Role of a Renewed 5NR MOU in the Evolving Spectrum of Horizontal Federal S&T Management

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PART I - 5NR: PAST TO PRESENT

1.0 INTRODUCTION

This paper was commissioned by Environment Canada to aid discussions on the renewal of the 5NR MOU (Memorandum of Understanding). Its purpose is to examine the origins and evolution of the 5NR MOU and to help Environment Canada and its 5NR partners to focus thinking about the role of a renewed MOU; especially in relation to other horizontal S&T management initiatives that have arisen since the 5NR was formed. In other words, the discussion paper is intended to provide advice on whether the 5NR MOU should be renewed, and if so, under what conditions.

To gather background information for this paper interviews were held with a number of senior officials of the participating departments - including some individuals who were instrumental in establishing the 5NR MOU, as well as with some interested third parties. A list of individuals interviewed is included in Appendix 1.

5NR is a leading example of horizontal management of S&T, and may offer useful lessons for future efforts.

The discussion paper is being written in a fluid policy environment in which calls are growing for increased "horizontality" in federal S&T, but where models or alternatives for increased collaboration have not as yet surfaced. 5NR is a leading example of horizontal management of S&T, and may offer useful lessons for future efforts. The expanded 5NR MOU was due to be renewed in January 18, 2001[1]. Over the past year, renewal of the MOU has been delayed, in part pending discussions of other horizontal initiatives, such as FINE[2].

In principle, the 5NR partners have 4 options. First, they could retain 5NR in its present form. Secondly, they could "remodel" 5NR in light of lessons learned. In the third place, they could "reform" 5NR, by adapting it to new challenges and opportunities. Finally, they have the option of terminating 5NR and awaiting further events to unfold. This report will explore the options.

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[1]The term of the MOU was 3 years.

[2]As of this writing FINE (Federal Innovation Networks of Excellence) is on hold; a planned Cabinet memorandum that would have sought authorization and new funding for FINE has been withdrawn for the present.

2.0 BACKGROUND TO 5NR

The *Memorandum of Understanding on Science and Technology for Sustainable Development* (Appendix 2) was originally signed in 1995 by four departments dealing with natural resources (Agriculture and AgriFood Canada, Environment Canada, Fisheries and Oceans Canada, and Natural Resources Canada). In recognition of the fact that environmental health is a key component of sustainable development, Health Canada became a signatory at the last renewal of the MOU, in 1998. The new group of departments was initially termed 4NR+H and more recently, 5NR.

Impetus for what became 5NR came directly from the then-Clerk of the Privy Council, at the time of the Federal S&T Review. The original 4NR departments[3] had been making similar points in discussions about the role of S&T in delivering government quality of life goals. Hearing the various presentations, the Clerk recognized that the plans contained a certain amount of overlap, and that there was a potential for increased collaboration. She strongly urged departments to coordinate their sustainable development activities. Deputies took this as a signal to work more closely together, and officials proceeded to draft what became the original 4NR MOU.

Impetus for what became 5NR came directly from the then-Clerk of the Privy Council, at the time of the Federal S&T Review ... She strongly urged departments to coordinate their sustainable development activities.

Thus, the original MOU was intended to bring the 4 natural resource departments together to work on advancing the federal sustainable development agenda. The MOU was viewed as a mechanism to further collaborative science on priority issues. The MOU was intended to go beyond interdepartmental exchange of information to facilitating integrated program planning, development, evaluation of issues and problem resolution while allowing departments to maintain management of their individual S&T programs.

2.1 The 5NR MOU

Key aspects of the 5NR MOU (Appendix 2) are listed below[4]:

2.1.1 Principles

- Conducting collaborative science and technology (S&T) activities for Sustainable Development in the Natural Resources Sector;
- That issues be led by the Department for which the issue is of primary interest;

[3] AAFC, DFO, Environment Canada and NRCan.

[4] Emphasis added

- Existing mechanisms be used as much as possible

2.1.2 Management

- Effective collaboration amongst the Departments to be exercised annually by the Deputy Ministers, to reach a consensus on issues and to assess progress on work to date

- Assistant Deputy Ministers with S&T responsibilities to represent Departments; ADMs to meet several times a year to:
  - raise and assess issues for potential collaboration
  - assign responsibilities and strike joint working groups
  - evaluate and report on progress of initiatives, and
  - review the direction and focus of the activities under the MOU

- Responsibility for chairing meetings to rotate amongst the five Departments

- Collaborative mechanisms that could be used by the Parties to any joint projects include: ad hoc working groups; joint science assessments; national science fora; joint science communications and promotions; other mechanisms, as appropriate

- An annual report and a plan of joint work for the following year will be prepared for consideration by Deputy Ministers.

2.2 The Broader Context of 5NR

The 5NR MOU was the product of the particular policy circumstances prevailing in 1995[5]. Program Review had just finished and SBDA science budgets had been trimmed 15-30%. This prompted a major review of priorities in most departments, and perhaps fostered an underlying recognition that increased collaboration among departments could help to alleviate the effect of shrinking budgets, especially on cross-cutting files such as "sustainable development".

Program Review ... perhaps fostered an underlying recognition that increased collaboration among departments could help to alleviate the effect of shrinking budgets, especially on cross-cutting files such as "sustainable development".

5NR was also created around the time when the Industry Canada Portfolio was being established. This consortium was formed to coordinate the activities of the various organizations reporting to the Minister of Industry. The idea of grouping organizations with complementary mandates was gaining currency, and so the idea of a 4NR grouping was consistent with this emerging approach.

[5]In particular, the government's emphasis on sustainable development.

5NR can also be seen in a much longer historical context, dating back to a lengthy series of critiques of federal S&T that began in the 1960s[6]. For example, the Glassco Commission reported in 1963 that *"... there is no universally accepted pattern for arriving at these vital (S&T spending) decisions"*. Decades later, Chapter 9 of the 1994 Report of the Auditor General catalogued other concerns over federal S&T management, and had 3 main themes:

- There was too much emphasis on government S&T and not enough on industrial research or university science;
- Priority setting for government S&T was weak; and,
- Federal S&T management practices needed improvement.

In 1998 the Auditor General[7] reviewed the implementation of the Federal S&T Strategy that had resulted from the 1994 Federal S&T Review[8]. The AG commented (emphasis added):

> 22.21 In the Strategy, the government recognized that to be a more effective partner in the country's innovation system, it needed to get its own house in order. It concluded that achieving greater coherence while preserving flexibility, responsiveness and ministerial accountability would require a more rigorous collective review of priorities and greater co-ordination of activities.
>
> 22.23 The Strategy also stated that improving top-level advisory and decision-making structures was not enough to ensure that the federal government's substantial investment in S&T would yield better results. The government recognized that to improve the management of its investment, it needed more co-ordination of S&T activities among federal agencies and collaboration on major horizontal issues - those that cut across departmental and agency boundaries. The Minister of Industry would lead the co-ordination of S&T policy and strategies across the federal government. This effort would be supported by another new body, the Council of Science and Technology Advisors.
>
> 22.43 However, more co-ordination does not necessarily lead to better management of horizontal issues. In our view, effective management of any important horizontal issue needs to include an action plan that orchestrates the relevant activities of departments and other players involved to achieve agreed-upon objectives; an accountability framework that transcends departmental jurisdictions; and a joint reporting mechanism to track results in relation to objectives.
>
> 22.53 The report[9] also provides little consolidated information on the performance of departments and agencies in horizontal areas.
>
> 22.84 The extent to which individual departments are improving the management of their science activities becomes less relevant, however, if they are not working together to better manage horizontal issues. Although

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[6]For additional details see: The Impact Group. The Roles of the Federal Government in Performing Science and Technology: The Canadian Context and Major Forces. Council of Science and Technology Advisors. Ottawa. March 1999.

