## Table 5
## Weighting Factors*
(See Clause 6.3.2.)

| Petrographic features | Multiplying factor |
|---|---|
| 1. Coarse aggregate with cracks | 0.25 |
| 2. Coarse aggregate with cracks and gel | 2 |
| 3. Coarse aggregate debonded | 3 |
| 4. Reaction rims around aggregates | 0.5 |
| 5. Cement paste with cracks | 2 |
| 6. Cement paste with cracks and gel | 4 |
| 7. Air voids with gel | 0.5 |

**These factors are applied to the total number of each type of defect to modify the raw numbers and consequently to reflect the probable impact of that defect on the deterioration of the concrete.*

## Table 6
## Typical Case Histories of AAR Expansion for Dams
(See Clause 7.2.5.)

| Location | Coarse aggregate | Time in years to cessation of reaction | Microstrain/year* | Ref.† |
|---|---|---|---|---|
| Kariba — Zambia | Gneiss | >35 | 0–20 | (1) |
| Saunders — Canada | Limestone | >27 | 20–41 | (2) |
| Churchill — S. Africa | Quartzite | 38 | 35–65 | (3) |
| Stewart Mtn. — USA | — | 38 | 66 | (1) |
| Gene Washington — USA | — | 30 | 66 | (1) |
| Beauharnois — Canada | Sandstone | >60 | 25–77 | (4) |
| Chambon — France | Gneiss | >58 | 10–80 | (1) |
| Mactaquac — Canada | Greywacke | >26 | 22–100 | (1) |
| Moxoto — Brazil | Granites | >20 | 27–105 | (1) |
| Copper Basin — USA | — | 20 | 130 | (1) |
| Friant — USA | Andesite | >50 | — | (1) |
| Maury — France | Granite | 33 | — | (1) |
| Fontana — USA | Greywacke | >43 | — | (1) |

**Maximum in situ strains: generally, lower strains occur in direction of maximum restraint and higher strains in direction of least restraint. Note that strains may not be linear over the entire expansion period and are dependent on restraint conditions. Ages of five dams suffering from AAR that were replaced ranged from 29 years to 64 years and averaged 46 years.*

*†References*

*(1) Canadian Electrical Association 1992;*
*(2) Danay 1994;*
*(3) Oberholster 1989; and*
*(4) Durand 1996.*

