing issues of a more technical nature.\(^1\)

Interviews were held with nine organizations actively involved in radon management either in BC or at the national level, and with Ministry of Environment staff, who provided information on similar air quality issues management. An interview guide was developed to focus the discussion, although not all questions were applicable to all interviewees. Interviews were held either in person or by phone. A

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\(^1\) For example, Health Canada’s recommended level for taking mitigation action is 200 Bq/m\(^3\); WHO recommends action at 100 Bq/m\(^3\). This issue was not explored.
summary of the results of the interviews is provided in section 3.3. In addition to interviews, other Canadian jurisdictions were contacted to obtain more recent information on radon management activities in their province/territory. This information, where provided by the jurisdiction, is contained in Table 6. Finally, an internet search was completed using known sources of radon management activity, reports and links provided by interviewees and other sources, and keyword search.

1.3 Organization of Paper

In addition to this introductory section providing background information on this project and radon levels in B.C., the paper is organized into the following sections:

- Section 2 provides a summary of recent and/or current radon programs/activities undertaken by government agencies across Canada, including Health Canada, and internationally, including the U.S., U.K., and other European countries;
- Section 3 provides an environmental scan of other radon program information, including best practice research and non-government activities to support radon management; and summarizes the results of interviews with people actively engaged in radon or similar programming in B.C.;
- Section 4 identifies the issues and challenges related to radon programming and reduction, and provides some discussion around those issues;
- Section 5 examines possibilities for radon programming; and,
- Section 6 contains appendices referenced throughout the report.

1.4 Background

Radon is a naturally occurring colourless, odourless and tasteless radioactive gas, formed by the breakdown of uranium in soil, rock and groundwater. Radon gas becomes a health risk if it accumulates to unacceptably high levels in enclosed spaces with inadequate ventilation (like basements) in homes or buildings where people spend a significant amount of time.

Long-term radon exposure is the leading cause of lung cancer among non-smokers, and dramatically increases the chance of lung cancer in smokers. The overall health risk of indoor radon exposure outweighs many other health risks, yet many homeowners do not recognize the health risk associated with radon exposure.

Recently, Health Canada lowered the national guideline level for radon in homes and some public buildings\(^2\) from 800 Becquerels per cubic meter (Bq/m\(^3\)) to 200 Bq/m\(^3\). According to Health Canada’s radon site, “the aim is to remediate and reduce the radon concentration to less than 200 Bq/m\(^3\). If the

\(^2\) This guideline applies to public buildings if they are primary residences (long-term care facilities, detention centres, etc.), or buildings where people spend extended periods of time (e.g. schools)
radon concentration is found to be greater than 600 Bq/m³, the remedial actions are recommended to be completed in less than a year; between 200 Bq/m³ and 600 Bq/m³, the remedial actions should be completed in less than two years.\(^3\)

**Radon Levels in B.C.:**

The B.C. Centre for Disease Control (BCCDC) website provides a map\(^4\) of radon concentrations in B.C.:

![Map of Main Floor Radon Concentrations in B.C. Communities](image)

A radon report prepared for WorkSafe BC by the BCCDC\(^5\) in 2009 included radon concentrations on main floors of homes in cities and towns throughout B.C. Table 1 contains this information, sorted to highlight the

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\(^5\) A Report for WorkSafeBC – Research Secretariat, Radon in British Columbia Work Places - November 2009: Principal Investigator/Applicant Dr. Ray Copes; pg. 11
areas in B.C. where testing for radon concentrations in homes produced the highest levels. As expected from the map above, the highest levels of radon concentrations are found in the interior and northern regions of the province.

**Table 1: Radon in B.C. Homes – Main Floor**

<table>
<thead>
<tr>
<th>B.C. City</th>
<th># Homes Tested</th>
<th>% of homes over 200 Bq/m³</th>
<th>Avg. Radon on Main Floor in Bq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearwater</td>
<td>50</td>
<td>40.3</td>
<td>447</td>
</tr>
<tr>
<td>Castlegar</td>
<td>71</td>
<td>30.9</td>
<td>240</td>
</tr>
<tr>
<td>Barriere</td>
<td>35</td>
<td>30</td>
<td>201</td>
</tr>
<tr>
<td>Invermere</td>
<td>10</td>
<td>20</td>
<td>180</td>
</tr>
<tr>
<td>Kimberly</td>
<td>24</td>
<td>16.7</td>
<td>99</td>
</tr>
<tr>
<td>Nelson</td>
<td>71</td>
<td>15.7</td>
<td>120</td>
</tr>
<tr>
<td>Atlin</td>
<td>15</td>
<td>14.4</td>
<td>118</td>
</tr>
<tr>
<td>Penticton</td>
<td>66</td>
<td>12.1</td>
<td>108</td>
</tr>
<tr>
<td>Prince George</td>
<td>75</td>
<td>12</td>
<td>127</td>
</tr>
<tr>
<td>Trail</td>
<td>31</td>
<td>10.1</td>
<td>107</td>
</tr>
<tr>
<td>Fernie</td>
<td>10</td>
<td>10</td>
<td>78</td>
</tr>
<tr>
<td>Valemount</td>
<td>47</td>
<td>6.4</td>
<td>79</td>
</tr>
<tr>
<td>Vernon</td>
<td>59</td>
<td>5.1</td>
<td>73</td>
</tr>
<tr>
<td>Cranbrook</td>
<td>88</td>
<td>4.5</td>
<td>50</td>
</tr>
<tr>
<td>Ft St John</td>
<td>67</td>
<td>4.4</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.C. City</th>
<th># Homes Tested</th>
<th>% of homes over 200 Bq/m³</th>
<th>Avg. Radon on Main Floor in Bq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelowna</td>
<td>70</td>
<td>4.29</td>
<td>83</td>
</tr>
<tr>
<td>Fort Nelson</td>
<td>49</td>
<td>4</td>
<td>67</td>
</tr>
<tr>
<td>Quesnel</td>
<td>68</td>
<td>1.5</td>
<td>53</td>
</tr>
<tr>
<td>Blue River</td>
<td>2</td>
<td>0</td>
<td>153</td>
</tr>
<tr>
<td>Little Fort</td>
<td>6</td>
<td>0</td>
<td>114</td>
</tr>
<tr>
<td>Creston</td>
<td>15</td>
<td>0</td>
<td>49</td>
</tr>
<tr>
<td>Kamloops</td>
<td>86</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>Terrace</td>
<td>66</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Stewart</td>
<td>6</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>Pemberton</td>
<td>15</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td>Whistler</td>
<td>21</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Squamish</td>
<td>16</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Victoria</td>
<td>59</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Vancouver/L. Mainland</td>
<td>138</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Queen Charlotte Isl.</td>
<td>64</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>

In addition to testing for radon concentrations in homes, 400 schools in interior and northern regions of the province were tested for radon between 1991 and 1999 and mitigation action taken where necessary. The following table (Table 2) taken from the BCCDC report for WorkSafe BC includes the following information on the levels and rates of radon concentrations in school districts in those regions, in comparison to rates found in homes in the same locations:

(accessed Sept 10, 2011)
Table 2: Comparison of radon in B.C. schools and homes in the same location

<table>
<thead>
<tr>
<th>School District</th>
<th>Mean Radon in SCHOOLS Bq/m³</th>
<th>Mean Radon in HOMES Bq/m³</th>
<th>% of Schools Above 150 Bq/m³</th>
<th>% of Homes Above 150 Bq/m³</th>
<th>% of Schools Above 750 Bq/m³</th>
<th>% of Homes Above 750 Bq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Thompson</td>
<td>137</td>
<td>159</td>
<td>70</td>
<td>53</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Nelson</td>
<td>164</td>
<td>122</td>
<td>45</td>
<td>19.7</td>
<td>5</td>
<td>1.4</td>
</tr>
<tr>
<td>Castlegar</td>
<td>100</td>
<td>240</td>
<td>38 *</td>
<td>41</td>
<td>15 *</td>
<td>6</td>
</tr>
<tr>
<td>S. Okanagan</td>
<td>81</td>
<td>107</td>
<td>14</td>
<td>16.4</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>Trail</td>
<td>57</td>
<td>111</td>
<td>13</td>
<td>16.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Penticton</td>
<td>38</td>
<td>107</td>
<td>5.6</td>
<td>16.4</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>Vernon</td>
<td>57</td>
<td>74</td>
<td>5</td>
<td>9.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Prince George</td>
<td>30</td>
<td>89</td>
<td>4.5</td>
<td>29</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kelowna</td>
<td>26</td>
<td>85</td>
<td>4</td>
<td>7.8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^1\) includes school board office  
\(^2\) comparison made with homes in adjacent school district

In addition to the work done in B.C. by the Ministry of Health and BCCDC, Health Canada has recently undertaken a two year project to gather long-term indoor radon measurements in approximately 18,000 homes across Canada (Cross-Canada Survey of Radon Concentrations in Homes). The first year data collection and analysis is complete. Results from B.C. are presented in Table 3 below (see Section 2.2.2 for results on other parts of Canada):

Table 3: Year 1 Raw Radon Results by Health Region (Health Canada)

<table>
<thead>
<tr>
<th>Health Service Delivery Area</th>
<th># Survey Participants</th>
<th>% Below 200 Bq/m³</th>
<th>% 200 to 600 Bq/m³</th>
<th>% Above 600 Bq/m³</th>
<th>% Above 200 Bq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kootenay-Boundary</td>
<td>43</td>
<td>69.8</td>
<td>25.6</td>
<td>4.6</td>
<td>30.2</td>
</tr>
<tr>
<td>East Kootenay</td>
<td>46</td>
<td>78.3</td>
<td>17.4</td>
<td>4.3</td>
<td>21.7</td>
</tr>
<tr>
<td>Okanagan</td>
<td>50</td>
<td>82</td>
<td>16</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>Northeast</td>
<td>81</td>
<td>90.1</td>
<td>8.7</td>
<td>1.2</td>
<td>9.9</td>
</tr>
<tr>
<td>Northern Interior</td>
<td>96</td>
<td>91.7</td>
<td>6.2</td>
<td>2.1</td>
<td>8.3</td>
</tr>
<tr>
<td>Northwest</td>
<td>88</td>
<td>93.2</td>
<td>4.5</td>
<td>2.3</td>
<td>6.8</td>
</tr>
<tr>
<td>North Shore/Coast Garibaldi</td>
<td>23</td>
<td>95.7</td>
<td>4.3</td>
<td>0</td>
<td>4.3</td>
</tr>
<tr>
<td>Thompson/Cariboo</td>
<td>51</td>
<td>96.1</td>
<td>3.9</td>
<td>0</td>
<td>3.9</td>
</tr>
</tbody>
</table>

\(^6\) Cross-Canada Survey of Radon Concentrations in Homes Year 1 Interim Report; Health Canada, 2010  
These results are consistent with earlier testing by the province, confirming that the highest radon concentrations have been found in the interior and northern regions of the province.

2. Radon Management Programs or Activities

2.1 Health Canada’s Radon Program

Health Canada’s Radiation Health Assessment Division (Radiation Protection Bureau) promotes and protects the health of Canadians by assessing and managing risks posed by radiation exposure in living, working and recreational environments.

Health Canada has been developing and implementing a radon program to reduce lung cancer incidence through the use of the following strategies (see Appendix 7.2: Planning for a sustainable Future: Health Canada’s 2011–2014 Sustainable Development Strategy):

Expert Advice:
The Radiation Protection Bureau provides advice to federal departments and agencies, other levels of government, industry, universities, hospitals, workers and the public on health issues related to radon exposure.

---

<table>
<thead>
<tr>
<th>Health Service Delivery Area</th>
<th># Survey Participants</th>
<th>% Below 200 Bq/m³</th>
<th>% 200 to 600 Bq/m³</th>
<th>% Above 600 Bq/m³</th>
<th>% Above 200 Bq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancouver</td>
<td>39</td>
<td>97.4</td>
<td>2.6</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>Fraser East</td>
<td>40</td>
<td>97.5</td>
<td>2.5</td>
<td>0</td>
<td>2.5</td>
</tr>
<tr>
<td>Richmond</td>
<td>24</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fraser South</td>
<td>29</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>North Vancouver Island</td>
<td>42</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fraser North</td>
<td>43</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>South Vancouver Island</td>
<td>45</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Central Vancouver Island</td>
<td>52</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

7 Information on Health Canada’s Radon program is taken largely from the Health Canada website at http://www.hc-sc.gc.ca/ewh-semt/radiation/radon/index-eng.php, with additional information provided by Health Canada staff contacts.

8 Appendix 6.2 provides information on Health Canada’s 2011–2014 strategy for radon management, and includes performance measures.
Federal Building Testing:
In 2007 Health Canada began testing radon levels in federal buildings to identify federal workplaces requiring remediation. Health Canada provides long-term radon detectors and instructions to the individual department or building manager and then provides the analysis and results. As of August 2010, 1,431 buildings were tested: 19 buildings were above 600 Bq/m³; 118 buildings were between 200 and 600 Bq/m³; and the remaining buildings were below 200 Bq/m³. Currently, Health Canada estimates that 7% of federal buildings that have been tested have average radon concentrations above 200 Bq/m³.9

Cross-Canada Survey of Radon Concentrations in Homes10:
This is a two year project to gather long-term indoor radon measurements in approximately 18,000 homes across Canada. The first year data collection and analysis is complete. Approximately 9000 homes were randomly selected across all provinces and territories and tested during the 2009/2010 fall and winter heating season11. The second year of the survey is underway.

Mapping:
Health Canada will be preparing maps using geological information, aerial surveys and information gathered through field work to map the levels of radon in Canada, similar to what the EPA had done in the U.S. No decision has been made as to whether these maps will be made widely available to the public through their website.

Public awareness:
The public awareness strategy is focused on homeowners, health professionals, and the building industry, and encourages testing and mitigation where warranted. The key message is that the only way to determine whether a home has a high radon level is to test for it. Various tools have been developed, as outlined in Table 4.

A mitigation guide is currently being prepared and will be posted on the radon website in the near future. Radon is also included in Health Canada’s HazardCheck12 website and print material.