[7]1998 Report of the Auditor General of Canada - December - Chapter 22 - The Federal Science and Technology Strategy: A Review of Progress

[8]Science and Technology for the New Century - A Federal Strategy. Ottawa. March 1996

[9]Minding Our Future. Ottawa. December 1997. (The first annual report on S&T activities)

> we observed increased co-operation among departments, our case study on the horizontal issue of climate change science demonstrates that, in this particular case, departments are still carrying out science activities on the basis of their own priorities rather than common goals.

The departments responded to the AG's report as follows:

> Our implementation of the Strategy continues and includes improving management of S&T human resources and building effective partnerships among levels of government and non-government stakeholders. Partnerships and collaborations include the interdepartmental S&T human resource initiative, the Climate Change Action Fund and the MOU on Science for Sustainable Development. The MOU itself has had a major impact in strengthening working relationships and increasing collaboration on key issues, such as climate change science, metals in the environment, nutrients and endocrine modulating substances. The success of the MOU will best be measured in the success of its individual projects, most of which are still in progress. The MOU was renewed in 1998 and was expanded to include Health Canada. The results of such co-operation and collaboration in S&T are becoming more evident as experience with these mechanisms and approaches grows. There are several other areas, such as Northern S&T and toxics substances research, where we are collectively just beginning to apply this experience. We feel that our efforts are having positive impacts and will continue to influence the co-ordination and co-operative management of federal S&T in the future.

In retrospect, it is notable that until recently, little attention was devoted to "horizontality" in the various reviews of federal S&T conducted over a period of nearly 40 years. Most studies have concerned themselves with the management of S&T within departments and not among departments. As indicated above, horizontality has been a concern of the Auditor General, whose reports indicate a certain degree of frustration with the pace of change.

From today's perspective, it is interesting that these criticisms were largely aimed at the operation of individual SBDAs; there was little discussion of or interest in issues related to collaboration among SBDAs. What is now termed "horizontality" appears to be a comparatively recent concern.

Excerpts from the 1994 Report of the Auditor General of Canada:
Chapter 9 Science and Technology
Overall Management of Federal Science and Technology Activities

1.65 The present allocation of funds among various fields is more incidental than the result of a well-formulated strategy. The lack of focus at the government-wide level contributes to a lack of focus in departments and agencies. The absence of government-wide guidelines and criteria has contributed to departments becoming involved in activities that we believe they should question. Moreover, the expected results of science and technology programs are defined in such general terms that they do not create a sense of urgency among the performers of research and development.

9.31 In 1967, under the chairmanship of Senator Maurice Lamontagne, the Senate Special Committee on Science Policy launched a thorough examination and assessment of science and technology in Canada. The Committee addressed many of the questions being reviewed today ... **9.32** In brief, the Committee called for both sectoral science policies and an overall science policy that would encourage industrial innovation and contribute solutions to social problems. It also stressed the need for evaluating federal scientific research to enable the government to maximize the return on its investment and shift resources to new needs and opportunities as they present themselves. It concluded that a coherent organizational system must replace the conflicting pattern of responsibilities then in place.

9.29 Policy direction, priorities and co-ordination of federal science and technology activities were addressed extensively in the 1963 report of the Royal Commission on Government Organization (Glassco). The Commission ... raised serious concerns about the lack of co-ordination and the piecemeal expansion of government scientific activity after the end of World War II, and concluded that Canada's scientific policy at the time was the result, not the cause, of growth in the many scientific activities undertaken by government.

9.46 As noted in paragraph 9.19, Canada has only modest resources to invest in science and technology, compared with many other developed countries ... Canada will probably be doing even less of the world's research in the future. Under these conditions, it is essential that our resources be invested in a way that will yield maximum return. As stated previously, this is not the present case.

9.49 To be able to make valid choices, the government must be clear about what it wants to achieve. A lack of focus at the government-wide level contributes to a lack of focus in departments and agencies. As we report in Chapter 10, our audit of selected science and technology organizations identified a need for improved understanding of needs and sectoral opportunities. This understanding requires the joint effort of scientific and non-scientific groups in departments and agencies with science and technology programs, and collective effort by departments, including the Department of Finance and the industry sector units in Industry Canada. Science and technology are only a means to achieving broader social and economic objectives. Chapter 10 also reports that science and technology organizations need to have clearer goals and priorities. We believe that establishing priorities at the government-wide level would contribute to their achievement within departments and agencies.

9.50 In summary, determining real science and technology priorities will require addressing fundamental questions such as: What are the greatest needs and opportunities? Where must the government be involved and why? Where should and could the government be involved and why? What should and could the government's involvement be? Without answers to these questions, the current review is unlikely to provide the government with a true strategy. Furthermore, we would expect to see the strategy identify priorities at the government-wide level as well as the sectoral level.

2.3 5NR Activities

From 1996 until the present, 5NR sponsored a set of 13 interdepartmental S&T activities. A number of these had a research component, while others would be more accurately described as "related science activities". Detailed information about the various 5NR Working Groups can be found in Appendix 3.

3.0 INTERVIEW FINDINGS

3.1 Perceptions of 5NR's Success

Senior officials interviewed for this project are consistent in their assessment of 5NR's success. Most individuals feel that 5NR was "somewhat" successful in achieving its original objectives, but that overall, success was only partial. Most participants would acknowledge that 5NR was moderately successful, but many expressed dismay that it was not more so. (Section 4 following discusses the barriers to success.)

3.2 Project Funding

Most 5NR activities (see Appendix 3) were financed by individual departmental contributions, rather than by an up-front fund allocated at the beginning of the year. In most instances departments considered whether or not to participate in individual 5NR projects on a case-by-case basis, rather than (for example) on the basis of a strategic plan or business plan. The notable exception was the set of Communications projects, to which departments committed funds at the beginning of the fiscal year. However, this form of funding was the exception rather than the rule.

All 5NR (funding) decisions required the agreement of all parties, and no department was required to participate in any project which was not a priority for it. Thus, all proposed projects required negotiation with all departments. Over the years, there was discussion about the option of each department contributing to a 5NR "fund", to which individual projects would apply. However, this option was not pursued due to the resistance of one or more departments to the up-front funding model.

3.3 Project and Program Management

Once funded, individual projects were managed by senior scientists from a lead department. Each project reported annually on its progress and an annual 5NR progress report was prepared (http://www.durable.gc.ca/index_e.phtml).

3.4 Positive Outcomes

Apart from the direct research outputs of 5NR-sponsored projects (see Appendix 3), individuals closely associated with 5NR reported a number of wider positive impacts of the agreement. Some of these were un-anticipated at the beginning.

Most notable is that 5NR built networks of personal acquaintance among executives, managers, and scientists. Many individuals reported that prior to 5NR departments tended to work in isolation and that there was a low level of acquaintance among S&T personnel from different organizations. Personal acquaintance is the cornerstone of collaboration, and 5NR fostered a far higher level of personal association. This was reflected in the comment of one interviewee, to the effect that nowadays "individuals cooperate, even if our institutions do not". The benefit is that individuals knew who in other departments to call when an issue of mutual interest arose. That had not previously been the case.

