MANAGED RETREAT AS A CLIMATE ADAPTATION STRATEGY IN ATLANTIC CANADA: LEGAL, SOCIO-ECONOMIC, AND ENGINEERING PERSPECTIVES ON COASTAL DISPLACEMENT

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ABSTRACT

Atlantic Canada faces a unique existential threat driven by the convergence of eustatic sea-level rise and regional isostatic subsidence. As traditional "hard" engineering defenses become increasingly untenable due to the "end-effect" and prohibitive maintenance costs, managed retreat—the strategic relocation of people and infrastructure—emerges as a necessary, albeit controversial, adaptation tool. This article examines the geomorphological drivers of shoreline recession using the Bruun Rule, evaluates the engineering paradox of "coastal squeeze," and analyzes the legal and socio-cultural barriers to relocation. By investigating current Canadian buyout policies and the deep-seated "sense of place" within maritime communities, the paper argues for a transition from reactive disaster management to proactive, land-use-based resilience.

1. Introduction: The Physical Reality of Coastal Squeeze

In Atlantic Canada, the conversation around climate change is no longer speculative; it is grounded in the accelerating loss of land. The region’s coastline is uniquely vulnerable due to a geological phenomenon known as **Post-Glacial Isostatic Rebound**. While the northern reaches of Canada are rising as the earth’s crust recovers from the weight of Pleistocene ice sheets, the periphery—including Nova Scotia, Prince Edward Island, and parts of New Brunswick—is experiencing "isostatic subsidence." This downward crustal movement compounds global sea-level rise (SLR), leading to relative sea-level rise rates that significantly exceed the global average.

This geophysical trend creates a "coastal squeeze." On one side, rising waters and intensified storm surges (such as post-tropical cyclones Fiona and Dorian) push the shoreline inland. On the other, human-built infrastructure—highways, homes, and historic town centers—acts as a rigid barrier. The natural landward migration of salt marshes and beaches is blocked, leading to the eventual drowning of these critical ecosystems. "Holding the line" through hard engineering is increasingly viewed not as a solution, but as a temporary and costly deferral of the inevitable.

2. Geomorphology and the Engineering Paradox

2.1 Modeling Recession: The Bruun Rule

To understand the scale of future displacement, engineers and geographers frequently turn to the **Bruun Rule**. This model provides a simplified relationship between sea-level rise and shoreline recession for sandy coasts. It posits that as sea level rises, the beach profile must shift upward and landward to maintain equilibrium. The formula is expressed as:

$$R = (S \times L) / (h + d)$$

Where R represents shoreline recession, S is the sea-level rise, L is the horizontal length of the active profile, h is the height of the dune or berm, and d is the depth of closure. In Atlantic Canada, where S is exacerbated by isostatic subsidence, even a modest increase in sea level can result in landward recession rates of 50 to 100 times the vertical rise. This technical reality renders many coastal properties uninsurable and physically unsafe within the current 30-year mortgage cycle.

2.2 The "End-Effect" and Down-Drift Erosion

The historical response to this recession has been the construction of seawalls, revetments, and groynes. However, these structures introduce an engineering paradox. Hard defenses disrupt the natural longshore sediment transport. When a seawall is installed to protect a single property, it prevents the natural erosion that feeds sand to neighboring beaches. Furthermore, waves hitting a rigid seawall reflect with high energy, scouring the "toe" of the wall and increasing erosion at the structure's flanks—a phenomenon known as the "end-effect." This leads to a domino effect where neighboring landowners are forced to build their own walls, eventually destroying the public beach and replacing a dynamic ecosystem with a sterile, high-maintenance rock corridor.

3. Social & Cultural Hurdles: The "Sense of Place"

Managed retreat is often technically sound but politically and socially explosive. In the Maritimes, the "sense of place" is not merely an aesthetic preference; it is an identity forged through centuries of maritime labor, family lineage, and proximity to the water. The prospect of moving a community like Percé, Gaspé, or the historic fishing villages of the South Shore of Nova Scotia involves more than relocating structures; it involves the severing of cultural ties and the loss of "intangible heritage."

Economic hurdles also play a role. Many coastal residents have their entire net worth tied up in their primary residence. When a property is designated for "retreat," its market value can vanish instantly. Without robust government intervention, managed retreat risks becoming "unmanaged abandonment," where the wealthy can afford to move while marginalized populations are left to weather the storms in decaying assets.

4. The Legal and Policy Framework in Canada

Who pays for the move? In Canada, the division of jurisdiction complicates the retreat process. While the federal government provides disaster financial assistance, land-use planning is a provincial and municipal responsibility. Current Canadian policies, such as the Disaster Financial Assistance Arrangements (DFAA), have historically focused on "building back" rather than "moving back."

However, shifts are occurring. Post-Fiona, there is an increasing recognition that buyout programs—where the government purchases high-risk properties at pre-disaster market value—are more cost-effective than repeated disaster payouts. Yet, legal challenges remain regarding "expropriation" versus "voluntary buyout." If a municipality changes zoning to prevent rebuilding on a flooded lot, is that a "regulatory taking" that requires compensation? Canadian courts have been hesitant to grant compensation for zoning changes, but as the climate crisis intensifies, new legal precedents for "compensated retreat" are essential.

5. Conclusion: Redefining Resilience

Resilience in the 21st century must be redefined. It can no longer mean the ability of a structure to withstand a 1-in-100-year storm; rather, it must mean the ability of a community to adapt its footprint to a changing landscape. Managed retreat is not a failure of engineering or policy; it is a pragmatic recognition of geological reality. By utilizing the Bruun Rule for planning, acknowledging the limits of hard defenses, and centering maritime culture in relocation strategies, Atlantic Canada can lead the way in climate-adaptive living. We must learn to move with the tide, for the tide will no longer wait for us.

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