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9 As of October 2010; and based on testing largely focused in areas of known radon concentrations.
11 Households were informed of results and information on radon remediation was provided to those households with elevated levels.
12 HazardCheck is an online resource from Health Canada providing information to consumers about environmental hazards in their homes, their potential health impacts and tips on how to reduce the impact (e.g. radon, carbon monoxide, mould and lead); http://www.hc-sc.gc.ca/ewh-semt/hazards-risques/index-eng.php (accessed August 16, 2011)
Health Canada recognizes mitigation certification programs offered in the U.S. through either the National Environmental Health Association (NEHA) or the National Radon Safety Board (NRSB) and recommends that certified mitigation experts be used\textsuperscript{13}. In addition, Health Canada is working with NEHA to develop a Canadian version of the NEHA mitigation certification course. Health Canada will not be administering the certification process (it will continue to be offered through NEHA).

Several social media campaigns have been undertaken:

- With the Canadian Medical Association (a mailer to physicians’ offices which included a factsheet and poster); and
- With the Lung Associations of various provinces – these varied by province, but generally included presentations at trade shows and the distribution of test kits.

\textsuperscript{13} The site provides a link to the Canadian Radiation Protection Association, which provides a list of testing and mitigation companies, and identifies those which are certified by NEHA or NRSB. The site also provides a direct link to the NEHA site, which lists Canadian testers and mitigation certified individuals.

---

**Table 4: Summary – Public Awareness Media Tools – Health Canada**

<table>
<thead>
<tr>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅ Radon - Another Reason to Quit (factsheet)</td>
</tr>
<tr>
<td>✅ Radon: Is it in your home? (Guide)</td>
</tr>
<tr>
<td>✅ Radon: Is it in your home? Information for Health Professionals (Guide);</td>
</tr>
<tr>
<td>✅ Radon: A Guide for Canadian Homeowners (CMHC))</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Website information</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅ Canadian Guideline for Radon in Indoor Air</td>
</tr>
<tr>
<td>✅ Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM);</td>
</tr>
<tr>
<td>✅ Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, Detention Centres)</td>
</tr>
<tr>
<td>✅ Guide for Radon Measurements in Residential Dwellings (Homes)</td>
</tr>
<tr>
<td>✅ Guidelines for Canadian Drinking Water Quality - Summary Table - Radiological Parameters</td>
</tr>
<tr>
<td>✅ Frequently Asked Questions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅ Radon - What you need to know (brochure and flash version)</td>
</tr>
<tr>
<td>✅ Video: Presence of Radon Gas in your Home</td>
</tr>
<tr>
<td>✅ Radon Educational Toolkit (DVD)</td>
</tr>
<tr>
<td>✅ Link to the Lung Association Radon Quiz</td>
</tr>
<tr>
<td>✅ Links to various. other sites with information on radon</td>
</tr>
</tbody>
</table>
Evaluation of the Indoor Air Quality Theme of the Clean Air Agenda:
An evaluation of Health Canada’s radon program was undertaken by National Research Council Canada between November 2009 and February 2010 as part of the evaluation of the Indoor Air Quality (IAQ) theme of the Clean Air Agenda, and examined the IAQ theme’s relevance, effectiveness, and efficiency/economy during the period from 2007/2008 to 2009/2010. The IAQ theme is one of eight themes in the Clean Air Agenda which received $23 million from 2007/2008 to 2010/2011. The IAQ theme has two programs, one of which is the Radon Program, led by Health Canada and receiving $15 million over the four-year timeframe.

Funding was provided under the Radon Program for three primary components:
- Mapping of Radon Zones and Affected Populations ($8.4 million for four years);
- Testing and Remediation of Radon in Federal Buildings Located in High Risk Radon-Prone Areas ($3.6 million for four years); and,
- Radon Education and Awareness Program ($3 million for four years).

Results were as follows:
- Mapping was proceeding as planned;
- Testing and remediation of federal buildings was off track due to a number of barriers and external factors. Barriers encountered included getting buy-in from departments at the senior level to conduct testing in their buildings, a lack of interest by those at the operational level, fewer buildings meeting testing criteria than initially anticipated, and differing expectations on who should be responsible for distributing and collecting radon detectors in federal buildings;
- The education and awareness component had mixed results. Program managers experienced a number of barriers implementing the program. Program managers developed a broad based radon communication strategy/plan which was approved by senior management for dissemination. However, approval was subsequently revoked and the plan could not be rolled out. Alternative methods were used to disseminate the information, however, the limited data available suggests that awareness levels have increased but not to the levels wanted.

2.2 In B.C. and Other Parts of Canada

2.2.1 B.C. Activities/Programs
In B.C., the majority of radon management activities have been undertaken by three organizations:

- B.C. Centre for Disease Control (BCCDC)
- Northern Health Authority (NHA)
- B.C. Lung Association (BCLA)

**BCCDC:**
The BCCDC has prepared several reports and maps on measurements of radon in homes and in schools in the interior of B.C. (sec 1.4). The Centre has also released a summary report (June 2011), identifying
areas of the province where residential radon concentrations are unlikely to exceed 200 Bq/m³ in the lowest lived area of the home, and identifying areas of the province where radon screening and pre-mitigation efforts would be most beneficial. The BCCDC continues to work with the NHA and the BCLA to map the results of their testing programs.

The BCCDC coordinates the Radon Inter-Government Information and Liaison Group. Group members include staff from the BCCDC, Ministry of Health, CMHC, BCLA, NHA, IHA, Provincial Health Services Authority and Health Canada. The Group provides a forum for sharing information on radon issues, and promotes ideas for increasing awareness and testing.

The Centre also is home to the National Collaborating Centre for Environmental Health (NCCEH), which has produced two recent reports on radon testing and mitigation. Links are provided to NHA and BCLA.

**Northern Health Authority:**
The Northern Health Authority is actively engaged in radon management in the north. In addition to having a funded position to address radon in the north, the radon program gets funding from the Northern Cancer Control Strategy (a partnership between NHA, B.C. Cancer Agency and the PHSA).

NHA’s radon strategy has three components:

- education and awareness;
- test kit sales; and
- mitigation support.

The education and awareness approach includes information dissemination on the NHA website (what radon is, how to test, etc.), and various outreach activities, including participation in a number of home shows and trade shows in the region. Several outreach sessions are planned for this fall. The position is also active on the Radon Inter-Government Information and Liaison Group. The radon position works

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14 See Section 4: [Options and Recommendations](#) for additional information on this report.
15 One idea recently promoted for action by the Group include a Radon Awareness Month.
16 “The NCCEH is one of six centres created to foster linkages within the public health community. This centre focuses on the health risks associated with the physical environment and identifies evidence-based interventions to reduce those risks. “[http://www.ncceh.ca/en/aboutus](http://www.ncceh.ca/en/aboutus), (accessed August 15, 2011)
18 The position is called “Lead, Healthy Community Environments”, which is dedicated to the prevention of environmentally caused cancer. The position is shared between two people, with one person working on radon issues and the other working on air quality issues.
as part of the Population Health team and the radon message is carried by other members of that team, where possible (e.g. tobacco awareness). The site also provides information on mitigation and new building construction.

The NHA program did a bulk purchase of test kits (Landhauer) in 2009, which they continue to offer for sale through their home shows, etc. (approximately 500 have been sold in the past two years at a cost of $30 to the public and $20 to NHA staff.). People are asked to fill out a reminder card, which is sent back to the purchaser after three months, to remind them to send the kit in for analysis. Results from the analysis are sent back to the NHA (no personal information is included, only the detector number) which is then forwarded to the BCCDC for mapping purposes (detector numbers are linked to postal codes). Results from approximately 160 kits have been received to date.

Mitigation support is offered in the form of information and assistance for homeowners in locating certified mitigation contractors. For example, because there are no certified migration contractors in the north, an initiative is currently underway to support some Prince George homeowners in getting advice on mitigation by having the certified mitigation contractor from Castlegar come to speak to the local building association.

B.C. Lung Association (BCLA):
The BCLA has been actively involved in radon awareness and testing for several years. Programs have been funded in part by Health Canada. The first campaign focused on the northern region of the province (information sessions, and the development of brochures in several languages). Following campaigns also included the interior of B.C.

The second phase of the program included the distribution of free test kits. The kits were advertised through a direct mail to their 130,000 donors in B.C. As a result of this direct marketing and awareness campaign, 500 free test kits were distributed within 2 months. Kits are now available for sale through BCLA for $30. Since the launch of the test kit initiative, they have either distributed or sold over 700 kits. Users are provided with instructions on how to use the kit and where to send it for analysis. BCLA asks for their consent to get a copy of the results, which are then sent to the BCCDC for mapping. No personal information is collected; only the postal codes are used to map the location. Calls to the BCLA with questions on radon and requests for test kits are indicators of the increasing awareness of the issue in these regions. No formal evaluation has been done on the program.

The BCLA will continue to support the efforts to increase awareness and testing, and now mitigation, by working with Health Canada, the CMHC and health authorities.

Other Activities:
Radon awareness and testing is also supported by the following organizations:

19 BCLA uses the Accustar test kit.
Radon Management: issues and options

- **Interior Health Authority (IHA):** The IHA has a position dedicated to air quality (Air Quality Specialist), whose area of responsibility includes radon. Because there are a number of radon hot spots in the interior, radon is an issue requiring attention. The IHA provides limited information on radon directly on their website, but the site contains a number of links to other sites providing excellent additional information on radon (BCCDC, BCLA, EPA, etc.) The IHA also has participated in a number of radon awareness forums in Castlegar, Clearwater and Penticton with Health Canada, BCLA and the CMHC and is active in the Radon Inter-Government Information and Liaison Group, researching and supporting new ideas to increase awareness and testing.

- **Canadian Cancer Society (CCS):** The CCS participated in a few home and garden trade shows around the province on radon awareness, with WorkSafe BC in 2009. There is some interest in doing an awareness campaign again next year, focusing either on radon or a broader awareness campaign (e.g. radon/asbestos).

- **Canada Mortgage and Housing Corporation (CMHC):** has supported the efforts of the BCLA and the health authorities by attending the public information forums. The CMHC also has a publication on radon that is available either on their website or by mail order[^20]. The CMHC also offers financial assistance to low-income homeowners for mandatory home repairs that will preserve the quality of affordable housing[^21]. The program helps people who live in substandard dwellings and who cannot afford to pay for necessary repairs to their home. Radon mitigation may be eligible for this program.

- **Donna Schmidt Memorial Radon Abatement Fund:** This is a program in Castlegar, organized and administered by Dana Schmidt, whose wife died two years ago of lung cancer linked to radon[^22]. Over the last two years, close to 1000 test kits have been distributed throughout Castlegar by the fund, free to anyone in the area. Mr. Schmidt is committed to education of people on the hazards of radon and is currently working on a brochure that he hopes to distribute to local real estate agents to encourage people to check on the levels of radon in homes before purchasing. He is also working with the Rotary Club (he is President of the Club).


[^21]: The program is being transferred to BC Housing, although there is no information available at present on the status of this program through the province,

The Club will provide funds for someone to refit their home if the radon level in their home is five times the acceptable level.

2.2.2 Other Provinces and Territories

Government radon management activities and programming varies considerably across other provinces and territories.

Health Canada’s Cross Country Survey Year 1 results indicate that approximately 7% of Canadian homes with elevated radon levels, with the highest levels occurring in Manitoba, New Brunswick, Saskatchewan, and Yukon. High levels of radon (above 600 Bq/m³) were found in test homes in the Yukon and New Brunswick (5.3%), and to a lesser extent, Nova Scotia (1.9%), Saskatchewan (1.6%) and Manitoba (1.4%). The remaining provinces and territories were at less than 1% for this level.

However, homes with elevated levels above the new guideline (homes with radon levels of 200 to 600 Bq/m³) were found in Manitoba (22.1%), Saskatchewan (14.2%), New Brunswick (11.7%), Yukon (10.6%) and Quebec (8.3%); other provinces and territories had rates anywhere from 3.9% to 6.5%, with only Nunavut having a 0.0% rate.

The following table is taken from Health Canada’s website:

**Table 5: Year 1 Radon Results by Province and Territory**

<table>
<thead>
<tr>
<th>Province/Territory</th>
<th>Below 200 Bq/m³</th>
<th>200 to 600 Bq/m³</th>
<th>Above 600 Bq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alta.</td>
<td>93.1%</td>
<td>6.5%</td>
<td>0.4%</td>
</tr>
<tr>
<td>B.C.</td>
<td>95.4%</td>
<td>3.9%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Man.</td>
<td>76.5%</td>
<td>22.1%</td>
<td>1.4%</td>
</tr>
<tr>
<td>N.B.</td>
<td>83.0%</td>
<td>11.7%</td>
<td>5.3%</td>
</tr>
<tr>
<td>N.L.</td>
<td>94.7%</td>
<td>4.4%</td>
<td>0.9%</td>
</tr>
<tr>
<td>N.S.</td>
<td>91.8%</td>
<td>6.3%</td>
<td>1.9%</td>
</tr>
<tr>
<td>N.W.T.</td>
<td>96.0%</td>
<td>4.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>NU</td>
<td>100.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Ont.</td>
<td>95.1%</td>
<td>4.3%</td>
<td>0.6%</td>
</tr>
<tr>
<td>P.E.I.</td>
<td>95.5%</td>
<td>4.5%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Que.</td>
<td>91.0%</td>
<td>8.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Sask.</td>
<td>84.2%</td>
<td>14.2%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Y.T.</td>
<td>84.1%</td>
<td>10.6%</td>
<td>5.3%</td>
</tr>
</tbody>
</table>
Government attention and activity has increased since Health Canada lowered its action level from 800 Bq/m³ to 200 Bq/m³.

**Awareness:** Governments have generally not concentrated on public awareness. Most public awareness initiatives have been undertaken by Health Canada in partnership with the Lung Association or other NGOs:

- Manitoba has looked at their public messaging to ensure consistency with Health Canada’s messaging on radon. They have information on their environmental health website, which they assessed as comparable to other provinces. They have not undertaken any other forms of awareness campaigns (trade shows etc.), and are in the very early stages of looking into the possible development of an awareness campaign.
- PEI’s radon survey and the public release of results may have resulted in decreased public inquiries. The Department of Environment recommends home owners conduct a long term test of their home (as per Health Canada recommendations) if they have concerns.
- Nova Scotia issues press releases annually in the winter to promote public awareness of radon (since 2007). The most recent press release was in January 2010.