Another positive consequence of increased association and collaboration was that levels of trust grew substantially. For decades, most departments tended to conduct their S&T activities in isolation, and often viewed one another as competitors for financial resources and political attention. There were suspicions that departments were trying to undermine each other's work; for example on environmental files, where some departments were seen as advocates of development interests while others were seen as advocates of environmental interests. As a result, there was a tendency to question the trustworthiness of other departments, which in turn put a damper on increased cooperation. Many people associated with 5NR cited the growth in trust as a significant achievement of the MOU, although they caution that maintaining trust requires that relationships be nurtured in an ongoing way.

Prompting these improvements was the fact that departments came together to work on projects of importance to the government. They tested new research and collaboration models on such files as endocrine disrupting substances, toxic substances, and communications.

At a time when the "horizontality issue" was not yet a major point of discussion within government, 5NR paved the way for collaboration by formalizing for the first time certain principles and mechanisms for interdepartmental collaboration. 5NR is possibly the most ambitious formal attempt to date in the federal government to manage S&T horizontally.

3.5 Future Intentions

Officials are unsure about the future direction that 5NR should take. They acknowledge that 5NR produced good science, but at the same time, there is a feeling that 5NR has run its course. There is a reluctance to abandon 5NR, because this would send a negative message to employees and to central agencies about the potential for future S&T collaboration.

The policy environment for federal S&T is highly fluid. Some interests are calling for complete integration of S&T across government, while others are more comfortable with moderate improvements to the status quo. There is no obvious way forward, and no strong champion for retaining 5NR. Departments have lost interest in 5NR and are cautious about investing new energy simply to remodel 5NR in its current form. At the same time, they acknowledge the need for new approaches to interdepartmental S&T collaboration (as well as collaboration with external organizations), but not at the expense of carrying out their departmental missions.

In short, a new vision and renewed energy are required to build on the lessons of 5NR.

4.0 FACTORS FOR SUCCESS

Most people closely associated with 5NR feel that even though the consortium did not achieve its full potential, it represented an important evolutionary step in collaboration among SBDAs, and also laid the ground for future models of interdepartmental collaboration or "horizontality". As such, 5NR can be seen as a prototype for horizontal management of federal S&T. Bearing in mind the growing interest among SBDAs in horizontality - what it means and how to achieve it - it is instructive to look at the factors that influenced the success of 5NR, and to learn the appropriate lessons for the future. Understanding its successes and failures can help to design any new or improved coordinating mechanism.

4.1 Science Without Borders

One factor driving collaboration among SBDAs is that increasingly, science itself is blurring the traditional boundaries that separate government departments. In other words, science doesn't respect administrative borders.

> *... science itself is blurring the traditional boundaries that separate government departments*

An excellent example is the field of genomics, which is relevant to all the 5NR players; although other examples abound (e.g. toxics in the environment, endocrine disrupting substances, clean water). With respect to the genomics example, a major issue facing many departments is whether and to what extent to build their own genomics capacity - facilities, equipment, expertise - or whether to share capacity with other organizations in government (and outside).

Another example is Kyoto/climate change, where the public (and the government) expect an integrated (science) response from SBDAs. Canada's S&T response to September 11 is a further example of horizontal S&T issues that will no doubt increase in importance in the future. Increasingly, horizontal files will put pressure on what one interviewee described as the traditional "Victorian" structures of government to work together. These structures carry on

because of legislative requirements and principles of ministerial responsibility, but they increasingly constrain the effective delivery of federal S&T solutions.

4.2 Building Trust

Although 5NR went a long way to establishing a climate of trust among departments, most officials privately believe that there is still a long way to go. The networks of personal and professional association that resulted from 5NR have helped to significantly increase levels of trust among the participants. But these associations are still delicate, and require ongoing support.

In our opinion, one significant drawback to disbanding 5NR without quickly replacing it with something more attuned to the times, is that there would be a diminution of collaboration and association, and therefore of trust. Should this take place, once weakened, it would take additional time and effort to re-establish the current level of trust.

At the heart of deficiencies in trust is the reality that individuals and their S&T organizations still have their primary allegiance to their home departments (sectors, branches, etc.), rather than to 5NR (or its replacement) or to the Government of Canada. 5NR did not find a way to alter those allegiances in any major way, which meant that significant and lasting improvements in planning and resource sharing did not take place. New management and governance mechanisms - for instance adopting new forms of horizontal planning and personnel employment (e..g "cross-appointments" of staff to 2 or more departments) - need to be looked at as ways to build allegiance to common interests.

4.3 Resolving Different Funding Philosophies

5NR members engaged in an ongoing dialogue/debate over the mechanisms for project funding. The two "camps" can broadly be described as the pay-as-you-go (or case-by-case) camp and the up-front funding (or funding "pot") camp. Most individuals agree that the 5NR Communications group operated the most effective program, and that it was one of a few examples of up-front funding; however, there was considerable reluctance to extend the up-front funding model to other joint R&D interests.

Experience shows that it is far easier for institutions to agree on the up-front funding approach when new money is available. The difficulty is that new money has not generally been available for horizontal initiatives, and in consequence most 5NR activity was funded from internal departmental resources. In these instances, resources were mostly diverted from other (lower priority) uses, and approved on a case-by-case basis, often reluctantly.

Central agencies - in particular Finance, Treasury Board and PCO - did not allocate new funds to support structural change in the management and delivery of federal S&T. Central agencies have

not recognizing that new funds - even a partial contribution in the form of matching funds - can go a long way to changing organizational behaviour in positive directions. (Even if they did recognize this, they offered little or no new support.) That meant that nearly all 5NR funding had to come from existing sources, and departments were reluctant to dip into their own funds, which had already been allocated through exhaustive (and often exhausting) internal priority-setting exercises. The absence of a significant pool of money inevitably limited the scale and scope of 5NR projects, and ultimately to a diminution of interest in the model.

It is hard to see how in future, a more ambitious, more horizontal effort (of the kind now being mooted by some senior officials) could succeed, given the experience of 5NR, unless SBDAs come to grips with the funding dichotomy issue.

4.4 Collegiality: A Strength and Weakness

The collegial nature of 5NR, in which all significant decisions required consensus among all parties, was both a strength and weakness. On the positive side, collegiality ensured that no decisions were taken without the commitment of all involved. On the negative side, it meant that no decision could be taken unless all agreed. The lack of a system of priority setting, "arbitration" or "mediation" meant that difficult decisions could not be made. To a certain degree 5NR's management structure was akin to:

- a Cabinet - without a Prime Minister empowered to lead and resolve differences;
- a symphony orchestra - without a conductor; or,
- a government department - without a permanent head.

If more ambitious S&T coordinating plans are envisaged for the future, then serious consideration will need to be given to improving management and decision making.

4.5 Planning & Priority Setting

There was general agreement among 5NR participants that planning and priority setting were weak, and acted as a brake on the success of 5NR. The 5NR MOU originally envisaged that:

- Consideration be given to focus on a limited number of issues of strategic interest on areas of mutual importance to Departments;
- A limited number of issues for common action by two or more Departments will be identified and addressed; and,
- An annual report and a plan of joint work for the following year will be prepared for consideration by Deputy Ministers

However, 5NR never had its own business plan or strategy - what the MOU termed a "plan of joint work". Each funded project did have a work plan, but there was no overall plan for the 5NR organization - no strategic direction. This is quite different to the situation in individual 5NR departments, each of which makes extensive use of business plans, strategic plans or their equivalent.

We suspect that the collegiality principle (see section 4.4 above) and to a certain degree a residual lack of trust, combined to interfere with strategic planning for 5NR. No department was willing to trust another department to create a strategic plan for 5NR that would both reflect common priorities, and not undermine individual departmental priorities: therefore, no plan was created. What resulted was something of a lowest-common-denominator approach to planning and priority-setting.