**Note:** *When ">" appears above, it indicates that the reaction has not stopped at this age.*

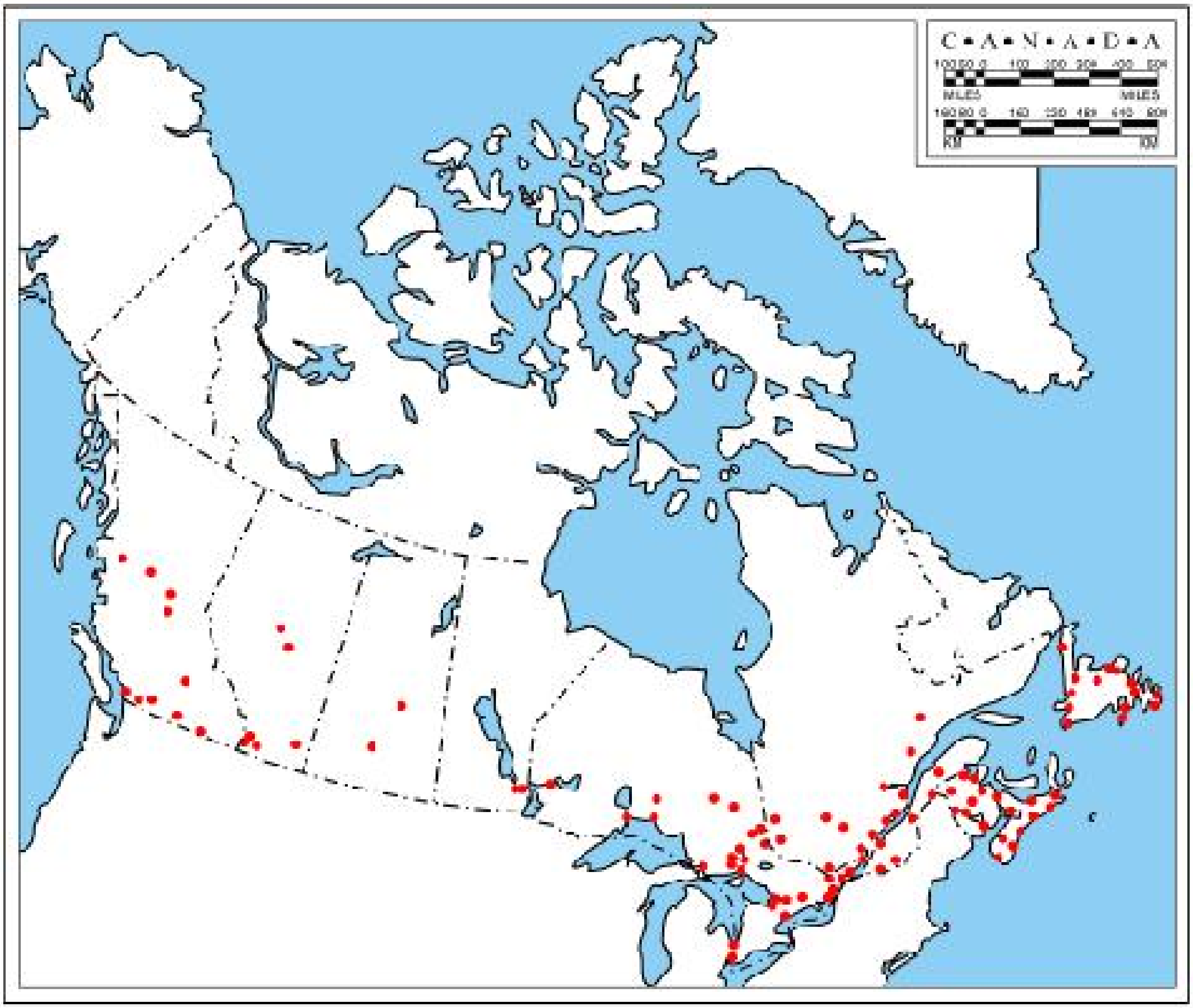



**Figure 1**
**Locations in Canada of Structures Affected by AAR**
(See Clause 3.5.)

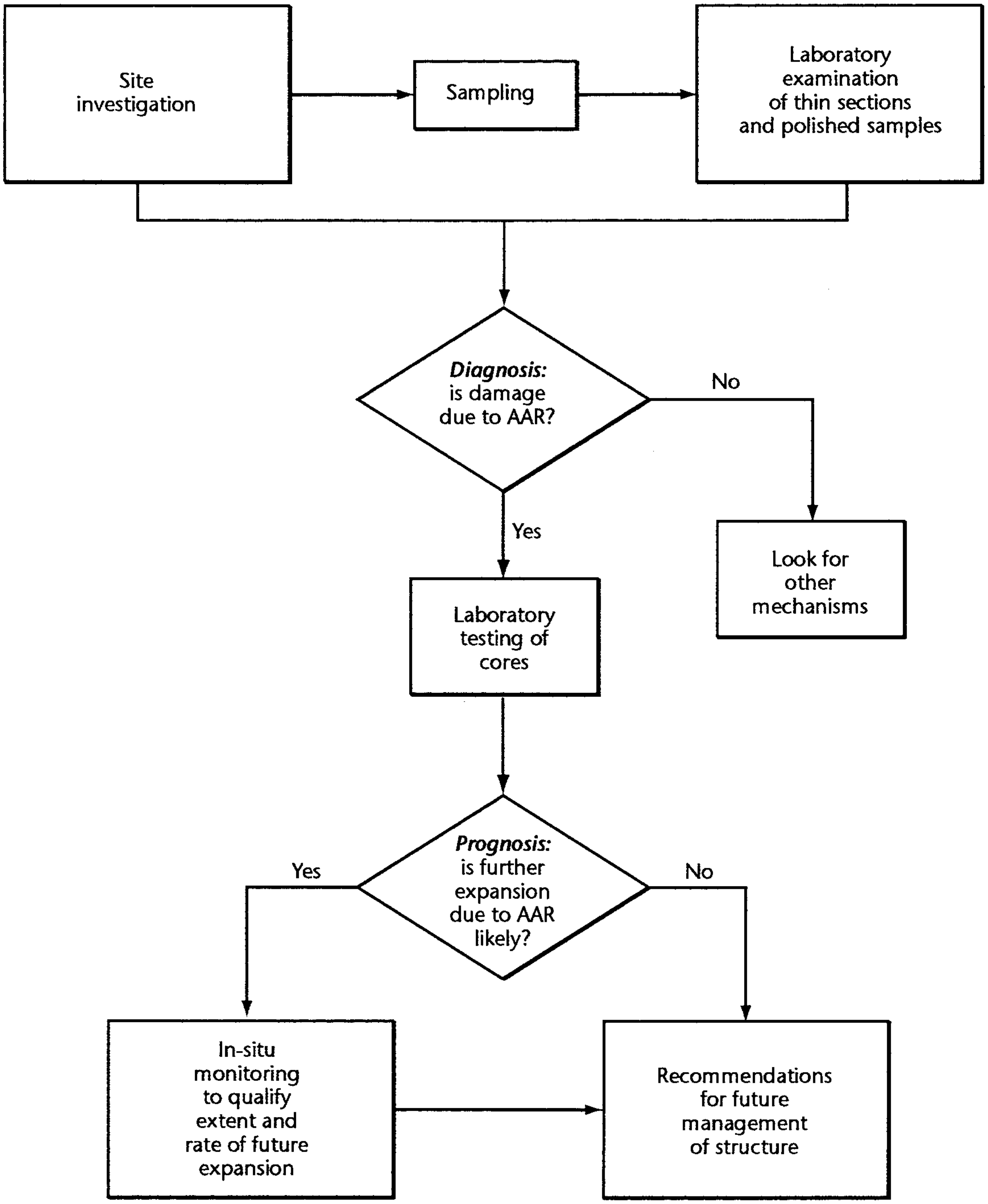



**Figure 2**
**General Procedures for Diagnosis of AAR in Structures**
(See Clauses 3.6, 5.1, and 5.2.)


**(a)** Severe cracking and spalling of concrete due to AAR in a 20-year-old median highway barrier; freeze-thaw action has greatly influenced the extent of deterioration.