**Testing:** Some provincial and territorial jurisdictions have concentrated on testing of government-owned and/or operated facilities, for example:

- Saskatchewan tested schools and hospitals in the 1990s, and repeated the testing in all schools (approximately 900) over the last 10 years. The last phase of testing also included testing of licensed daycares. Saskatchewan has begun to map results, however the data is limited and therefore they have only prepared preliminary maps.
- Manitoba tested about 120 government-owned building last year (schools, government housing, etc. - not hospitals or long term care facilities). They were selected at random for testing, as part of the first phase of an initiative on radon. The second phase of the project is currently underway. The province has hired a consultant to repeat those tests and propose a mitigation strategy where needed, and to get an idea of the cost of mitigation. Costs are expected to vary widely, depending on what needs to be done. The project is intended to give them an understanding of the scope and allow for future planning.
- Nova Scotia began testing of provincially-owned buildings in 2007 as part of a five-year program. Results of testing are available on the government website (accessed August 22, 2011) up to 2008. More than 5,000 radon tests (multiple tests in some buildings) were completed by June 2008 in public housing, schools, health-care facilities and provincial buildings. Rooms in 109 buildings exceeded the national guideline (accessed August 22, 2011). The status of this project is not certain, although there were 118 buildings tested for radon last year (some re-tests). There was no mitigation strategy

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attached to the testing, although some buildings were mitigated by the Department of Community Services.

- PEI did a survey of provincially owned buildings over a two year period (2008 and 2009). Due to predominantly shale stone geology in PEI, they did not expect to find significant levels of radon. Four buildings were recommended for remedial action and three for follow up testing. A provincial committee from six departments/agencies recommended that due to low levels of radon detected that survey work not be continued and that any further concerns with radon would be dealt with on a case by case basis.

- In New Brunswick, testing of schools and district offices was undertaken beginning in 2008. Five schools were remediated in 2009; with remediation work planned for another 21 schools in 2010. The government has allocated $2 million for 2011-12 for radon testing and remediation, as part of the provincial government’s ongoing evaluation and remediation process for all schools. In 2008, the government also offered free testing for uranium in water and radon in air for homes and businesses in parts of the province, after the Department of Health became aware that the results of a 1981 study to identify levels of uranium in water and radon in air may not have been reported to individuals in the area who participated in the study.

**Ontario:**
Public Health Ontario (PHO) is an arm's-length government agency providing environmental and occupational health information and services, amongst many other functions. Information or activities related to radon do not, however, appear to be mentioned. In practical terms, information on radon appears to be distributed by local Public Health Units (36 such units in Ontario), autonomous corporations under provincial legislation, administered by a medical officer of health, reporting to the local board of health. The board is largely made up of elected representatives from local municipal councils.

In April 2011, a private Member’s Bill (Bill 182) on radon was introduced in the Ontario legislature. The Act was intended to raise awareness about radon, provide for the Ontario Radon Registry and reduce radon levels in dwellings and workplaces. The Bill was referred to Committee before the session ended. The Act would have:

- provided for the establishment of the Ontario Radon Registry, and required radon measurement specialists and laboratories to provide the Registry with specified information, including information to allow for mapping across Ontario;

## Table 6: Government Radon Management by Province/Territory26

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Provincial Government Website Information</th>
<th>Provincial Radon Management Program/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.C.</strong></td>
<td>Limited information on health website; linked to HealthLink BC File #42, May 2010</td>
<td>No provincial government public awareness activities are underway (health authority specific)</td>
</tr>
<tr>
<td><strong>Ministry of Health</strong></td>
<td>Linked to BCCDC for more information on radon and other radiation issues.</td>
<td>Some testing of schools done in high radon areas through BCCDC</td>
</tr>
<tr>
<td></td>
<td>Limited information on health website; linked to HealthLink BC File #42, May 2010</td>
<td>No provincial government public awareness activities are underway (health authority specific)</td>
</tr>
<tr>
<td></td>
<td>Linked to BCCDC for more information on radon and other radiation issues.</td>
<td>Some testing of schools done in high radon areas through BCCDC</td>
</tr>
</tbody>
</table>

### Alberta

- **Ministry of Employment and Immigration Radiation Health and Safety Resources**
  - No information; linked to Health Canada's radon website
  - No government public awareness activities

### Saskatchewan

- **Ministry of Health Environmental Health**
  - Limited information on health website; linked to Ministry of Labour information as occupational health issue
  - Links to Health Canada and CMHC radon information sites.
  - Tested schools, hospitals, licensed daycares; RCMP detachments in the past 10 years.
  - No government public awareness initiatives

### Manitoba

- **Manitoba Health Environmental Health**
  - Basic information that complements and supports Health Canada messaging.
  - Information on the prevalence of radon in Manitoba; fact sheet buildings/homes
  - Information on health impacts.
  - Currently are testing public buildings and developing mitigation strategies
  - Are currently considering the need and design of a public awareness campaign, beyond what is there on their website.

### Ontario

- **Public Health Ontario**
  - No information although PHO is responsible for environmental health; public health units appear to be the only limited source of health, awareness, testing and remediation information (via links to other sites)
  - No known government awareness programs or activities.

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26 Information on current radon management activity was requested from government staff in each province and territory. The information presented in the table is a summary of information taken from government websites and discussions with staff, where staff responded.
### Radon Management: issues and options

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Provincial Government Website Information</th>
<th>Provincial Radon Management Program/Activities</th>
</tr>
</thead>
</table>
| **Nova Scotia**       | ● Basic information (FAQs) that complements and supports Health Canada messaging.  
                       | ● Links to resources including test kit retailers and consultants specializing in radon; links to Health Canada, CMHC and other information sites. | ● Annual press releases since 2007 to increase public awareness of radon. |
| Department of Environment  
http://www.gov.ns.ca/nse/radon/ |                               |                                               |
| **New Brunswick**     | ● Basic information on radon (FAQs), with a link to Nova Scotia’s site on radon, Health Canada’s site and to the NB Lung Association. | ● Since 2008, ongoing testing in schools and remediation where needed  
                       | ● No known government awareness programs or activities |                                               |
| Department of Health  
http://www.gnb.ca/0053/radon/index-e.asp |                               |                                               |
| **PEI**               | ● No information other than results of the radon testing surveys from 2008 and 2009 of government owned buildings | ● Tested schools, and other government owned buildings in 2008 and 2009.  
                       | ● No government public awareness initiatives |                                               |
| Department of Health and Wellness  
| **Newfoundland/Labrador** | ● Radon is listed under Air Quality and is linked to Health Canada’s site | ● No known government awareness programs or activities |
| Department of Health and Community Services  
http://www.health.gov.nl.ca/health/publichealth/envhealth/air.html |                               |                                               |
| **Yukon/NWT/Nunavut** | ● Website does not provide information on radon | ● Provides free detectors to homeowners (loaned detectors which are returned)  
                       | ● Completed a campaign in 2008 with WCB on all government buildings and completed mitigation |                                               |
| Department of Health and Social Services  
www.hss.gov.yk.ca |                               |                                               |
• required public education programs to be conducted on the health risks associated with exposure to radon and ways to reduce the risks, encourage homeowners to measure the radon level in the normal occupancy area of their home, and to take action to reduce the radon level if it exceeds 200 Bq/m$^3$ per year;
• required testing of radon level in the normal occupancy area of every provincially owned dwelling;
• required owners of an enclosed workplace to test before December 31, 2016 (maximum fine for non-compliance would be up to $500,000); and
• amended the Ontario Building Code with respect to radon.

2.3 Internationally

2.3.1 U.S.
The U.S. has been active in radon programming for many years, supporting and encouraging radon research, education, awareness, testing and mitigation, although programming supports vary considerably at the state and local levels. Current activities are listed in Appendix 6.4.

In June 2011, senior U.S. partner agencies announced a U.S. Federal Radon Action Plan to increase efforts on radon reduction and mitigation in homes, schools and daycare facilities, as well as radon-resistant new construction. 27 Radon causes an estimated 21,000 lung cancer deaths in the United States every year. The national strategy is intended to increase public understanding of the risk, advance effective government radon policy, promote testing, mitigation and radon-resistant construction as a standard practice in real estate and construction industries, and deliver financing and other incentives to help homeowners mitigate high radon levels.

The Action Plan has the following objectives:
• operating radon mitigation systems in 3.1 million (30 percent) of the estimated 9.2 million homes with an elevated radon level; and,
• 100% of new single family homes constructed with radon-reducing features in high-radon potential areas.

Barriers that prevent widespread, voluntary radon risk reduction are seen to be the following:
• Limited public understanding of the gravity of the risk and the fact that the solution is proven and uses readily available technology.

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Radon Management: issues and options

- Perceived high costs of mitigation and radon-resistant construction relative to the perceived increased value at the time of resale.
- Limited nationwide availability of certified radon measurement and mitigation professionals.

Three broad strategies are laid out in the action plan:
- demonstrating the importance, feasibility and value of radon testing and mitigation;
- providing economic incentives and direct financial support for testing and mitigation; and,
- building demand for services from the professional, nationwide radon services industry.

The specific activities associated with each strategy are outlined in a summary document from the Action Plan (Appendix 6.3).

There do not appear to be any states that require disclosure of radon risk during real estate transactions. Regardless, radon is becoming more of an issue; for example, Illinois’ Radon Awareness Act and the Illinois Real Property Disclosure Act requires that a seller of a home disclose information if aware of unsafe concentrations of radon in the home (they do not require that testing or remediation work be done). Mortgage companies and home buyers will now often request a radon test when purchasing a house, and people are being cautioned about full disclosure of facts when selling.

While home owners can get some protection before buying, tenants do not have a way to limit exposure to high radon levels, as there are no known requirements or incentives for landlords to test or mitigate.

Very few areas require radon-resistant new construction:
- 25 states/3 districts/territories do not have any radon resistant construction codes either statewide or in local jurisdictions;
- 19 states have some local jurisdictions that have radon resistant construction codes, but not statewide;
- 6 states have statewide radon resistant construction codes that apply to certain specific circumstances;
- 4 states have statewide code guidelines, but local jurisdictions must adopt them.

U.S. Environmental Protection Agency (EPA):
The EPA provides the scientific foundation on radon, and facilitates the development of technical guidance, protocols and standards needed for risk reduction. The EPA has funded state-wide radon risk reduction programs and supports outreach and education campaigns, as well as partnerships with states, tribes, NGOs and the radon services industry.

28 EPA Listing of States and Jurisdictions with RRNC Codes (current to June 2011); http://www.epa.gov/radon/rrnc/code_listing.html (accessed August 22, 2011)
Each state has a radon contact that can offer specific state information on radon. For example, some states regulate or certify providers of radon measurement and mitigation services by requiring registration, certification, or licensing and some states issue identification cards. To date, 14 states have some form of radon requirements for radon service providers.

The EPA radon website is engaging, and provides multiple services, sources of information and links to radon information:

- Zonemaps - EPA Map of Radon Zones/Radon Zone Map/Radon Potential Map
- Publications – multiple publications in English and/or Spanish, including:
  - A Citizen's Guide To Radon: The Guide to Protecting Yourself and Your Family from Radon
  - Home Buyer's and Seller's Guide to Radon
  - A Consumer’s Guide to Radon Reduction: How to Fix Your Home
  - Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes on mitigation, guides for tenants, home buyers and
  - Radon - A Physician's Guide: The Health Threat With A Simple Solution
  - Model Standards and Techniques for Control of Radon in New Residential Buildings
  - Radon in Schools
- Information links – offering contact information for state specific information, mapping, and information on construction and design considerations, etc.

The site also offers an extensive array of media products that can be ordered online (EPA's media viewing and ordering is provided to the EPA and its partner organizations through a contract agreement).

Media campaigns include:

- Living Healthy & Green (Green Sox) campaign - media includes TV and seven unique music genres for radio stations and MP3 players. The entire campaign is available in multiple media formats and sizes for newspapers, magazine, billboards and the Web in both English and Spanish;
- Public Service Announcements – various. media formats, and themes – Surgeon General Warnings, Man on the Street, etc.;
- Videos (e.g. Breathing Easy: What Home Buyers and Sellers Should Know About Radon; Dr. Oz Discusses: The #1 Cancer Risk at Home; the “Office” episode available on uTube);
- Living Healthy & Green (former NFL kicker Fuad Reveiz) - a
campaign designed to educate the public about radon in homes (features Reveiz, now a home builder who uses radon-resistant construction).

The EPA established four U.S. Regional Radon Training Centers (RRTCs) in 1988 to provide training to public officials, nonprofit and private firms, and the public regarding the health risks posed by radon and to demonstrate methods of radon measurement and mitigation in residential, educational, and other environments. The Midwest Universities Radon Consortium (MURC) is one of them, and is located at and managed by the University of Minnesota. Kansas State University is a member of MURC and operates the EPA Radon Hotlines:

- 1-800-SOSRADON (1-800-767-7236) to purchase radon test kits by phone (kits are also available for purchase online);
- 1-800-55RADON (557-2366) to get live help for your radon questions;
- 1-800-644-6999 Radon Fit-It Hotline - for general information on fixing or reducing the radon level in your home;
- 1-800-426-4791 Safe Drinking Water Hotline. For general information on drinking water, radon in water, testing and treatment, and standards for radon drinking water.

Kansas State University also conducts the National Radon Poster Contest, and provides referrals to state radon programs, radon test kit coupons (for kits offered through their site), radon mitigation promotion and other outreach activities. This annual poster contest is for children ages 9 to 14 to encourage testing for homes for radon. Entries are accepted from March through October, with winners announced in January. Winners are honored at a special luncheon in Washington, DC, and winners, a parent and the sponsoring teacher receive an all-expense paid trip to Washington, DC to attend.