Contributing to this situation is the fact that the 5NR MOU did not explicitly envisage that the S&T planning groups within departments would also attempt to harmonize their efforts. For the most part, 5NR was viewed as an S&T exercise, and not an integrated science-policy exercise.

As a result, in some respects 5NR acted as a "body without a brain". That is, it had identifiable activities, but no identifiable plan. As such, 5NR became topic-driven, because there were good individual projects to fund, rather than plan-driven, because there was no plan.

4.6 Inconsistent Buy-In

A number of individuals consulted in the course of this project expressed variations of the view that "ADM priorities were not necessarily DG or Director priorities". Their point was that individuals in any organization who manage S&T operations on a day to day basis, often resist adjusting their modus operandi based simply on new expectations.

In fact, it appears that the sociology of collaboration (or lack thereof) dictates that it is equally as difficult for labs within a single department to collaborate with one another, as it is for them to collaborate with labs in other departments. A number of ADMs expressed the view that a major challenge is getting their own people to work together; working with outside people and organizations adds yet another layer of complexity to collaboration.

Individuals in organizations get their signals about the organization's priorities in a number of ways: certainly from pronouncements by executives, and from formal arrangements such as MOUs, but more importantly they test the seriousness of priorities from concrete actions taken, especially with respect to resource allocation and priority setting. If the actions don't match the pronouncements, the message that employees take away is that the message isn't serious. It became apparent to many managers that 5NR was not a high priority for their departments, and they responded accordingly.

4.7 Governance, Management, Leadership and Accountability

There were clearly a set of governance, management, leadership and accountability problems with 5NR. A number of individuals familiar with 5NR described it in terms such as "bureaucratic, rigid and procedural". Governance of 5NR was left essentially to ADMs, but there was no strong, independent secretariat to hold things together for them. For instance, because responsibility for chairing meetings rotated continually, no one was consistently in charge[10]. Moreover, the need for collegiality overcame the need for planning, governance and management, which is somewhat ironic: few departments would allow the negative aspects of collegiality to constrain action in their own organizations, but 5NR departments seemed content to put up with the negative consequences of collegiality for purposes of the MOU. (This is not to diminish the importance of collegiality, but simply to point out that it has its limitations as well.)

Collegiality also constrained leadership. At various times senior officials did attempt to lead 5NR in directions they felt to be important, but were hamstrung by the continual need to reach consensus, not to alienate their peers, and not to appear to be promoting a position that would favour one department (their own) over others. One senior official remarked that from the beginning it took an inordinate amount of time and energy to keep 5NR on track. It was difficult to sustain that time and energy in the long term (see section 4.8 below).

With respect to accountability, it is not apparent that researchers, managers and executives were held accountable for the success of 5NR: that is, whether they incorporated their 5NR duties into their own (departmental) accountability accords, or whether in fact 5NR imposed any accountability expectations of its own on participants. So long as individuals' primary allegiance and accountability was to their department and not to 5NR, it was hard to impose discipline on participants, in the form of timetables, deliverables, milestones. Inevitably, there was a tendency to sacrifice 5NR responsibilities when confronted with competing departmental requirements.

4.8 Management Interest

As time went on, fatigue began to set in and the attention of departmental executives to 5NR - DMs and ADMs - began to wane. 5NR was seen as tackling interesting and useful projects, but the feeling was growing that it was not making a big difference in the grand scheme of things, and that other developments and issues - such as FINE, clean water or terrorism - were overtaking and subsuming 5NR . Executives could see no "big picture" into which 5NR fit. New projects which had a natural 5NR link - for instance FINE - began to be implemented without reference to 5NR. After a time, 5NR became somewhat moribund, and declining interest contributed to the delay in renewing the MOU.

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[10]Another aspect of the lack of trust among departments?

4.9 Support From the Centre

5NR received little attention or support from central policy and coordinating agencies (PCO, TB, Finance, Industry Canada) which should have had an interest in the success of this major horizontal S&T initiative. After all, 5NR represented a major effort to implement the Government's 1996 Federal S&T Strategy. Writing about the Strategy, the Auditor General recognized that:

> The Strategy gives full recognition to the importance of departments and agencies working together and increasing intergovernmental co-operation and co-ordination. Various initiatives are also under way to improve the assessment of the results and impacts of federal science and technology activities, and to report on the growth of Canada's knowledge-based economy.

From the perspective of line departments, attention from central agencies is always a mixed blessing: on the one hand it often involves unwelcome scrutiny of their activities, but on the other offers the possibility of gaining advice and support. Regrettably, the inability of 5NR to capture the attention of central agencies over time reinforced the perception that it was not "making a difference", and led in part to declining interest among DMs and ADMs.

4.10 Organizing Theme

5NR was established at a time when "sustainable development" was emerging as a major concern of government[11]. The problem was (and is) that there is no strong conceptual model or organizing theme underlying the notion of sustainable development. As such, 5NR has had difficulty translating the sustainable development theme into either a strategic approach or into concrete projects.

This is reflected in the fact that our review of 5NR projects (Appendix 3) could find only 1 project which was directly linked to sustainable development[12]. Sustainable development is a hard idea for individuals and organizations to get their heads around or to take action over. It turned out to be a diffuse organizing theme for 5NR. In practice, there were two problems with using sustainable development as the organizing theme. The first is that it proved difficult in practice to implement. The second, is that important issues in which 5NR could and should have played a role - for instance FINE - by-passed the 5NR system: after all, if a project was <u>not</u> defined as sustainable development, why involve 5NR?

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[11]The passage of time reveals that sustainable development never garnered real enthusiasm or support.

[12]The Valuing Natural Capital Working Group

5.0 CONCLUSIONS

5.1 5NR - An Important Step Forward

In spite of the fact that 5NR did not fully achieve its potential, it represented a significant step forward in the evolution of collaboration among departments on S&T files - or what is today being termed "horizontality". It is important to remember that 5NR represents what was possibly the first large scale formal attempt by a group of major federal S&T performers to coordinate their S&T efforts[13].

The original motivation for 5NR had been to coordinate individual departmental requests for S&T funds to support the government's sustainable development activities. Over time, departments began to recognized the benefits to be gained from a forum for discussing and selecting projects of mutual interest and coordinating research activities that crossed departmental lines, whether or not the projects fell strictly into the sustainable development category. However, this recognition was more implicit than explicit and the MOU continued to emphasis the sustainable development objective rather than a more general modus operandi that would have emphasized joint planning, priority setting, infrastructure sharing, and project implementation.

The fact that the theme chosen to organize collaboration - "sustainable development" - turned out to be difficult in practice to implement, does not detract from 5NR's achievement. It would be hard to envisage a new generation of collaborative approaches without the 5NR experience. In our opinion, it would be a great mistake to abandon 5NR and not put in place its next iteration.

5.2 5NR Explored the Boundaries of Collaboration

As described in section 4 of this report, there were many factors at play that ultimately limited 5NR's effectiveness: buy-in, trust, financing, management, emphasis on collegiality, planning, priority-setting, and so forth. Yet without the 5NR experience SBDAs would not know what barriers need to be overcome in designing any follow-on to 5NR - or any other future large scale collaboration. As a pilot or prototype, 5NR was extremely successful in exploring the boundaries of collaboration. From this perspective, 5NR should not be seen as a failure, but as a "pathfinder project" that cleared the way for future improvements.

[13]Over time there have been many less-formal collaborative arrangements, but none as ambitious as 5NR.