**(b)** Map-cracking due to AAR affecting the parapet wall of a 25-year-old highway bridge (a). Cracks show typical staining giving the appearance of permanent dampness (b).

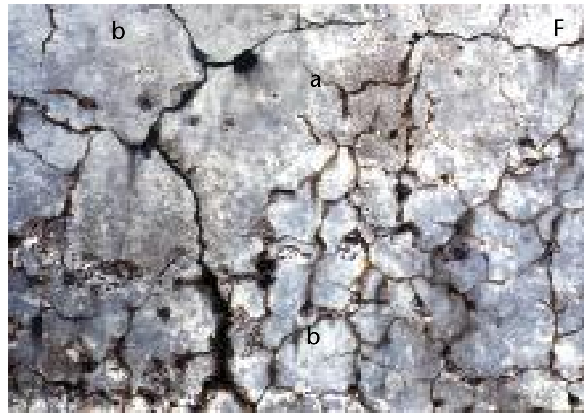

**(c)** Regular cracking pattern influenced by the presence of reinforcement in the massive concrete foundation of columns of a 25-year-old highway bridge affected by AAR (a). Cracking due to AAR accelerates deleterious processes such as corrosion of reinforcing bars (b). Gel exudations and efflorescence can also be observed (c).


**(d)** Longitudinal cracking following the stress fields in reinforced concrete column of a 25-year-old highway bridge affected by AAR.

**Figure 3**
**Cracking**

(See Clauses 4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.2.6, 4.3.3, 4.3.5, 5.5.3, and 5.5.4.)

**(e)** Exudations of alkali-silica gel at the surface of a concrete foundation adjacent to a 25-year-old highway bridge.




**(f)** Map-cracking (a) due to AAR. Frost-susceptible argillaceous limestone particles have caused popouts in the concrete surface (b).

**Figure 3 (Concluded)**


**(a)** Relative movements between pier blocks of a 15-year-old concrete dam affected by AAR; ASR cracking is also observed.


**(b)** Relative movement between a pier block shows cracks due to ASR (a) and the adjacent deck slab of the above dam causing spalling of concrete (b) and extrusion of sealing material along the joint (c).


**(c)** Relative movement of a concrete pier caused by the expansive forces generated by the adjacent retaining wall (on the left).


**(d)** Overview of a small concrete structure incorporating a sluice-gate.

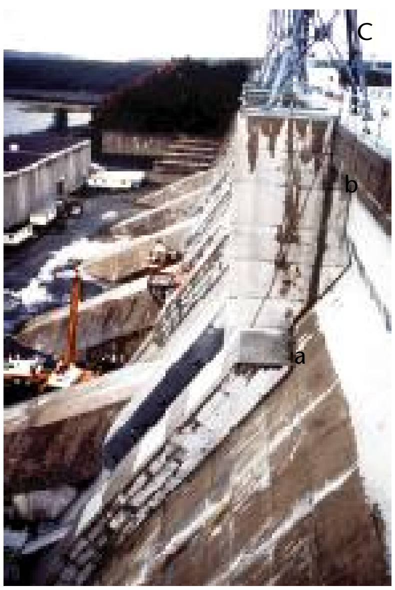
**Figure 4**
**Signs of Expansion Causing Deformations and Operating Problems**
(See Clauses 4.3.2.1, 5.5.3, and 5.5.4.)


**(e)** Expansion and cracking due to AAR in a wing wall of the above structure, causing problems in operating the sluice-gate.

**Figure 4 (Concluded)**

**(a)** Seepage of reservoir water along horizontal cracks and construction joints and associated leaching in a 50-year-old concrete dam affected by AAR.

**(b)** Severe horizontal cracking in the spillway of a 15-year-old concrete dam affected by AAR.




**(c)** Cracking on the downstream face (a) and in the upper part of a pier pedestal (b) of a 25-year-old dam affected by AAR.

**(d)** Pattern-cracking on the top of a pier block of the dam shown in Figure 5(c).

**Figure 5**
**Cracking and Other Symptoms in Various Parts of the Structure**
(See Clauses 4.3.2.2, 5.5.3, and 5.5.4.)


**(e)** Map-cracking (a) and associated leaching (b) in a 25-year-old transformer concrete foundation affected by AAR.


**(f)** Map-cracking (a) and gel exudation (b) in a 20-year-old electricity tower concrete foundation.


**(g)** Expansion of the concrete has caused shearing of steel bolts (c).

**Figure 5 (Concluded)**