A Radon Video Contest was also held in 2008, where they asked for 30-60 second video submissions with the theme "Radon: Test, Fix, Save a Life". They received 30 submissions, with the winning entry a lung cancer survivor who shared his personal story. The video is now available in various media formats, web banners and print ads.

The EPA also:

- coordinates the Radon Professionals Speaker’s Bureau, a resource of professionals from the American Association of Radon Scientists and Technologists (AARST), to speak at events;
- regularly hosts Webinars to promote sharing of information and improve strategy among public health professionals, radon professionals and other stakeholders;
- offers states and tribes grant funds (State Indoor Radon Grant (SIRG) Program) to finance their radon risk reduction programs; recipients must provide a minimum of 40% in matching funds.
RadonLeaders.org was launched in 2008 and is an online learning and action network supporting the Radon Leaders Saving Lives Campaign. RadonLeaders.org connects radon stakeholders through interactive tools (e.g. Blogs, Discussion Forums), and features radon information and resources. In 2007, leaders from Conference of Radiation Control Program Directors (CRCPD), AARST, and EPA’s radon program launched the Radon Leaders Saving Lives Campaign, with the goal of doubling the number of lives saved from radon-induced lung cancer within 5 years.

2.3.2 U.K.
The U.K. was one of the first countries in the world to introduce a national radon control policy in 1987. Radon program management is now the responsibility of the Health Protection Agency (HPA), an independent organization that was set up by the U.K. government in 2003 to protect the public from threats to health from infectious diseases and environmental hazards. The Agency estimates that radon is responsible for an estimated 1,100 lung cancer deaths a year in the U.K.

The Agency’s Radiation Protection Division provides advice and information to the general public, health professionals, and national and local governments. The Centre for Radiation, Chemical and Environmental Hazards (a separate division of the Health Protection Agency) manages laboratory intercomparisons of passive radon detectors. These comparisons are scheduled at regular intervals and have been conducted since 1997.

Agency policy recommendations have included:

- recently introducing a new “Target Level” of 100 Bq/m³ but retaining its “Action Level” of 200 Bq/m³;
- In May 2008, recommending changes to the U.K. Building Regulations and Standards to ensure that all new building and building renovations incorporates measures to reduce indoor radon concentrations (radon preventative measures were only required in new buildings in areas with elevated radon levels).

“UKradon” ²⁹ is the public face of the Agency on radon. Their site offers a wide range of information on radon, including links to reports and newsletters published quarterly by the HPA on radon policy and practice in the U.K. The site offers radon services for homeowners and employers, including the sale of risk reports on a property and the sale of radon detectors for homeowners or for workplaces. Risk reports can be prepared for any home or small workplace in Great Britain with a valid postal code. These reports provide the estimated probability that a particular address is above the Action Level for radon.³⁰ This information also provides an answer to one of the standard legal enquiries on house


³⁰ Users are cautioned that the only way to find out whether a property is above or below the Action Level is to carry out a radon test measurement.
purchases in England and Wales. Anyone buying a currently occupied property in a Radon Affected Area is encouraged to ask the present owner whether radon levels have been measured in the property, and if yes, ask for the results and any remedial measures, whether radon levels were re-tested, and the results of re-testing. Risk reports and measurements also provide important information for employers about their legal responsibilities for the health and safety of their employees.

Maps of Radon Affected Areas have been available since 2009 for England and Wales, Scotland and Northern Ireland, however, new digital mapping techniques have recently enabled the HPA and British Geological Survey to produce a new radon map of Scotland (July 2011) with greater accuracy. As a result, building regulations will be modified in Scotland so that all new buildings and renovations proposed within the identified risk areas are constructed with the required radon protection measures. Local authorities are encouraged to test any public buildings and to take action if required.

Employers are encouraged to test for potential radon exposures and are usually required to test in any workplace in Radon Affected Areas. If a radon level in any part of a workplace exceeds 400 Bq/m³, the employer is obliged to take action, including informing staff of their risk and nominating a staff person to oversee remediation. The HPA recommends a five point plan which includes testing, ongoing surveillance until remedial action is complete and periodic follow-up testing. The HPA offers surveillance service, and can also advise on more complex protection issues where required. The Health and Safety Executive (HSE) (Britain’s version of WorkSafe BC) has a site dedicated to radon information. The HSE works with employers to create radon awareness and helps them to understand their responsibilities and to take action where needed.

The U.K. government has conducted awareness and testing campaigns since the mid-1980’s with mixed results, in places where levels of the gas are believed to be highest (see 3.4.1 for more information on the effectiveness of these campaigns).

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Homeowners are encouraged to check to see if their homes are in the high level areas by ordering a Radon Risk Report (the cost is £3.60) and if so, to test. Two detectors are mailed to the home with instructions and a pre-paid envelope to return the kit. Results are mailed back to the homeowner within four to six weeks (the cost is £49.80). Sometimes a free re-measurement is available to check the remedial action. The test kits are the three month detectors, and homeowners are instructed to place them in the living room and bedrooms where people spend most of their time. Measurement results are held in an HPA database and used for statistical purposes, but individual results are not disclosed without express permission. Detectors remain the property of the HPA.

A “screening” test is also made available for those wanting an early result of the success of remedial work (the cost is £91.08). These are extra detectors placed next to the three-month detectors, which are then returned after two weeks. Results are provided in five working days.

2.3.3 Other European Countries

Between September 2009 and January 2010, the European ALARA Network (EAN) surveyed participants to the network on the national management of radon exposure, asking if there was a specific radon policy in their country; when it was implemented; their action or reference levels for workplaces and domestic dwellings; and what stage they were at in implementing the policy. This survey was undertaken in response to the newly released WHO recommendations in September 2009 (WHO Handbook on Indoor Radon recommends a reference level of 100 Bq/m³ and if compliance with this level cannot be achieved, the reference level should not exceed 300 Bq/m³). Many countries have initiated a process to revise the regulations or review the recommendations. Seventeen countries responded, namely Armenia, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Slovenia, Spain, Sweden, Switzerland, the U.K.

Belgium:
Belgium’s radon protection regulations were introduced in 2001, and an action plan has been in operation since 2005. Previous radon activities (measurement campaigns, mapping, public awareness, brochures, etc.) were carried out by the Health Ministry in collaboration with different universities and research centres since the early 90s. Mapping of radon-prone areas has been completed, and public

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33 The European ALARA Network (EAN) was created by the European Commission to conduct research on topics dealing with optimization of all types of occupational exposure, as well as to facilitate the dissemination of good ALARA practices within all sectors of the European industry and research. See [http://www.eu-alaranet/images/stories/Pdfdivers/SurveyRadon/survey-ean-radon.pdf](http://www.eu-alaranet/images/stories/Pdfdivers/SurveyRadon/survey-ean-radon.pdf) for a summary.
awareness activities, ongoing measurement campaigns and building prevention actions (training of building professionals, spreading of information, etc.) are annually defined in the frame of the radon action plan and focused on specific regions based on radon maps.

**Denmark:**
At the end of 2009, the Danish Building Authority lowered the allowable levels for radon to 100 Bq/m$^3$ for new buildings, and for existing buildings, to 100 Bq/m$^3$ for simple remedial measures and 200 Bq/m$^3$ for more comprehensive and costly remediation measures.

**Finland:**
In Finland, all new houses must be designed and constructed so that indoor air is “free of harmful concentrations of gases, particles or microbes or odours, which decrease the indoor comfort.” The current “action level” is 400 Bq/m$^3$, but this is under review. A radon-technical design is required in all building as a main rule in the whole country.

For workplaces and public buildings, employers must measure the radon level if there is reasonable cause to suspect that the level of 400 Bq/m$^3$ might be exceeded (where people work regularly) and take action to lower the exposure if the action level is exceeded. All schools, nurseries, public buildings have to be below 400 Bq/m$^3$ even if the buildings are not used regularly.

**Switzerland:**
Switzerland has had a national radon program since 1994. Their legislation addresses limits, measurements laboratories and programs, building regulations and protective/ remedial actions and risk management through the radon technical and information center (inclusive national radon database and education/training of consultants). Their website offers extensive mapping information, information on health impacts, radon resistant construction information, municipal information and links, etc.

If the 1000 Bq/m$^3$ limit is exceeded, the Federal Radiological Protection Ordinance prescribes radon remediation. Tenants have a legal right to demand remediation. New buildings in high risk areas require radon resistant construction.

The Swiss Federal council has just approved (May 24, 2011) the National Action Plan Concerning Radon for 2012-2020. The plan involves:

- revised legal regulations based on the new findings concerning the health effects of radon;
- increased measurement and mapping of high risk zones based on the new criteria;
- better radon protection in new construction;
- remediation where required;
- making radon an integral part of the training of construction experts; and,
- an increase in public awareness to the radon problem.
Sweden:
There are two national targets: the radon concentration should be lower than 200 Bq/m³ in schools and pre-schools by the year 2010, and in homes by 2020.

The Energy Declaration of Buildings Act (in force January 1st 2009) requires that all newly built homes and buildings sold or rented out (after this date) must have an energy declaration filed by the owner with the National Board of Housing (which maintains a registry).

One of the factors covered by the declaration is radon, common in Swedish homes, especially those built from 1929 to 1978. Before an energy declaration can be drawn up for an existing building, the owner must ensure that the building is inspected by an independent expert. Mitigation is strongly recommended, but not required, for existing dwellings with levels greater than 200 Bq/m³. For owners of apartment rental buildings, the municipalities can demand radon measurements and mitigation if the action level is exceeded. For single-family homes with radon levels exceeding 200 Bq/m³, homeowners can apply for a subsidy to cover up to half the cost of mitigation, with a limit of about $2,500. In Sweden, it is estimated that 500 people die every year as a direct result of exposure to high levels of radon.

3. Environmental Scan and Research Results

3.1 World Health Organization
The World Health Organization (WHO) launched the International Radon Project (IRP) in 2005. The key elements of the Radon Project include:

- developing evidence-based public health guidance to assist member states to formulate policy and advocacy strategy;
- guidance on methods for radon measurements and mitigation; and,
- development of approaches for radon risk communication.

In September 2009, the WHO Handbook On Indoor Radon: A Public Health Perspective was published. This handbook focuses on residential radon exposure from a public health point of view and provides detailed recommendations on reducing health risks from radon and sound policy options for preventing and mitigating radon exposure.

34Swedish homeowners’ radon concerns rise ahead of new rules; The Local: Sweden’s News in English; Published: 30 Jul 08 [http://www.thelocal.se/13366/20080730/](http://www.thelocal.se/13366/20080730/) (accessed August 23, 2011)
The material is organized into six chapters:

- Health Effects Of Radon – information on lung cancer risks in radon-exposed miners, and in the general population from indoor radon and the burden caused by this lung cancer; it also addresses links between radon and other diseases;
- Radon Measurements – information on measurement devices, protocols and quality assurance for radon measurements;
- Radon Prevention And Mitigation – organization of radon prevention and mitigation actions, radon prevention strategies in new constructions, and in existing buildings;
- Cost Effectiveness Of Radon Control – a framework of cost-effectiveness analysis, previous economic evaluations of radon prevention and mitigation and an example of a cost-effectiveness analysis;
- Radon Risk Communication – fundamentals, strategies and channels; framing radon risk issues for risk communication; core messages for radon risk communication and examples of communication campaigns;
- National Radon Programs – organizing a national radon program, national radon surveys, national reference levels and building regulations and building codes.

The key messages from the chapter on radon risk communication are the following:

- The communication of radon risk and prevention messages is challenging because radon is not widely known and may not be perceived as a health risk by the public;
- An assessment of perceptions and the level of knowledge regarding radon in the target audiences are strongly recommended. This should be done both before and after a risk communication campaign;
- As part of radon risk communication, the development of a set of core messages aimed at target audiences is recommended. These messages should be simple, brief, and to the point;
- Effective risk communication requires co-operation between organizations, clear and coordinated messages, and the enlistment of collaborators with good community credibility;
- In addition to informing the public, a primary objective of radon risk communication is to persuade policy makers that radon is an important public health issue that requires action.

Some of the key points raised in the Handbook regarding communication include the following:

- The communication strategy chosen depends on the extent of the problem, the objective and the communication of that objective, the budget, and reference levels and building codes. A radon risk communication program must have clear and achievable objectives, focused on informing different target audiences about radon and persuading those audiences to take action. All radon risk communication messages should be tested and adapted to the individual target audiences;
- An effective communication strategy will include multiple strategies and methods of communication. Target audiences can be identified as either direct audiences (home owners,
tenants, builders, architects, smokers, real estate agents, etc.) or indirect audiences (government decision makers, lawyers, health profession, etc.) and messages should be developed for each. It is important to assess the perceptions and level of knowledge regarding radon in the target audiences (surveys are an excellent approach);

- A radon risk communication program should also be a cooperative effort involving both technical experts (e.g. radiation scientists, epidemiologists) and communication experts (e.g. social scientists, psychologists, journalists);
- A statement of risk to an individual requires a description of the probability or likelihood of harm and of the severity of the harm (in the case of radon, the harm is mainly lung cancer). An example for a risk message is “There is no known threshold below which radon exposure carries no risk. The lower the radon concentration in a home, the lower the risk”. The concept of relative risk may be difficult to explain to the general public - it may be preferable to express risks in absolute terms (e.g. the absolute number of estimated cases per year related to radon exposure, or lifetime risk estimates for smokers and non-smokers exposed to different concentrations). Information on combined radon and smoking effects may also assist tobacco control campaigns by highlighting the fact that exposure to radon significantly increases the lung cancer risk for smokers.
- Radon risk communication should be focused on a small number of core messages expressed in simple, readily understood language. The format of the messages should be tailored to each target audience. They should be simple, brief, and to the point (e.g. Radon causes lung cancer; Radon is a radioactive gas present in homes; Radon is easy to measure; you can easily protect your family from radon etc.)
- While increasing awareness of radon and the health risk is difficult, convincing people to take action is even more difficult. The reasons for this apathy or reluctance to take action are complex. It is important to use credible and respected senders of the messages (e.g. local health authorities, medical practitioners, school teachers) and appropriate distribution channels. The success of the message will depend upon the adaptations made to the target audience, the trusting relationship between the communicator and the audience, and the clarity of the message

3.2 Non-Government Activity
There are several non-government (non-profit or for-profit) organizations in the U.S. and Canada that have been created to support radon education, testing and mitigation. The following are a few examples:
American Association of Radon Scientists and Technologists (AARST)\(^\text{35}\):
AARST is a nonprofit, professional organization dedicated to excellence and ethical performance of radon measurement, mitigation and transfer of information for the benefit of members, consumers, and the public at large.