5.3 Calls for Horizontality are Growing

Paradoxically, just at the time when interest in 5NR is waning, the need for new approaches to horizontal coordination and management of S&T within government (and with the outside world) is on the rise. For example, as this report is being written, "reallocation" is emerging as a leading concern of government. On the surface, reallocation would imply the need to reallocate resources among federal S&T organizations, so that those resources are better aligned with government policy. Individual SBDAs are best positioned to determine their individual reallocation options, but who can identify reallocation options across departments?

Underlying the reallocation theme is a concern that with the federal government spending around $1.9 billion annually on its own S&T, there must "surely be some degree of duplication or overlap in federal S&T capacity". In the view of central agencies, any such duplication would need to be eliminated before the government will consider new funding requests.

In principle, mechanisms such as 5NR offer ideal fora for coming to grips with reallocation and priority setting exercises. But only if they can find ways to overcome the barriers to collaboration. If they can not, then chances increase the government will find other ways to allocate its S&T spending.

5.4 Science-Policy Linkages are Key

In its desire to implement collaborative S&T projects, 5NR lost sight of the need for strong science-policy linkages. It did a reasonably good job of bringing the working S&T community together, but was far less successful in bringing together the S&T policy and planning community. As a result the kind of strong science-policy linkages that departments acknowledge to be key to their own work, was absent from the work of 5NR. 5NR facilitated many projects, but there was no overlying strategy. In our opinion, any new models of horizontal S&T collaboration also need to incorporate horizontal S&T policy, planning and priority setting.

5.5 Leadership is Essential

Structural change cannot take place in the absence of leadership at the highest levels. At the present time 5NR leaders are fatigued and to a degree dispirited. In consequence the 5NR file has languished pending some new direction for federal S&T to emerge. In the past year senior management attention has been diverted to other horizontal S&T initiatives, in particular FINE and CRTI. But the recent uncertainty over the future of FINE, for the moment there is a lacuna in the direction of horizontal federal S&T as senior officials wait to see how the dust settles.

PART 2 - FROM 5NR TO 8NS

6.0 CREATING COMMON PURPOSE

What then to do with 5NR? Has the experiment ended? Is there a logical follow-on? Is there value to a renewed partnership effort among the 5NR departments - and possibly other compatible departments and agencies? If so, how would such a partnership work? How would a 5NR follow-on fit into a larger effort to organize horizontal S&T management in the federal government? Part 2 of our report addresses these questions.

6.1 5NR - A Shared Mission

The starting point for our analysis is to understand what, if anything, links the missions of the 5NR departments - what is their common purpose. Is there any special reason that these 5 departments should work together more closely with one another than they do with other federal departments or agencies[14]? What use does their S&T have to citizens and society?

... there is a **powerful unifying theme** among the 5NR departments, which has previously been overlooked. What sets these departments apart is that operating individually and collectively through 5NR, each fulfills 3 complementary missions. Each organization:

1. **Protects society from nature;**
2. **Protects nature from society; and,**
3. **Develops nature (in sustainable ways) to the benefit of society.**

In our opinion, there is a powerful unifying theme among the 5NR departments, which has previously been overlooked. What sets these departments apart is that operating individually and collectively through 5NR, each fulfills 3 complementary missions. Each organization:

1. **Protects society from nature;**
2. **Protects nature from society; and,**
3. **Develops nature (in sustainable ways) to the benefit of society.**

Accomplishing these 3 objectives is an ongoing challenge. Each of the 5NR departments tries to fulfill its mission in its own way, yet there are striking similarities in the issues they confront and the methods that they employ.

[14]We will address the issue of working relations with organizations outside of the federal government later on in this section.

6.1.1 Protecting Society from Nature

Each one of the 5 departments has, as one of 3 primary missions, the goal of protecting society from the forces of nature. Although humanity depends on nature for its existence, it is simultaneously in a relentless battle for survival with the forces of nature. In important respects nature is neither static nor benign. It is constantly evolving new forces and agents[15] and modifying old ones[16] which threaten our health, well-being and economic prospects: be they harmful microbes, diseases of aging, invasive species, naturally-occurring toxins[17], severe weather, forest fires, climate change, earthquakes, and so on.

Nature includes not only living things (people, animals, plants, microbes), but also ecosystems (the environments that support life); and, the notion of "natural commerce" (human economic activity that relies on the renewable and non-renewable products of nature).

Each of the 5NR departments - Agriculture, Environment, Fisheries, Health and Natural Resources - is intimately involved in protecting society from the forces of nature which pose a constant threat to our well-being. Each of them deals with similar scientific challenges - albeit in different ecological settings. For example, a major concern of each department is "disease". AAFC deals with diseases in agriculture (e.g. Colorado potato beetles, BSE). DFO is concerned with disease in aquatic systems (e.g. shellfish toxins). CFS is concerned with the effects of disease on forest ecosystems (e.g. Tomentosus Root Disease). Environment Canada is conducting research on wildlife disease (e.g. tuberculosis). A major focus of Health Canada is emerging diseases that affect health (e.g. West Nile Virus).

Departments may respond on their own to disease issues in some instances (e.g. Colorado potato beetles), whereas in many instances (e.g. West Nile Virus) federal S&T responsibilities cross departmental boundaries. Protecting society from the adverse forces of nature is a major preoccupation of each of the 5NR departments, and defines their unique role.

6.1.2 Protecting Nature from Society

Not only does each of the 5NR departments devote considerable S&T effort to protecting society from the forces of nature, they also protect nature from the

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[15] e.g. West Nile Virus

[16] e.g. antibiotic-resistant Tuberculosis, influenza

[17] e.g. mercury, arsenic

inexorable forces of human activity. Left unchecked, human activity would alter the natural environment(s) that supports human, plant, and animal life (and commerce) in ways that could be detrimental to society. Human activity inevitably has consequences for air and water pollution, wildlife habitat destruction, movement of invasive species, degradation of agricultural lands, environmental effects of genetically-modified organisms, destruction of forest ecosystems, creation drug-resistant microbes, and so on.

Leaving the natural environments which we rely on for our health and economic well-being in a better state than we inherited them, is a major preoccupation of each of the 5NR departments. In their own domain - farms, forests, aquatic environments, etc. - each devotes significant S&T resources to understanding and mitigating the impact of human activity on our life-supporting environments and ecosystems. Many of the protection-of-the environment issues they deal with transcend departmental boundaries. For example, agricultural runoff is a major concern of at least 4 of the 5NR departments: AAFC, EC, HC, and DFO.

6.1.3 Developing Nature

A considerable amount of economic activity in Canada involves the exploitation or development of nature[18] and natural commodities[19]; what might otherwise be termed "natural commerce". Ensuring that society develops nature in sustainable ways to the benefit of society is the third major mission of the 5NR departments.

Each of the 5NR departments, for example, is actively involved in using the tools of genomics to develop, improve or remediate natural products or systems. AAFC develops new GM plants. DFO develops GM fish. CFS develops GM trees. HC regulates GM drugs. EC is interested in the use of GM microbes for cleanup of environmental spills. All 5 departments also have important roles to play in laying the S&T knowledge base for regulating how other economic players develop nature.

Thus, the missions of the 5NR departments are remarkably similar. In its own way, each department: Protects society from the forces of nature; Protects nature from the forces of society; and, Develops nature in sustainable ways for the benefit of society. In many respects the only thing that distinguishes them is that they fulfil their missions in different ecological settings: farms; oceans, rivers and lakes; crown lands; forests; and human populations. In fulfilling these missions the 5NR departments have a unique role to play; one that truly sets them apart from other SBDAs[20].