AARST Members are typically industry practitioners, members of academic institutions, staff of regulatory or environmental, health, energy or other governmental agencies, and other individuals interested in radon science and technology.

National Environmental Health Association (NEHA)\(^\text{36}\):
NEHA is a professional society with over 4,500 members. Its purpose is to "advance the environmental health and protection professional for the purpose of providing a healthful environment for all".

The association has seven national credential programs, an annual Educational Conference and a number of technical workshops each year. In addition, NEHA is a resource for the environmental health professional, and publishes the Journal of Environmental Health, has an online bookstore, provides networking and committee participation opportunities, and develops positions on environmental health concerns. The NEHA National Radon Proficiency Program is the leading certification program for radon professionals in North America.

National Radon Safety Board (NRSB):
National Radon Safety Board is a single purpose, non-profit organization, providing certification, accreditation, and approval for the following categories of radon service providers:

- Certification for Radon Measurement Specialists and Technicians
- Certification for Radon Mitigation Specialists
- Accreditation for Radon Laboratories
- Accreditation for Radon Chambers
- Approval for Radon Measurement Devices

Radiation Safety Institute of Canada\(^\text{37}\):
The Radiation Safety Institute is a national, not-for-profit corporation. It began operations in Elliot Lake, Ontario in January 1981 directly in response to a human disaster in the Elliot Lake uranium mines in Northern Ontario. The Radiation Safety Institute of Canada is a self-governing organization with a highly educated and professionally qualified staff of radiation scientists, educators and other professionals.

The Institute offers research, education, measurement and monitoring services in the broad field of radiation, however, there are some services specifically devoted to radon:

- their National Laboratories run the Institute’s Radon Monitoring Program - for industrial and environmental work sites that require frequent or continuous monitoring to ensure that radiation levels are maintained below regulatory exposure limits and guidelines; and,
- sale and analysis of radon tests for the public. They offer both short and long-term tests (Radon Test Kit Price: $55 + Tax). Kits are processed and analyzed by their own laboratories, and results are sent within 4 business days of receiving back the monitor. They will also answer any questions about the results, by calling their staff.

**Radon Atlantic:**
Radon Atlantic specializes in radon measurement, risk analysis and mitigation, and is NEHA certified in both radon measurement and radon mitigation in 2009. It is an active member of AARST and the Canadian Radiation Protection Association. It offers full radon analytical services including measurement and risk assessment, including real Estate services include pre-purchase testing and radon resistant new home construction. They are part of the NEHA “speakers” group. They have:

- assisted Health Canada with their radon mapping efforts in the Atlantic region;
- assisted CMHC with research efforts;
- worked throughout Nova Scotia and northwest U.S., on homes, institutions and office buildings.

**CanSar**
Cancer Survivors Against Radon is a U.S. non-profit society, created in January 2010. Members are survivors of cancer that has a probable link to radon. Members make presentations to community organizations, do TV and radio interviews, etc. Their latest campaign is “Radon Tee World Trek” which consists of a black t-shirt displaying “Reduce Radon”, to raise radon awareness and to urge testing and mitigation of elevated radon levels. “Capital Steps to Radon Action” is an annual event held on the fourth Wednesday of January (National Radon Action Month) when people all over the U.S. stand on the capitol steps in their state to educate others on the danger of living and working with high levels of radon. CanSar will also mail one free radon test kit to a lung cancer patient or immediate family member so that their house is tested for radon. There is no cost to join.

### 3.3 Interview Results
Interviews were conducted with nine organizations actively involved in radon or related programs and research, both here in B.C. and as part of the Health Canada Radon Program. Organizations interviewed included:

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- Health Canada
- B.C. Lung Association
- Canadian Cancer Society (B.C. and Yukon)
- B.C. Centre for Disease Control
- Canadian Mortgage and Housing Corporation
- Northern Health Authority
- Interior Health Authority
- Ministry of Health (B.C.)
- Ministry of Environment (B.C.)

The purpose of the interviews was to gain:

- an understanding of the radon management activities that have been undertaken or are currently underway, particularly in B.C.\textsuperscript{39};
- knowledge of other radon programs and activities in other jurisdictions; and
- input into what a provincial radon program might look like, and the challenges that a provincial program might face.

An interview guide was used to gather information on [five] areas of interest\textsuperscript{40}:

- the organization’s activities with respect to radon management, the goals of the activity/program, and results and/or outcomes if available;
- their knowledge of other jurisdictions’ radon programs, and identification of environmental health issues with similar challenges as radon management;
- thoughts on the possible administration and design of a provincial program, the scope or focus of a provincial program, and the barriers that such a program might face;
- thoughts on possible approaches and related challenges to awareness campaigns and general communication on radon; and,
- identification of issues with respect to radon testing and analysis, and mitigation issues.

Results of interviews on radon management activities and linkages to other programs are contained in other areas of this paper; however, some key points emerged from the discussion on the following other areas of interest:

\textit{On the possible administration and design of a provincial program, the scope or focus of a provincial program, and the barriers that a program might face:}

\textsuperscript{39} This information is included in 2.2 In BC and Other Parts of Canada.

\textsuperscript{40} The interview guide was a guide only, as not all questions were applicable to all interviewees, given the range of knowledge of interviewees of radon and their involvement in radon management issues.
Several people noted that the administration and design of a program would be dependent on the goals of a provincial program and the level of funding available. Others suggested that regardless of the specific goals or funding for a provincial program, a provincial coordinator is needed to direct the development of a provincial strategy and support individuals working in the field, by providing such services as a coordinating role for sharing information, and managing research, policy development, and funding requests at a provincial level.

Interviewees generally agreed that a provincial program would likely need to be implemented through the health authorities, and that NGOs would play an important role in any outreach campaigns because of their presence in many communities (both in terms of their local connections and in terms of communities of interest e.g. air quality), and because of the strength of their reputation in communities. The suggestion was made that each health authority should be in a position to provide basic radon management information to its constituents, or if in areas of high radon concentrations (Northern Health and Interior Health), that more intensive programming be developed and supported by the province and health authority to meet local needs.

Most agreed that the province needs to focus its efforts on those geographical areas that have the highest levels of radon (although this was tempered by comments on messaging around testing). Opinions varied on whether new construction or existing buildings should be targeted equally, or whether one or the other should be the primary focus of a provincial program. Many commented on the need for the province to address testing and mitigation of its own public buildings, including hospitals and long term care facilities, and schools. Several commented on the challenge that the province faces in this respect, in terms of “practicing what it is preaching”. Many homeowners do not test because they will need to address the situation if radon is found in their homes. The same challenge faces the province in terms of being required to mitigate for radon, if it is found in public buildings. The situation is similar to the challenge facing public buildings requiring seismic upgrading (a particularly sensitive issue to manage when schools require upgrading).

In terms of looking at other environmental issues for possible approaches or opportunities for collaboration, suggestions included looking at the federal HazardCheck program where homes are encouraged to check for several possible hazards, including lead, mould and radon; and looking for opportunities to work with environmental and tobacco air quality staff to help spread the message on radon.

On possible approaches and related challenges in public awareness and communication on radon:

All interviewees agreed that public awareness of radon varied considerably but was probably quite low. All interviewees also agreed that the appropriate time to do awareness campaigns was in the fall/winter, to encourage testing when there was less natural ventilation.

In terms of strategies in increasing awareness, suggestions included:
• approach people directly about radon testing, using outreach opportunities – e.g. trade shows;
• always target the most vulnerable areas first, whether it’s in terms of geographic location or other factors. An exposure registry would be an important tool;
• offer test kits at a reduced cost to encourage testing;
• testing daycares by requiring it as part of the licensing process;
• target smokers first as they are at greatest risk;
• target real estate transactions as they are the driver for action on radon;

In terms of messaging, suggestions were:
• It’s a health risk that needs to be addressed;
• “Did you know?” followed by “There is a solution” – a positive message that empowers people to act;
• Testing is easy;
• Mitigation isn’t expensive although this was seen as problematic, as it could be expensive and there are few mitigation experts in the province to give you good advice on what can be done);
• Protect the ones you love.

On the identification of issues with respect to radon testing and analysis, and mitigation:

• Test kits (availability) – several interviewees noted that encouraging people to buy test kits could be a challenge sometimes, because there was often no local supplier stocking the test kits. Because there is so little demand for them, most retailers will not supply them, although some are willing to do special orders. One person pointed out that any test kits sold through private suppliers did not contribute to our mapping of radon in the province.
• Test kits (short-term) – some interviewees thought there is a role for short-term test kits, in terms of flagging whether there is a potential issue, or for real estate purposes. Others thought it was important to be consistent with Health Canada’s messaging regarding the use of long-term kits. In discussions with a provincial representative, he believed there was new evidence that short-term kits were fairly accurate and had a greater role to play.
• Mitigation (certified contractors) – several interviewees commented on how few certified mitigation experts there were in B.C., and how difficult it was to get good advice. Builders are generally aware of radon as a potential issue but they are reluctant to do RRNC because of the added cost. One person suggested that if builders thought that there might be a potential for legal action against them for not using RRNC (negligence issue), that they might be more willing to incorporate this type of construction. The expectation is that the provincial building codes will adopt the national code for RRNC.
• Mitigation (financial assistance) – while mitigation can be relatively inexpensive, it may still be a barrier to some.
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- **Training/education** – several interviewees suggested that including information or some form of training on radon in building courses would help in the future, in terms of having the new builders/contractors at least aware of the issue.
- **Real estate transactions and disclosure** – this was generally recognized as a sensitive issue for both real estate agents and property sellers. Suggestions included working with the real estate industry on how to approach the issue; and/or regulating disclosure. The suggestion also was made that disclosure could be used as a selling feature – “radon free”.
- **Workplace policy** – it wasn’t clear that WorkSafe BC has taken on radon in the workplace as an issue that needs to be addressed.

### 3.4 Better/Best Practices

#### 3.4.1 Radon Awareness Campaigns

An internet search was conducted to determine if there had been any evaluations of radon awareness programs in the past ten years, and whether or not better or best practices with respect to approaches to radon awareness programs could be determined from those evaluations. Several journal articles provided good insights into ways to approach radon campaigns, and are summarized below:

_Awareness and Perceptions of the Risks of Exposure to Indoor Radon: A Population-Based Approach to Evaluate a Radon Awareness and Testing Campaign in England and Wales_

A study by researchers at Cardiff University in Wales (funded by the Department of Health Radiation Protection Research Program in Britain) evaluated the locally directed radon roll-out program that was conducted in England and Wales between 2001 and 2005. The program was intended to increase radon awareness and testing rates.

The U.K. government ran a number of awareness and testing campaigns in England in the mid-1980’s and again in Wales in the late 1990’s. Free home test kits were offered to homeowners in high risk areas, with written advice for those at or above the action level on how to take remedial action. Until 1998, these offers were sent out centrally by the National Radiological Protection Board (precursor to the HPA). Results showed that while many homeowners took advantage of the free test kits, remedial action was low, even in areas where awareness was high. As a result, a more locally directed approach was adopted.

This new approach was piloted in 1999 with three local authorities, which acted as the local face to the campaign. The program was sponsored by the government through the HPA but actioned by the local

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authorities. Participating local authorities were required to appoint a staff person to organize the activities of the program and to be approachable for members of the public. Results showed considerably better results in terms of people approaching local authorities for advice and the number of remedial actions undertaken. In response to these findings, the government launched the Radon Roll-Out Program in 2000. The program had 3 goals:

- To raise public awareness of the adverse health effects of indoor radon
- Increase the number of residents testing for radon in affected areas
- Encourage residents with high radon levels to take remedial action.

The program's key features were that:

- Homeowners were pro-actively contacted
- High testers were actively supported in remediation through individual advice on options at radon road shows and free house visits.

The approach was standardized, with specific elements determined according to local preferences and circumstances. More than 30 local authorities had participated by 2005. The HPA continues to offer these types of programs with local authorities.

The researchers reviewed various studies that showed that despite sometimes high levels of awareness, people do not feel at risk and do not find it necessary to test for radon. It is not seen as an immediate health threat. Overall, however, from those studies using population-based surveys, there was "strong cross-sectional evidence that prompts of a free test kit together with targeted media campaigns may encourage people to test their home for radon."

In the study of the effectiveness of this approach, a representative sample of 1,578 residents were interviewed who lived in radon-affected areas of 15 local authorities in England and Wales that were eligible for participation in the program. The study systematically sampled across participating and nonparticipating local authorities, "actionable" and "non-actionable" radon-affected areas, and geographic regions with different campaign histories (Wales, Southwest England, and the rest of England).

Results of the study were as follows:

- The program was effective in raising awareness and testing. Overall, 20% of respondents had already completed a radon test, or were in the process of testing, particularly if they lived in participating areas (twice as likely to have tested as those people living in non-participating areas). Older respondents were more likely to have already tested and those with a lower socio-economic status were 50% less likely to have tested.
- Men were nearly twice as likely to have heard of radon as were homeowners generally, and older people were far more likely to have heard of radon than were younger people. Those
with lower socio-economic status. were also less likely to have heard of radon. People living in the actionable areas and in those areas where local authorities had participated in the program were more than twice as likely to have heard of radon.

- Higher levels of awareness did not necessarily translate into higher levels of concern, although residents of participating areas were less likely to respond to the concern question with “don’t know”, suggesting that while the program may not have affected the risk perception, the program had provided people with enough information about whether or not they should be concerned (potentially by assessing the actual radon levels). Men were generally more aware but less concerned.
- People in Wales were less aware than those in England, where there had been campaigns conducted for several more years (suggesting that awareness is linked to ongoing public awareness campaigns).