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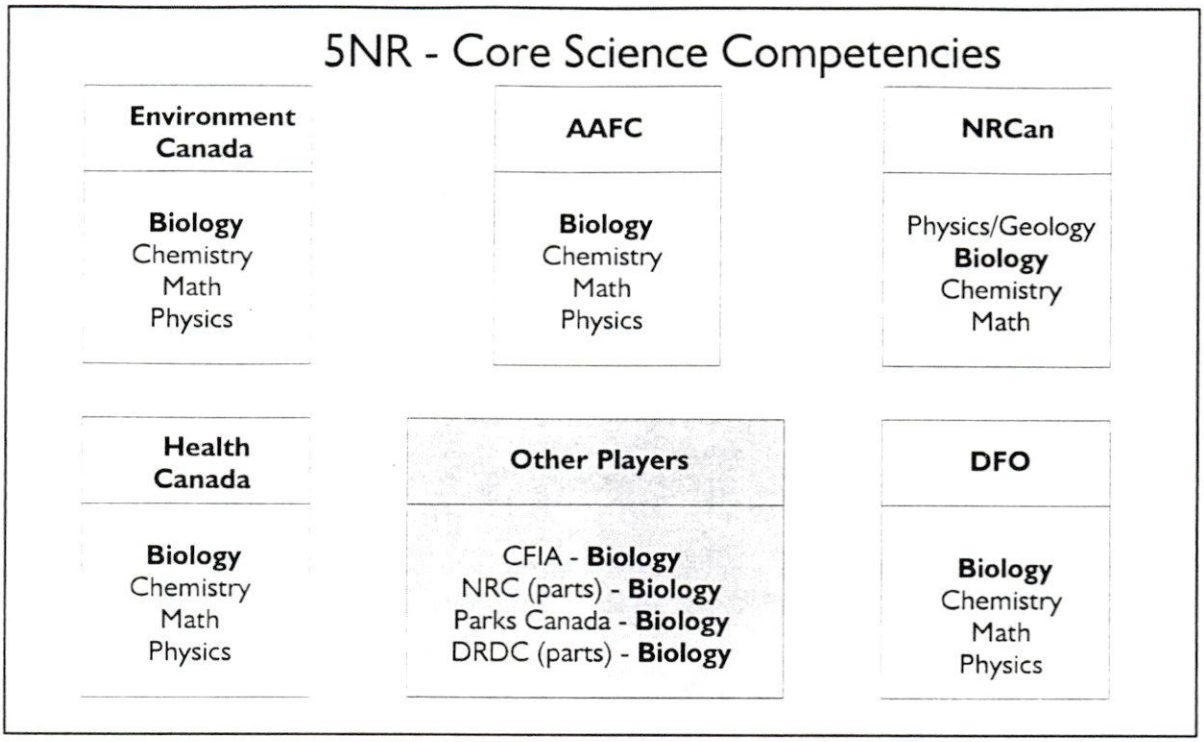
[18]For example, eco-tourism.

[19]For instance, crops, aquatic animals, forests, minerals, etc.

[20]With the exception of a few organizations that we will discuss later

6.2 Core Science Competencies

The preceding discussion demonstrated that the 5NR departments have a unified mission that is unique within the realm of federal S&T. The 5NR departments rely on a common core science competency to fulfill their missions - the science of biology[21]. In all 5 instances, biology is the science that defines each department's S&T competency. Biology, in its largest sense, is the science base which each department cannot do without: whether in the form of plant biology, physiology, veterinary medicine, biochemistry, molecular biology, ecology, limnology, genomics, and so forth.



AAFC, DFO, EC and HC in particular are heavily reliant on biology; they are concerned primarily with living things and their supporting environments. Each uses the concepts, methods and tools of modern biology as the basis of its S&T and applies them to living things and the ecosystems which support life. Each uses the tools of biology to protect society from nature, protect nature from society, and develop nature for the benefit of society. Of course, they also draw on other sciences in pursuit of their mission - notably chemistry, with lesser amounts of mathematics[22] and physics - but these are mostly employed in support of biological inquiry.

[21] We are using the term biology in its widest sense to include related disciplines ranging from molecular biology to ecology.

[22] Including computing and modelling

That said, each 5NR member also has major components which are not biology oriented. For example, the Meteorological Service of Canada is located in Environment Canada, and MSC is largely oriented towards physics, chemistry and mathematics. Likewise NRCan is essentially bifurcated: whereas the Canadian Forest Service is heavily reliant on biology, other parts of the department (MMS, ESS, ES) are largely concerned with physics and geology[23]. So, to be accurate, we would say that on the whole the 5NR departments have biology as their core science competency, but also incorporate other disciplines.

Biology is also central to the mission of a number of other SBDAs - or significant parts of them: in particular, CFIA, a number of NRC Institutes[24], Parks Canada, Canadian Museum of Nature, and a number of DRDC establishments[25]. However, these departments/agencies are not presently involved in 5NR, more for historical reasons than functional reasons.

Disciplinary Analysis of 5NR Working Groups

Working Group	Biology	Chemistry	Physics	Math	Other
Children's Environmental Health	X				
Biota of Canada Information Network *	X				
Nutrients Science and Policy	X	X			
Endocrine Disrupting Substances	X	X			
Pesticides	X	X			
Toxics Working Group	X	X			
Integrated Coastal Zone Management	X				
Metals in the Environment *	X	X			
Climate Change and Variability *			X		
Valuing Natural Capital					X
Knowledge Integration					X
Science and Implementation of the Precautionary Approach					X
Communications					X

The relevance of biology to 5NR is confirmed by analyzing the scientific orientation of the various working groups that were created (see Table following). It is apparent that a majority of working groups were biology-oriented, with support from chemistry. Four other working groups could best be described as "corporate" or "related science activities (RSA)"; the Communications working group and the Knowledge Integration working groups are examples.

[23]Once again, in their broadest interpretation

[24]In particular BRI, IBD, IBS, and PBI

[25]Especially DRDC-Toronto and DRDC-Suffield

In many respects the 5NR departments are the federal government's "natural science safety-net". They utilize the principles, methods and tools of biology in its broadest sense, to protect society from nature, protect nature from society, and develop nature in sustainable ways for the benefit of society.

6.3 5NR Organizing Themes

With hindsight, a core problem with 5NR is that it embodied two organizing themes that ultimately constrained fuller and more meaningful collaboration among the partner departments. The first theme that caused difficulty was "natural resources" and the second was "sustainable development".

From the previous analysis we would argue that the 5NR departments are better described as natural **science** departments than natural **resource** departments. This distinction is more than wordplay; it has important implications for increasing (or constraining) horizontality, or interdepartmental collaboration. All of the 5NR departments have natural science as the overriding focus of their S&T activities. And all are essentially biology-oriented S&T organizations (excepting for the NRCan caveat described above).

However, only 3 departments have an unambiguous "natural resources" mandate. AAFC, DFO and CFS clearly do have a natural resource orientation, but two others - HC and EC - do not fit comfortably within the natural resource framework[26]. In designating all 5 collaborating departments as "natural resource" departments the 5NR MOU created what turned out to be an uncomfortable alliance of interests.

More importantly, the natural resource designation had the effect of focussing interdepartmental collaboration largely on (downstream) one-off problems that could be defined in natural resource terms, at the expense of seeking more fundamental collaboration on broader (upstream) natural science issues. By focussing collaboration exclusively on solving specific "natural resource" problems on a case-by-case basis - endocrine disrupting substances, nutrients in the environment, children's environmental health, etc. - departments were deflected from addressing more fundamental opportunities to integrate their policy and science capacities around the 3 core missions; protecting society, protecting nature, and developing nature for the benefit of society.

Paradoxically, collaborating on smaller projects gave the illusion of meaningful progress, and constrained departments from collaborating on larger issues that appear in today's light to be more important to the government; in particular, issues related to horizontality and reallocation. That is not to say that the projects that 5NR worked on were not useful or important, simply

[26]So much so, that Health Canada's involvement in 5NR has always puzzled observers. EC has been uncomfortable with the exploitation approach that is implied by "natural resources"

that in focussing exclusively on harvesting the "trees", 5NR never succeeded in managing the "forest".

The second organizing theme that was not successfully implemented was "sustainable development". Sustainable development is a "how" (to do development) and not a "what" (development to do). That is, it is concerned with how development should take place (in sustainable ways) and not on what should be developed. Sustainable development has not proved to be a pragmatic organizing principle for government, and ultimately did not help 5NR to organize its affairs. Evidence of the difficulty that 5NR had in implementing the sustainable development theme can be found by analyzing the function of the 5NR working groups that were funded.

It is apparent that only one 5NR working group (Valuing Natural Capital) corresponded directly with the Sustainable Development theme. Twelve other working groups had no strong relationship to sustainable development per se. This has two implications.

First, it confirms that despite their nominal sustainable development mandate, in practice 5NR found it hard to make use of sustainable development as an organizing theme for collaborative S&T; there was only one sustainable development project to work on. In our opinion, this reinforces the conclusion that sustainable development was not a helpful organizing principle.

Analysis of 5NR Working Groups by Mission

Protection For Nature
- Nutrients Science and Policy
- Integrated Coastal Zone Management
- Biota of Canada Information Network
- Toxics Working Group
- Endocrine Disrupting Substances
- Pesticides

Protection From Nature
- Climate Change and Variability
- Metals in the Environment
- Children's Environmental Health

Corporate Issues
- Knowledge Integration
- Science and Implementation of the Precautionary Approach
- Communications

Sustainable Development Of Nature
- Valuing Natural Capital

Secondly, our analysis indicates that 5NR officials intuitively understood that there were important reasons for working together - for protection for nature (e.g. coastal zone management), protection from nature (e.g. metals in the environment), and to advance various corporate S&T issues (e.g. knowledge integration). But with sustainable development as the "official" organizing theme - and overshadowing other (more relevant) organizing themes - the agreement never gained momentum, because it was difficult to identify obvious sustainable development projects or programs.

So, in conclusion, we believe that "natural science" is a more practical and inclusive organizing principle for 5NR - or any successor to it - than "natural resources" or "sustainable development". In future, cooperating departments and agencies should seriously consider organizing themselves around the idea of a natural science consortium.

7.0 MOVING FORWARD ON S&T HORIZONTALITY

Although the consensus among participants in the MOU is that 5NR did not fully achieve its potential, its accomplishments should not be minimized. 5NR:

- Sponsored valuable interdisciplinary research;
- Built networks of personal acquaintance among executives, managers and scientists;
- Established a level of understanding and trust among departments;
- Tested new research, management and collaboration models;
- Formalized principles and mechanisms of collaboration (i.e. the MOU); and,
- Taught lessons about how to achieve (and not achieve) horizontality in S&T.

5NR represents a significant step forward in the search for "horizontality"- large-scale S&T collaboration among groups of SBDAs. It represents the most ambitious effort to date within the federal government to formalize S&T working relationships among departments. More importantly, the 5NR experience makes it possible to draw on the lessons learned and move forward with an improved cooperative arrangement among SBDAs.

7.1 A Growing Need for Collaboration

Pressure is mounting for SBDAs to work together, and to be seen to be doing so. A number of factors are at play. First and foremost is that many of the "big" S&T issues facing the government and society transcend departmental boundaries: clean water, environmental effects of GMOs, Northern S&T, air quality, toxins in the environment, climate change and adaptation, sustainable agriculture and aquiculture, bioterror, invasive species and emerging diseases, to name some of the most obvious. Increasingly, the big issues require multi-sectoral, multi-departmental responses. Citizens and politicians expect there will be an integrated federal government response to these issues, rather than a series of individual departmental responses.

Secondly, science itself is evolving. It is creating new disciplines (e.g. genomics) and sub-disciplines (e.g. proteomics, bioinformatics) that impact on a wide range of applications and end-uses: in agriculture, aquiculture, forestry, human health, wildlife, and so forth. The evolution is challenging traditional scientific and departmental specialties, and raising questions about the extent to which individual departments and agencies can or should build - and share - capacity (facilities, equipment, and expertise) to exploit them.

In the third place, despite a succession of collaborative efforts over the past 5 years to gain additional core support for federal S&T[27], SBDAs have been less than successful in convincing federal "investors"[28] to increase financing, except on a case-by-case, problem-by-problem basis (e.g. the recent CRTI initiative). Central agencies are calling on SBDAs to "get their act together", to "show them the big picture", and to "demonstrate how they're working together to address the big priorities of government". Recent experience suggests they are making this a prerequisite for additional investment in federal S&T.

Finally, the current theme of government finance is "reallocation". This is code for eliminating duplication and overlap, and coordinating priority setting, planning and program delivery. Federal in-house S&T is a $1.9 billion annual endeavour, and total federal S&T spending amounts to $3.7 billion. In any government, central agencies are concerned that large apparently un-coordinated spending programs may harbour waste, overlap and duplication, and that these need to be reduced before new investments are made. They want assurance that these concerns are being address by the federal S&T community.

SBDAs need a concrete mechanisms to ensure that they are indeed working together effectively, and to help them demonstrate such to their critics. Despite its weaknesses 5NR showed that it was possible for SBDAs to voluntarily and cooperatively move in the right direction. The new opportunity is build on the 5NR experience and move to the "next level" of horizontality.

7.2 The Next Step: From Thematic Horizontality to Structural Horizontality

In retrospect, 5NR was an experiment in what might be termed "thematic S&T horizontality". 5NR created temporary working relationships among participants to address one-off "themes-of-opportunity": e.g., Metals in the Environment, Children's Health, etc. The advantage of the thematic approach is that action can be taken relatively quickly to concentrate resources from different departments to address specific problems or issues. The weakness of the thematic approach is that it does little to integrate or alter the underlying structure and mechanism of federal S&T. Thematic horizontality creates a surface layer of collaboration without actually affecting underlying resources, capacities, planning or delivery mechanisms.

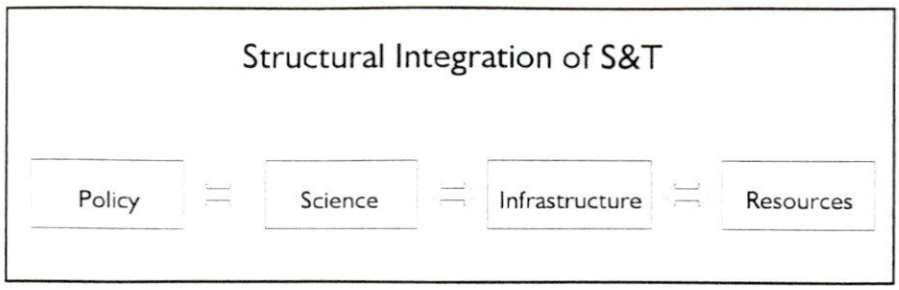
Thematic collaboration will always be a necessary element of horizontality, but not a sufficient one. Collaborative research programs and projects ultimately need to be based around specific themes, but thematic horizontality won't address some more fundamental challenges of S&T horizontality in the federal government, including planning, priority setting and resource sharing (of facilities, equipment, expertise, and associated costs). One difficulty with the 5NR MOU is that it spawned a number of thematic research projects, but in the final analysis, participants judged that the "whole was less than the sum of the parts". The underlying structure of