**Good Practice Guide:**

As noted in the study above, the British government had a large, centrally-organized measurement campaign in the late 1990s where they offered a free test kit to every home in England with a greater than 5% probability of being above the Action Level. This approach was then replaced with a new, locally-directed approach, with its emphasis on encouraging remediation. The new approach was first piloted, and then rolled out throughout affected areas in England and Wales.

To support the roll out of the program, a Good Practice Guide was developed along with a “toolkit” of publicity materials that had been used successfully in the pilot phase and which could be used in the roll-out. While the Guide does not appear to be available on-line any longer, a summary of the Guide was included in the autumn 2000 edition of the Environmental Radon Newsletter. Key to the change in the approach was that the emphasis of the program changed from one based on testing/measurement and provision of information, to one where the greatest emphasis was on encouraging remediation.

The key points of the Guide are summarized below:

- Develop local program ideas - Before developing a program, review the characteristics of the local area and the nature of radon problem. Suggestions for types of activity and the type of resources and support that available were included in the Guide.

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42 This presents an interesting scenario, as lower socio-economic people are also more likely to smoke and are therefore at greater risk to the effects of radon. They are also less likely to be homeowners, which may mean that any campaigns need to include landlords as a target group rather than using a general population awareness approach.

• Review what has been done before – This will help establish a baseline from which to move forward, and will help those responsible learn lessons from the work that has already been carried out.

• Draw up an Action Plan – The Action Plan describes what is to be done and is the formal agreement between the local authority and the department. It sets out the activities to be pursued, the roles of the participants, the target groups of householders to be approached, the resources to be utilized, the timing of the various parts of the project, and the exit strategy how the project period will draw to a close after the agreed period of action.

• Encourage partnerships – Working in partnership, both internally and externally to the local authority, can greatly enhance the effectiveness of the program. The Guide gave advice on the partners that might be encouraged to become involved.

• Publicity and persuasion – Messages used need to be carefully constructed, delivered through the appropriate medium, and consistent in what they are saying. Advice is given on how to achieve this.

• Contact householders – The main objective of the roll-out program was to encourage householders with homes above the radon Action Level to carry out remedial action. Contacting householders at the right time, in the right way, with the right information was therefore very important. Guidance was offered which reflected the experience gained in the Pilot Studies.

• Assist in the remediation process – In addition to raising awareness, disseminating information and delivering advice about radon remediation, a local project can actively assist householders by being supportive throughout the remediation process, which will greatly increase the likelihood of the householder seeing the remediation work through to completion.

• Manage information – information will be generated which will be of lasting value to each local authority. This information can be best managed if a system is established at the outset to manage it. The Guide provided advice on how to set about doing this.

A report on the Rollout Program in South Lakeland District in the Northwest of England was included in the spring 2002 edition of the Newsletter. Of the 7259 households that were offered free radon tests, about 26% requested a test and of those, 14% were above the Action Level. Contacting all of those homes was ongoing; however they reported that the concern of homeowners regarding high radon levels was less often related to the health impact as it was to the impact on the property value. While the process of contacting people individually was time consuming, many people were taking remediation action, as a result of this intervention.

44 Environmental Radon Newsletter, Issue 30: Phil Greenup, South Lakeland District Council
An Evaluation of Strategies For Promoting Effective Radon Mitigation45:
Although this study is very dated (1990), it is still relevant in terms of understanding the perception of risk associated with radon, and suggestions for improving the effectiveness of radon programs.

The underlying reasons for lack of response to the risk of radon are reported to be as follows:
- The objective probability of the risk is below the level where people understand the risk and respond appropriately;
- There are no perceptual clues or reminders to alert people to the risk;
- The risk is natural as opposed to technological and there is no villain;
- People’s experience is benign in the sense that they have lived many years in their homes with no ill effects;
- The effect if the risk is far removed from the initial exposure – it takes years of exposure for the ill effects to happen;
- Exposure is voluntary – people choose their home with or without direct knowledge;
- The risk varies and depends on multiple factors.

A successful program requires that a homeowner:
- Buy a test kit;
- Do the test and send it in for analysis;
- Read the results and assess whether there is a problem;
- Perhaps do another test to confirm that they have a problem;
- Take remedial action; and,
- Retest.

Because the process takes so long, there is ample opportunity for the homeowner to lose interest. There are many ways suggested for improving the process at each stage, many of which are related to careful messaging, knowing the target audience, direct follow up etc. However, the report suggests that the greatest impact may be realized by presenting radon information at the time of home sale, either through a regulatory requirement, or through a program aimed at realtors, lenders and others involved in home sale transactions.

Radon Programmes and Health Marketing46:
This recent article written by two radiation experts in the Czech Republic focuses on the challenges of an effective radon program. The article supports the concept of using social marketing approaches to

achieve better outcomes in awareness programs (see Section 3.4.2 for a further discussion of social marketing).

The Czech radon program began more than 20 years ago, and there has been legislation, awareness and testing programs in place offering free measurement and subsidies for mitigation. Despite these efforts, the effectiveness of the radon program seems to be low. The article analyzes the potential causes and provides suggestions for improving outcomes:

**Barriers:** Sufficient financial resources are required to support the administration the program, surveys, and potentially for subsidizing testing and mitigation. Legislation must also support effective policy to help reduce radon levels, but first, decision makers must be convinced of the need for this legislation, through the provision of convincing evidence.

**Awareness vs. Perception:** While people may become more aware of radon, they may not perceive radon as a high risk. Factors which make radon a low risk include the fact that the situation is one which they can control, it is voluntarily taken, and of a natural origin.

To improve the effectiveness of awareness programs, there are two possible approaches:

- **Education** – of legislators, building trades, health professionals, in schools, etc. These are effective but long-term approaches;
- **Social marketing** – using health marketing techniques to get the message out and change behaviour. If properly done, they have been proven to be effective.

A social marketing approach requires that a goal must be set (e.g. homeowners of buildings with radon concentrations >1000 Bq m³ to undertake a remedy). Then, three things need to done correctly:

- WHAT to say: the content of the message should be formulated correctly; it must be short, clear, interesting, explain benefits, and have an emotional content;
- WHOM to say it to: the target groups should be defined, their attitudes recognized and preferences known;
- HOW to say it: communication channels should be specified; actual form and wording and frequency determined.

A qualitative survey has to be carried out, using in-depth interviews and focus groups with two groups of respondents—those having high radon concentration in their homes and those who are just building their own house or planning to buy or build it very soon.

Key points included:

- There is no use in targeting people living in leased housing or the elderly, as they are less likely to be interested in mitigating the danger. However, a younger target group (young people acquiring their home) often do not usually have sufficient resources to remediate the building, so some form of support is likely essential;
People are less likely to remediate a house the longer the time the person has lived in the house with high radon levels (‘... we have survived here until now, we'll continue stand it’);

People are most susceptible to health issues when they acquire a new property;

Families with children and adolescents, or young people planning a family are more susceptible to remediation messages;

In a family, women often care for the family health and men are responsible for the technical aspects of the problem and decisions concerning larger investments. The wife has the ability to considerably affect the husband’s decision. Men can be motivated by convincing them that the technical solution is functional and feasible.

Motivation can be suggested to the target groups based on their needs. For example, people with the emotional need to be a good parent can be positively motivated by the message ‘remediation of the house is the right thing you can do for your family’.

For the motivation to be successful, people must be persuaded about the harmful health effects of radon. People usually do not fully understand statistical terms; the best way to do this is use a graph showing increase of lung cancer incidence with the indoor radon concentration. Comparing the dose from radon with the dose from other sources is a very useful. Also, experts and physicians or family doctors play a very important role as an information source.

Myths about radon remediation and health effects may exist in the community. These need to be recognized and addressed directly with evidence. Many people are afraid of the technical remedy. It is necessary to assure people that the remedy can usually be finished in less than five days, usually without destroying the floors in the living space of the house.

3.4.2 Other Environmental Health Programs with Similar Challenges

There have been other health protection issues which have faced similar challenges as those facing radon testing and mitigation, in terms of awareness and changing behaviour. There are also opportunities that can be explored with other programs, in terms of raising awareness and cross-promotion. The two programs that were mentioned by those interviewed were the tobacco program and the wood burning stove program.

While each of these programs faces similar challenges to the radon issue, there are likely many other environmental programs that attempt to change behaviour, if not for personal health reasons, then for the health of the environment which ultimately affects quality of life. These other programs have not been explored but many of them may have attempted to affect behaviour through awareness campaigns and incentive programs.
Community based social marketing (CBSM) was used in the development of the wood burning stove program. The site [www.toolsofchange.com](http://www.toolsofchange.com) provides specific social marketing tools, case studies, and a planning guide for helping people take actions and adopt habits that promote health, safety and/or sustainability. The site is based on the work of Doug McKenzie-Mohr47, a Canadian environmental psychologist, and an expert in CBSM. The tools of CBSM have been used to foster sustainable behavior in many areas, including energy conservation, environmental regulation and recycling. This approach to social marketing recognizes that simply providing information is usually not sufficient to initiate behavior change. It therefore promotes the use of tools and findings from social psychology to discover the perceived barriers to behavior change and ways of overcoming these barriers.

As outlined, the development of an effective program begins with identifying barriers; a step often overlooked because many program developers believe that they already know the barriers, or lack time or funding. Despite the fact that these perceptions by program developers are speculative, they become entrenched in the program design. Identifying barriers adds to the time in implementing a program (4-6 weeks) however, delivering an ineffective program is costly both in terms of money and time. Strategies to identify barriers include focus group, observational studies, and surveys, particularly looking at people who take action and people who do not. The development of a sound strategy depends on carefully identifying way to overcome the barrier.

Several things will help bring about behavioural change:

- **Commitment** – when an individual agrees to an initial small request, the likelihood that they will subsequently engage in a more substantial activity increases dramatically;
- **Prompts** – a prompt is a visual or auditory aid to remind people to carry out an activity that they might otherwise forget;
- **Pilot and evaluate** – conducting the program on a smaller scale before it is rolled out allows time for an evaluation of the success of the program, to help refine the program.

Provincial Wood Burning Stove Program:
The provincial wood stove exchange\(^{48}\) was designed to encourage British Columbians to change out their older, smoky wood stoves for low-emission appliances including new CSA-/EPA-certified clean-burning wood stoves. The program offers a rebate on the purchase of a new appliance and provides education on reducing emission. A rebate is offered when proof is provided that an old wood-burning appliance has been recycled at a legitimate depot, and that the new appliance purchased to replace it meets CSA B415 or EPA emissions standards. The following information is taken from the website:

- A social marketing approach was used in promotions so research questions were designed to identify barriers to changing out uncertified appliances and the kind of incentives that would be needed. Focus groups and questionnaires were used to understand customers - what do they need to hear to carry out the desired action and behaviour change? Anyone involved with administration of the program was involved with continuous knowledge building and training — how many stoves to exchange, emission comparisons, what technology is out there and how does it work, how much does it really cost to change out an existing appliance?
- Partnership - Identifying the right partners and what they could contribute to the program's success was a top priority. Partnerships focused on funding for program staffing and incentives for residents, as well as supporting policy and education. Partners included:
  - B.C. Ministry of Environment
  - Hearth Products Association
  - Local governments (Building inspections, fire departments, and administration)
  - Local space heating retailers
  - Environment Canada
  - Northern Health Authority
  - Credit Unions
  - B.C. Lung Association
- Outreach approaches were varied, including radio, TV, newspaper, door knob hangers, etc. A complete list is available on the website. As well, the Coordinator’s Toolkit included templates for evaluating programs. Some ideas on what to evaluate are listed below.
  - Total number of exchanges in each year of the program (multi-year)
  - Improvement in neighbourhood air quality (multi-year)
  - Quantity and content of enquiries by caller and agency including media, local government, AMS, MOE
  - Level and method of awareness of exchange
  - Motivation for exchange
  - Quality of experience for everyone including partners and staff

The following variables were seen to play a factor in the success of the programs:

Radon Management: issues and options

- Size of rebate
- Advance notice
- Media mix
- Quality of experience for homeowner before and after new purchase
- Community goal and bylaws

Tobacco Program:
The Tobacco Program has been active for many years and is well established. It has relied on a variety of approaches to reducing the number of smokers in B.C., including social media and support services (QuitNow Services offered through the BCLA). Tobacco programs are delivered through local health authorities, and offer the opportunity to coordinate outreach activities with radon awareness programming, as is currently being done in the Northern Health Authority.

4. Discussion and Analysis

Several issues were identified through the environmental scan and interviews. Under each general heading, questions raised by the research and environmental scan are presented below, followed by a discussion.

Public education and awareness:

*How should a communication strategy be developed? How do you identify your target markets? Where do you target your efforts at education and awareness?*

Both experience in other jurisdictions and research into the effectiveness of radon public education and awareness initiatives have shown the need for a well-developed communication strategy.

The need for investing in the development of a well thought out community strategy cannot be overstated. Identifying and understanding the target markets and understanding the barriers to effecting behavioural change can make the difference between a successful and unsuccessful program. Working through a planning
process, such as the one provided through the toolsofchange.com website, will allow the program to develop messaging tailored to different communities and constituencies. Once a communications strategy has been developed, the focus can then shift to implementing the strategy, and adapting and modifying it, based on results achieved.

In addition to educating the public, research has shown the need for educating decision makers on radon, the health effects, the impact of radon on health care costs.

What does it cost to mount a public education and awareness program?

The cost of a public education and awareness program will be dependent on the timing, campaign location, chosen media, reach (GRPs49), and quality of the campaign itself. Estimates for developing the creative materials and buying air time and advertising space are based on a tobacco cessation campaign conducted by the Ministry of Health in 2005 and 2006 (costs are approximate):

- Development of campaign and creative - $150,000
- Media buys – Radio (North East/South East/Central Interior/North Interior) $40,000 per week
- Media buys – TV (Prince George, Kootenays, Okanagan) - $30,000 per week
- Print – Guerilla postings, Restobar miniboards (Vancouver/Victoria) - $20,000/month
- Printing costs – Posters - $15,000

As an example, using the costs outlined above, a social media campaign (developed for an estimated cost of $150,000) and using radio and guerilla postings for two weeks in the north and interior regions of the province would cost in the range of $100,000 to $150,000. There are other ways of getting the message out, however not as broadly based, such as public service announcements, using videos on UTube and other social media sites, NGO support, etc. Also, there may be opportunities to work with other jurisdictions on developing a campaign strategy and creative, or using existing media (such as the EPA material) and modifying it to meet various target audiences, as it is likely that the target audiences will be similar to those in the U.S.

Print material will also be required for distributing at trade shows, informational seminars, public forums etc. This could be either existing print material (such as the CMHC brochure), and/or material developed specifically as part of the campaign strategy. The cost of print material depends on the

49 A standard measure in advertising, it measures advertising impact. It is a percent of the target market reached multiplied by the exposure frequency. Thus a program which advertises to 30% of the target market and gives them 4 exposures, will have 120 GRP. Wikipedia Encyclopedia:

http://en.wikipedia.org/wiki/Audience_measurement The weights for radio for the tobacco campaign were 20 GRPs and for TV 150-200 GRPs in these regions/week.
materials used, colours, and volumes. The tobacco campaign budgeted $15,000 for print distribution, outside of the print required for the guerilla/Restobar postings.

**Focus of program management:**

*What geographical areas should the program focus on – areas of highest radon concentrations, or a broad provincial-wide focus?*

In June, 2011 the BCCDC released a report summarizing the results of their analysis on residential radon sampling data gathered in previous years. The purpose was to assess the regional likelihood of concentrations exceeding Canadian health safety guidelines (200 Bq/m³). Results suggested that some regions are at very low risk of radon exposures exceeding the Health Canada guideline. The conclusion reached was as follows:

“Based on results from the BCCDC data, we recommend that communities in the Intermontane, Omenica and Foreland tectonic plates should be prioritized for radon screening and mitigation. The BCCDC data also suggest that Greater Vancouver and Greater Victoria could safely be exempted from any new building code requirements pertaining to soil gas intrusion.”  

This question was also asked of the interviewees and most supported focusing on areas where the radon levels were higher, as opposed to a broadly based provincial program. However, the suggestion was made that at a provincial level, basic information on radon and related risks should be readily available to all residents, regardless of their location, in case those residents want to find out more about radon and the associated risks, to allow them to make the decision on whether to test their home. This information could be provided through health authority websites, to the degree appropriate for the particular region (for example, VIHA could provide basic information and the level of risk for the area (low), while NHA would likely provide more information, including programming specific to the region). This addresses to some degree the messaging from Health Canada, which stresses that the only way to know is to test.

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50 Residential radon in British Columbia and its regional likelihood of exceeding the Health Canada safety standard; British Columbia Centre for Disease Control, June 2011

51 The Intermontane, Omenica and Foreland tectonic plates in BC lie east of the Insular and Coastal tectonic belts.
Based on the recommendations of the BCCDC and interviewees, the logical focus of a more intensive program would be in those communities located in the interior and northern regions of the province, and would exclude communities in Vancouver and the lower mainland, Victoria and Vancouver Island, coastal communities (such as the Queen Charlottes, Squamish, Whistler, Pemberton), and possibly some northwest and southwest communities (such as Terrace, Stewart, Kamloops and Creston).

What should be the program focus from a program management perspective?

This question was asked of interviewees from the perspective of whether a radon program should focus on privately owned homes, workplaces, or publicly owned buildings such as schools, hospitals, workplaces, etc., or privately owned homes. Most agreed that there needed to be a focus on both privately owned homes, and publicly owned facilities. Most provinces to date have focused their attention on publicly owned buildings, presumably because of the exposure of governments in this regard.

Testing:

Should testing be subsidized and what are the costs?

Although testing is not expensive for individual homeowners, it is still difficult to encourage individuals to pay for the test, when they don’t perceive a real or immediate threat.

Other jurisdictions and NGOs have offered either free test kits or kits at a reduced price. When the BCLA offered free test kits to their direct mail contacts, the response was immediate. The NHA has offered subsidized test kits, with good results. Test kits can be purchased through retail outlets (e.g. Canadian Tire, Home Hardware, etc.), however they are difficult to find, as many stores do not want to stock a slow moving item. The added disadvantage of directing homeowners to department stores is that the stores will often offer the short-term kits which are less expensive than the long-term kits, and which are not recommended by Health Canada.

One of the findings from the work by Doug McKenzie-Mohr (see 3.4.2) is that a commitment on the part of the individual increases the likelihood of ongoing engagement or further action. This is particularly important with radon testing, because the homeowner not only needs to place the radon test kit in specific locations as per the directions, but they also need to remember to send the kits in for analysis after a certain period.

Cost of test kits are around $30 in the U.S. (which includes shipping and analysis fees). In Canada, there were three sources for radon test kits found through an internet search - Radiation Safety Institute of Canada, Radon Detect and Radon Atlantic. Both the Institute and Radon Atlantic use the E-Perm system, while Radon Detect offers the E-Perm for short-term testing and the Accustar for long term.

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testing. The E-Perm test kit from the Institute is $60 (no price is listed for Radon Atlantic), and the Accustar kit from Radon Detect is around $30 (all include shipping and analysis). Both BCLA and NHA reported that they had been able to do a bulk purchase and receive a discounted price for the kits.

What test kits are the best ones to use?

In terms of quality of the test kit, there does not appear to be a certification process for test kits. There are multiple types of testing devices, and there are certified testers available in Canada to conduct the testing for homeowners. For do-it-yourself testing (as promoted by radon programs) there are generally two types of detectors – the alpha track detector and the electret ion chamber. Radon Detect also provides a digital readout type detector (Safety Siren Pro 3 radon).

A Consumers Report on radon test kits in 2009 recommended the Accustar Alpha Track for a long-term kit, based on accuracy and reliability. The report included ratings on short-term kits as well (not shown below). Short-term kits were reported as unreliable, some off by as much as 40%.

<table>
<thead>
<tr>
<th>Brand &amp; model</th>
<th>Price</th>
<th>Overall score</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LONG-TERM KITS</strong> Typically exposed for 90 days or more before lab analysis.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accustar Alpha Track Test Kit AT 100 CR Best Buy</td>
<td>$28</td>
<td>79</td>
<td>Poor</td>
</tr>
<tr>
<td>RSSI Alpha Track Long Term Radon Test AT-101</td>
<td>25</td>
<td>71</td>
<td>Poor</td>
</tr>
<tr>
<td>Pro-Lab Long-Term Radon Gas Test Kit RL116</td>
<td>40</td>
<td>70</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>DIGITAL-READOUT METER</strong> Usable as short- or long-term for real-time results.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Siren Pro Series 3</td>
<td>120</td>
<td>52</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

Source: Consumers Report Health.org

Both the BCLA and NHA purchased bulk supplies of radon detectors from U.S. sources (Accustar test kit, and the Landauer (RadTrack) kit). Interviewees reported some problems with mailing test kits across the border, experiencing delays which could potentially impact the accuracy of the results of the test, therefore purchasing from a Canadian source would be advisable.

Opinions of interviewees varied on whether short-term detectors or long-term detectors should be used. Research suggests that short-term tests produce more unreliable results, partly because the short time that the detectors are in the house. However, the choice of detector used may impact the

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53 Certified by NEHA/NRSB programs in the U.S. Canada does not have a certification program, although HC provides a link to the NEHA/NRSB site, which lists people certified for testing and mitigation in Canada.

accuracy of the results. There may also be circumstances where a short-term test is useful, such as in real estate transactions, or where high readings are anticipated and an early indicator may be warranted.

**Mitigation and prevention:**

*What are the challenges with respect to mitigation?*

While people may be willing to test for radon in their homes, mitigation is often the stumbling block.

In B.C., there are only two certified migration experts (both reside in the interior and only one is in the construction business). Certification by building contractors for radon mitigation is not seen as a priority by home builders/construction personnel. Health Canada is, however, currently preparing a mitigation guide, which may to some extent address the lack of expertise by builders.

In addition to the lack of expertise, homeowners are concerned that the cost of mitigation will be too high. While that possibility exists, the literature suggests that costs are generally under $5,000 for a home. Messaging must be clear on this point, and adapted to the audience to encourage action. In Britain, the radon program focused on encouraging remediation. With those homes above the action level, homeowners were contacted and provided information, guidance and ongoing assistance throughout the remediation process.

The issue of mitigation comes to the forefront in real estate transactions. Homeowners may be reluctant to test for radon to avoid knowing that a potential hazard exists, something that if known to them may (morally or legally) be required as part of the real estate disclosure statement. In the U.S., there aren’t any states that require disclosure of radon risk, however in some states, a seller must disclose information *if aware* of unsafe concentrations of radon. It is becoming more common in the U.S. for mortgage companies and real estate agencies to raise the issue of radon testing. In Britain, people can ask for a radon report on any property. The report will provide the estimated probability of a particular address being above the action level for remediation. These reports are becoming a standard legal enquiry on house purchases in both England and Wales. The evaluation done in the U.S. in 1990 of strategies for promoting radon mitigation (see 3.4.1) suggested that the greatest impact of any radon mitigating strategy was likely to be realized by presenting radon information at the time of home sales, either through a regulatory change, or through programs that targeted realtors, lenders and others involved in the sale of a home.

Tenants do not have any protection against high levels of radon, either in Canada or in the U.S. Switzerland and Sweden were the only countries in the environmental scan that provided protection

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55 Some researchers suggest that marketing campaigns exclude those that are either unlikely to take remedial action (e.g. the elderly), or those that are not owners of the property (see 3.4.1).
for tenants by giving tenants the legal right to demand remediation or requiring a declaration by the owner.

Many interviewees commented on the need for the province to test and mitigate for publicly owned or regulated buildings (such as daycares), as Health Canada is doing for federal buildings.

*Is prevention through radon-resistant construction the better way forward?*

The requirement for radon-resistant construction has been slow to be implemented, although changes are being made in some areas, both in Canada and the U.S. The National Building Code was modified recently, and the B.C. building code will likely address the issue for high risk areas. Opinions of interviewees varied on whether it was more important to focus efforts on addressing existing construction or on existing buildings; regardless, radon-resistant construction was seen as a strategy.
**Administration and Partners:**

*What administration model is most effective?*

The administration model developed for a provincial program will depend on the strategy of a provincial radon management program.

There already exists a Radon Inter-Government Information and Liaison Group, chaired by the BCCDC (which also provides administrative support to the group). This group provides a forum for information sharing and discussion on radon management issues. If the province wants to pursue a provincial strategy, a Ministry led initiative would be better suited, in that the Ministry is responsible for provincial health policy and has better access to decision makers and funding.

The results of a study completed recently by Cardiff University on the radon program in Britain revealed the importance of working with local authorities (see 3.4.1). A local authority was best suited from at least two perspectives. Not only were they able to better adapt a program to local needs, but people were more inclined to approach local authorities for advice and there was better action taken on remediation. Interviewees generally supported the idea of a provincially led radon program, implemented through health authorities and in conjunction with partners such as the BCLA.

*What partners might be good partners in a radon management program? What should their role be?*

Identifying the right partners and what they could contribute to the program’s success was a top priority for the wood burning stove program. This experience is supported by other jurisdictions and by the WHO Report. As part of the development of a radon management strategy, identification of potential partners would be a priority.

The BCCDC has been a key partner with the province in the analysis of existing data and mapping of radon prone areas in B.C. Other partners may be needed, depending on the specific strategy. For example, for a public awareness strategy, the BCLA and B.C. Cancer Society have partnered with Health Canada and WorkSafe BC on radon public awareness campaigns in the past and have indicated their interest in working with the province on this issue. These organizations are natural allies in that their interests in air quality and cancer prevention are aligned with the purpose of increasing public awareness of radon. Opportunities may exist for partnering with other associations in the area of public awareness. As an example, Preventable.ca, a B.C. non-profit organization, promotes messages with a public safety focus. While their efforts have been on injury prevention, they may be open to expanding their focus.

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56 A registered BC non-profit organization, governed by a board of directors representing organizations including the BCAA Road Safety Foundation, Insurance Bureau of Canada, London Drugs, Ministry of Labour, Pacific Blue Cross, TELUS and WorkSafe BC, with financial and in-kind support of over 30 other companies and organizations. The organization uses a positive approach to prevention, empowering people to make positive choices.
The identification of partnerships will be an important part in the development of a provincial strategy. Other potential partners might include the building industry, insurance industry, trade schools, real estate industry, green industry, etc.

5. **Options and Recommendations**

An effective provincial radon program will be dependent on the ability of the province to develop a broadly-defined and comprehensive strategy. Providing public information on radon gas and potential remediation options are important first steps. However, research has shown that increased awareness of radon as a health issue does not necessarily translate into mitigation action. Additional and complimentary initiatives are required to achieve significant mitigation action.

Research has shown the benefit of providing direct support and subsidies to homeowners to take the necessary steps in mitigating the level of radon entering their home. Therefore the education strategy should also place emphasis on fostering capacity with the building industry on remediation options and techniques. Where testing indicates high levels of radon gas, building owners will need information on remediation techniques and will need to work closely with the building industry for solutions and best options.

The scope of a comprehensive strategy and the specific activities undertaken will depend on funding and could include the following components:

- Public education and awareness campaigns (including test kit distribution);
- Targeted testing and mapping of private homes located in high risk areas
  - Test kit subsidies;
- Testing and remediation in government buildings located in high risk areas;
- Support for building remediation through capacity building;
  - Work with building industry to raise awareness and develop skills in radon remediation;
  - Cost-shared remediation subsidies; and
- Other activities/strategies support, e.g., research grants.
6. Appendices

### 6.1 Interviewees

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name/Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC Ministry of Health</td>
<td>Rupert Benzon (Manager Land Use Innovation, Health Protection Branch)</td>
</tr>
<tr>
<td>BC Ministry of Environment</td>
<td>Glen Okrainetz (Manager, Air Protection, Environmental Standards Branch)</td>
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<tr>
<td>BC Centre for Disease Control</td>
<td>Dr. Tom Kosatsky (Director of Environmental Health Services, and Scientific Director, National Collaborating Centre for Environmental Health)</td>
</tr>
<tr>
<td>Canadian Cancer Society</td>
<td>Kathryn Seely (Public Issues Manager)</td>
</tr>
<tr>
<td>BC Lung Association</td>
<td>Dr. Menn Biagtan (Program Manager)</td>
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<tr>
<td>Northern Health Authority</td>
<td>Barb Oke (Healthy Community Environments Lead)</td>
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<td></td>
<td>Kim Menounos (Healthy Community Environments Lead)</td>
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<tr>
<td>Interior Health Authority</td>
<td>Greg Baytalan (Air Quality Specialist)</td>
</tr>
<tr>
<td>Health Canada</td>
<td>Winnie Cheng (Regional Radiation Specialist, Environmental Health Programs, British Columbia Region)</td>
</tr>
<tr>
<td></td>
<td>Marsha MacDonald (HC Federal Radon Program)</td>
</tr>
<tr>
<td>Canada Mortgage and Housing Corporation (CMHC)</td>
<td>Allan Dobie (Sr. Consultant, Information Transfer and Research)</td>
</tr>
</tbody>
</table>
Implementation Strategy 2.2.2
Implementation Strategy for Indoor Air Quality

Create a database of indoor radon concentrations, map areas of high radon potential in Canada, test for radon in federal buildings in high-risk, radon-prone areas. The strategy includes a radon awareness program. (Health Canada)

Description of Implementation Strategy

The implementation strategy is comprised of three primary components:

1. Development of a radon potential map of Canada: using geology, aerial surveys and fieldwork to identify levels of natural radiation in targeted areas, the Department will map areas of high radon potential in Canada. This component is expected to lead to increased knowledge of risks, health impacts and mitigation strategies related to radon.

2. Testing of radon in federal buildings located in high risk radon-prone areas: by testing for radon in approximately 10,000 federal sites located in known and/or potentially high-risk radon areas, it is expected there will be increased knowledge of risks, health impacts and mitigation strategies related to radon.

3. Radon education and awareness program: through the design, implementation and coordination of a broad-based public awareness and education campaign, the Department aims to improve public awareness of health risks and causes of elevated radon, and inform Canadians of strategies to reduce their risk. The Health Canada radon awareness program focuses on raising awareness of radon and the potential health risks from exposure, as well as encouraging Canadians to test their homes and to reduce radon levels, if necessary.

In addition, a database of indoor radon concentrations will be developed and will be updated as new information is acquired from residential surveys, radon measurement service providers and members of the public. This information is important to perform validation of models used to produce a radon potential map.

Relationship between the Implementation Strategy and the FSDS Target

This implementation strategy relates to Theme 1 Target 2.2 Indoor Air Quality.

The Department will create a database of indoor radon concentrations, map areas of high radon potential in Canada, and test for radon in federal buildings within high-risk, radon-prone areas. By assessing indoor air pollutants, including radon and other pollutants, there will be increased knowledge of risks, health impacts and mitigation strategies related to indoor air quality. As part of this strategy, the Department will also carry out a radon awareness program, which aims to improve public awareness of health risks and causes of elevated radon, and inform Canadians of strategies to improve it.

This departmental strategy will lead to increased use of knowledge by government to develop regulations, guidelines and recommendations, and increase the use of knowledge by the public to reduce health risks associated with radon and other pollutants.

Over time, these outcomes will indirectly contribute to reducing the adverse effects of poor indoor air on the health of Canadians.
Radon Management: issues and options

Link to Health Canada’s Program Activity Architecture and Outline of Non-Financial Performance Expectations

<table>
<thead>
<tr>
<th>Strategic Outcome 2: Canadians are informed of and protected from health risks associated with food, products, substances and environments, and are informed of the benefits of healthy eating.</th>
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</thead>
<tbody>
<tr>
<td>Program Activity 2.6: Radiation Protection</td>
</tr>
<tr>
<td>Program Sub Activity 2.6.1: Environmental Radiation Monitoring and Protection</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance Indicators</th>
<th>Targets</th>
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<tbody>
<tr>
<td>Number of federal buildings tested for radon by 2011-2012.</td>
<td>2,000 federal buildings.</td>
</tr>
<tr>
<td>Number of hits on Health Canada radon web page;</td>
<td>10% increase in hits and downloads over each previous year.</td>
</tr>
<tr>
<td>Number of downloads of <em>Radon: A Guide for Canadian Homeowners</em>;</td>
<td>Date to achieve target: Ongoing (data to be assessed on an annual basis).</td>
</tr>
<tr>
<td>Number of public inquiries;</td>
<td></td>
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<tr>
<td>Number of brochures and fact sheets ordered.</td>
<td></td>
</tr>
<tr>
<td>Percent of data inputted into database.</td>
<td>100% of data received inputted by end of fiscal year.</td>
</tr>
<tr>
<td>Number of field soil measurement projects completed in major population centres in 2011–2012;</td>
<td>One field soil measurement project completed in three communities in British Columbia.</td>
</tr>
<tr>
<td>Number of documents completed on mapping radon potential areas;</td>
<td>Validated map of southern Ontario completed by 2011–2012.</td>
</tr>
<tr>
<td>Number of provinces mapped for radon potential.</td>
<td>Protocol for mapping radon potential using numerous data parameters and process for validation completed by 2011–2012.</td>
</tr>
</tbody>
</table>
6.3 Excerpt from U.S. Federal Government Planned Actions to Reduce Radon

FEDERAL GOVERNMENT ACTIONS TO REDUCE RADON RISK

- EPA, HUD, USDA, and HHS will collaborate on an interagency radon outreach initiative that builds on existing campaigns addressing home-based risks and/or healthy homes.
- DOE will develop a communications campaign to educate all personnel – living on and off base – about the health risks associated with radon exposure and solutions to address these risks.
- HUD will incorporate radon testing and mitigation into all agency programs as possible to include public and other assisted housing.
- HUD will prepare a plan within the next 18 months to collect radon test results as part of its ongoing inspection protocol of public and assisted housing as the first step in conducting a baseline study of its housing stock.
- HHS will include radon in healthy homes activities (CDC National Center for Environmental Health).
- HHS will work to increase radon awareness among states participating in the National Comprehensive Cancer Control Program (CDC Division of Cancer Prevention and Control).
- HHS and EPA will explore including radon in environmental health tracking (CDC National Center for Environmental Health).
- HHS will update the current Topological Profile for Radon (Agency for Toxic Substances and Disease Registry).
- DOE and HUD will promote radon awareness through their weatherization and healthy homes outreach.
- DOE will send a message on the hazards of radon to its approximately 70,000 employees.

- DOE’s Power Save Loan Program will make radon mitigation an explicitly eligible/allowable expense within the 25% non-energy related set-asides.
- USDA will develop working agreements with nonprofits that can assist 501 home repair grantees and loan recipients in funding mitigation efforts wherever radon is found at or above the EPA 4 pCi/L action level.
- USDA will educate Rural Housing Guarantee Program lenders and State Housing Finance Authorities about radon risks and encourage the testing of existing homes in Zones 1 (high) and 2 (medium) areas.
- USDA will leverage financing through renovation/repair programs and essential community programs to test and mitigate radon in schools and daycare facilities.
- VA will promote radon testing and mitigation through a comprehensive disclosure of the radon health risk to borrowers.
- VA will expand providing a radon mitigation cost set-aside through its Home Loan Guarantee program.
- EPA, HUD, and USDA will engage the philanthropic community to support radon risk reduction in the context of their support for local healthy homes programs.
- EPA and Treasury will work together to facilitate the deductibility of radon testing/mitigation costs within Health Spending Accounts.

- DOE will review and update, as appropriate, the Unified Facility Criteria to reflect current standards for radon measurement, mitigation, and radon-resistant new construction for low rise buildings (e.g., multifamily, schools, daycare facilities).
- DOE will identify the universe of low rise buildings in high radon potential areas (Zone 1) and, for those buildings not previously addressed, develop a testing and mitigation plan for those at or above the EPA 4 pCi/L action level.
- EPA will invest in new standards of practice for school measurement and mitigation, multifamily mitigation, and quality assurance.
- DOE will finish the radon study as part of the National Evaluation to determine whether the Weatherization Assistance Program (WAP) impacts radon levels in homes.
- DOE will test various remediation protocols to determine what level of effort is required when radon is discovered in a home at the level required after WAP services are delivered.
- DOE will add a healthy homes curriculum to WAP training requirements that includes radon identification and remediation protocols.
- DOE will include training, described above, as part of DOE’s routine health and safety training such that every worker in the WAP network will be trained over the next 2 years.
- HUD’s Healthy Homes Production Program grantees will check for sources of radon, such as from radon, as required by HUD’s Healthy Homes Building Tool. Mitigation is required for high radon levels.
- USDA will collaborate with the Cooperative Extension Service (CES) to focus their testing efforts on new and existing Rural Housing financed properties.
- USDA will educate multifamily housing developers about radon risks and what construction mitigation strategies can be used when radon is found.
- USDA will promote radon testing and mitigation through Rural Development Housing and Community Facilities Programs.
- DOI, through the National Park Service, will test approximately 5,000 residential units for radon.
- DOI, through the Bureau of Indian Affairs, will test approximately 3,500 residential units and 500 schools, and will work with tribes to increase awareness of the radon risk.
- GSA will explore testing for radon and mitigating high levels in childcare facilities through the Federal Real Property Program.
- GSA will promote professional radon services to federal tenants.

**APPENDIX 1: OVERVIEW OF CURRENT FEDERAL ACTION ON RADON**

<table>
<thead>
<tr>
<th>AGENCY</th>
<th>CURRENT ACTION ON RADON</th>
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| U.S. Department of Agriculture (USDA) | - USDA partnered with EPA on the Healthy Indoor Air for America’s Homes program in the mid 1990s, a national initiative through Cooperative Extension Systems to assist states with the measurement and mitigation of radon.  
- USDA developed radon guidance for federal land managers, specifically “Rehabilitating Affordable Rural Housing” and “A Guide for Financing Radon Mitigation to Reduce Exposure in Existing Housing.”  
- USDA supported public outreach on radon through education programs, public newsletters, promotion of the Radon Poster Contest, and National Radon Awareness Week. |
| U.S. Department of Defense (DOD) | - DOD currently has an active program to test housing stock, and to mitigate if levels are found to be at or above the EPA radon action level of 4 pCi/L.  
- The DOD Unified Facilities Guide Specifications address radon testing and mitigation. Radon testing and mitigation are also incorporated into three sets of active DOD building criteria. |
| U.S. Department of Energy (DOE) | - DOE is conducting a field study on the link between weatherization and radon levels in homes through the Weatherization Assistance Program.  
- The Weatherization Assistance Program’s new Program Guidance permits Weatherization crews to test for radon.  
- Radon measures are addressed in DOE’s “Workforce Guidelines for Home Energy Upgrades,” released through Vice President Biden’s “Recovery Through Retrofit” Initiative. |
| U.S. Department of Health and Human Services (HHS) | - The Centers for Disease Control and Prevention (CDC) has co-authored every version of the Citizen’s Guide to Radon with EPA.  
- The National Institutes of Health (NIH) have conducted research on radon, including occupational and residential research on the health effects of indoor radon, and an updated analysis of radon exposure data from miners.  
- NIH contributed to the National Academy of Sciences’ Biological Effects of Ionizing Radiation, Reports IV and VI (BEIR IV, BEIR VII), and participated in the North American Residential Radon pooling study.  
- NIH gave testimony on radon health risk to the President’s Cancer Panel.  
- The Office of the Surgeon General (OSG) issued a “National Health Advisory on Radon” in 2005, and included radon in its 2009 “Call to Action to Promote Healthy Homes.”  
- OSG has coordinated with EPA on public service announcements highlighting the Surgeon General’s 2005 advisory. |
| U.S. Department of Housing and Urban Development (HUD) | - HUD incorporated radon into its healthy homes strategic plan, Leading Our Nation to Healthier Homes. The HUD Office of Healthy Homes is seeking increased collaboration with other HUD offices that oversee housing assistance and mortgage programs to promote radon testing and mitigation.  
- A Radon and Mold Release Agreement (HUD-9548-E) is required in all sales contracts for HUD-acquired single family properties.  
- A HUD form discussing radon and home inspections (HUD-92564-CN) is required to be provided by mortgagees to prospective homebuyers at first contact for all new transactions involving single family FHA mortgage insurance on existing property.  
- The HUD Section 203(k) mortgage financing program is HUD’s primary tool for rehabilitating and improving single family homes. The program allows home buyers to finance the purchase and repair or improvement of a home using a single mortgage loan. Reducing radon levels in a home is an improvement that can be financed through the Section 203(k) program. |
| U.S. Department of Interior (DOI) | - The U.S. Fish and Wildlife Service has a radon policy for measurement and mitigation for radon exposure in owned or leased buildings and non-public water sources.  
- The U.S. Fish and Wildlife Service has a Hazard Communication Program which provides a framework for providing health and safety information and training for special emphasis programs, including radon. |
| U.S. Department of Veterans Affairs (VA) | - The VA Home Loan Guaranty program tends to be guided by HUD policy on radon testing and mitigation.  
- VA is reviewing its real estate valuation/appraisal procedures to account for radon. |
### Radon Management: issues and options

<table>
<thead>
<tr>
<th>AGENCY</th>
<th>CURRENT ACTION ON RADON</th>
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<tbody>
<tr>
<td>U.S. Environmental Protection Agency (EPA)</td>
<td>• EPA provides the scientific foundation on radon, and facilitates the development of technical guidance, protocols and standards needed for risk reduction.</td>
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<td>• EPA provides $8 million in radon grants to states and tribes each year to fund state-wide radon risk reduction programs.</td>
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<td>• EPA supports outreach and education campaigns, as well as partnerships with states, tribes, NGOs and the radon services industry.</td>
</tr>
<tr>
<td>U.S. General Services Administration (GSA)</td>
<td>• GSA conducts radon testing in all of its leased and newly-owned buildings. If levels are found to be at or above the EPA radon action level of 4 pCi/L during testing, the property must be mitigated and retested following the mitigation.</td>
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<td>• Radon services are included in two GSA Schedules.</td>
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