[27]These include: rust-out, science capacity, Northern S&T, and FINE

[28]PCO, Finance, Treasury Board, Cabinet

collaboration was un-changed, and when interest in specific projects waned, so to did collaboration. In other words, collaboration tended to be episodic.
The next phase of collaboration - the level of collaboration that central agencies appear to be looking for[29] - could best be described as "structural horizontality". Structural horizontality means at least partially integrating a number of ongoing S&T functions, especially:

- Planning
- Priority setting
- Personnel allocation
- Associated research cost allocation
- Facility and equipment sharing
- Evaluation and reporting



Structural horizontality creates a framework for ongoing collaboration and resource sharing that extends beyond any specific research or science project or program. Structural horizontality requires an integration of policy, science, infrastructure and resources. Whereas 5NR was moderately successful at integrating science, it was far less successful at integrating policy, resources or infrastructure. Any follow-on to 5NR needs to address the spectrum of structural integration issues head-on.

7.3 Managing by Matrix

Structural horizontality implies the need for the government's **S&T resources to be managed in a matrix**. The challenge is for research resources - people, facilities, equipment and cash - to be concurrently aligned with existing departmental mandates and with inter-departmental mandates (once they are specified). There is also a need to be able to swiftly shift S&T resources to address new, high priority (interdepartmental) S&T files as they emerge, without going through a labourious and time-consuming negotiating process among stakeholders.

Our parliamentary system of government implies that decisions on the funding and organization of S&T will be principally on departmental lines. The challenge is to find a way to use current

[29]Even if they have not clearly articulated their desire.

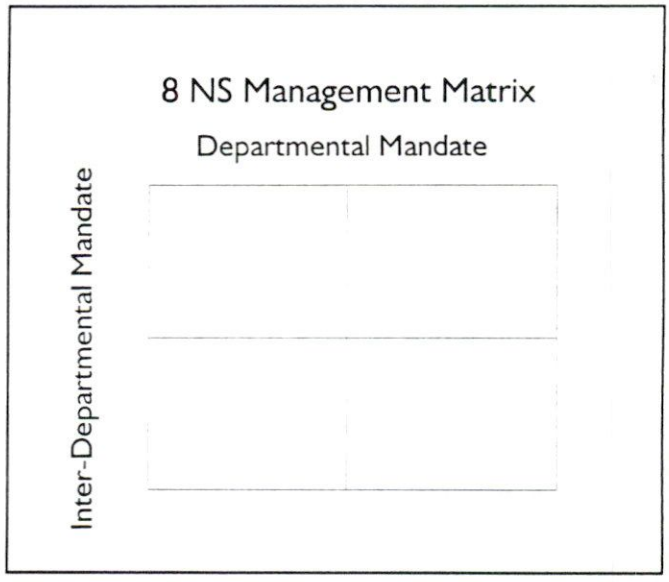
resources to address both individual priorities and shared priorities with other SBDAs. This calls for a form of matrix management, with its associated structures and mechanisms.

Let us take a private sector example to illustrate how matrix management works. In large computer and business services companies such as IBM, Hewlett Packard, or Sun Microsystems, there is a need to operate with one foot in the "technology camp" and the other in the "markets camp". As technology companies, these firms need to organize themselves around their various technology/product lines (storage devices, memory devices, networks, software, PCs, servers, etc.). But simultaneously, they need to organize themselves around their markets: high performance computing, financial services, government, oil & gas, higher education, utilities, etc. These firms have evolved matrix management systems in which individuals work concurrently for their technology groups and their market groups.

In the case of federal S&T, the matrix is defined by departmental priorities and by government or interdepartmental priorities.

One can extend the matrix management approach to federal S&T, where research groups need to work concurrently for their own departments and apply their resources - facilities, equipment, expertise and money - to addressing larger S&T priorities of government. A research team in, say, agriculture may be applying its genetics expertise to developing a new plant variety. Simultaneously, that team needs to apply its resources to developing a regulations to test for the environmental effects of GMOs, under the Canadian Environmental Protection Act (CEPA). Or, a research team assessing a new real-time test for West Nile virus in the blood supply, also has the expertise to participate on an interdepartmental team developing a federal strategy on invasive species. Or a fisheries research team working on diseases related to aquiculture, can participate in an interdepartmental study of climate change adaptation.

In the case of federal S&T, the matrix is defined by departmental priorities and by government or interdepartmental priorities (see diagram following). Each SBDA has well-established mechanisms for determining its own priorities. Each year they develop business plans (and variations of these) to codify their priorities. They have external advisory committees to vet priorities and plans. And, managers are held accountable for achieving performance targets. But as yet, there is no comparable system for establishing and managing interdepartmental S&T priorities.



Not all federal S&T needs to be conducted collaboratively; horizontality needn't apply to every facet of departmental or interdepartmental S&T. Our hypothesis is that on average, each department will need to devote around 80% of its resources to addressing the S&T issues that are unique to it. The other 20% will be devoted to horizontal issues. That said, some departments, such as Environment, may find they need to devote a larger proportion of resources - perhaps up to 50% - to interdepartmental S&T files. But on average, a 20% interdepartmental S&T load is a reasonable starting point for planning purposes. Over time, experience will determine the actual need for collaborative S&T, and this may well change over time.

*Matrix management also extends to **infrastructure** - capital facilities, equipment and fixed operating costs*

Matrix management also extends to **infrastructure** - capital facilities and equipment and related operating costs. Horizontality implies the need to coordinate the acquisition and operation of research infrastructure. A case in point comes from the field of genomics. The tendency is for each department to acquire its own in-house genomics facilities and equipment to ensure that it has access to genomics services (e.g. gene sequencing) when needed. This will inevitably lead to duplication, overlap and under-utilized resources. Federal S&T needs a mechanism where resources can be consolidated and prioritized, so that they can serve the needs of individual departments and of groups of departments. The real issue is timely access to services, rather than ownership of genomics facilities.

7.4 Specifying Horizontal Priorities: Integrating Policy and Science

A successful follow-on organization to 5NR needs an autonomous capacity for planning and priority-setting - for creating an integrated S&T plan. Although the original 5NR MOU called for a "plan of joint work", and despite at least one substantial effort to develop a plan[30], a viable plan never emerged. One reason, we believe, is that 5NR had no autonomous planning group; it had to "subcontract" planning to "volunteer departments". This mechanism never proved effective.

In the absence of a strategic plan or business plan, it is hard to set priorities. Without a group mandated by and responsible to the collective, it is hard to develop a plan. The logical conclusion is that a 5NR follow-on requires is own capacity for horizontal planning and priority setting.

7.5 Collaborative Mechanisms

The original MOU outlined a small number of collaborative mechanisms - 4 in total - that participants intended to use to facilitate their cooperative work:

[30]A joint 5NR planning session was held at Camsell Hall.

- Ad hoc working groups;
- Joint science assessments;
- National science fora; and,
- Joint science communications and promotions.

The 5NR experience is that some mechanisms were used more than others. All of the 5NR projects made use of ad hoc working groups. Joint science assessments, communications and promotion also worked well. It does not appear that much use was made use of national science fora.

In retrospect, the mechanisms specified in the original MOU were limited in scope. For one thing, they were geared to "downstream activities" - performing S&T and communications - rather than to "upstream activities" - such as planning for S&T. We think that any follow-on to 5NR should consider making use of a number of additional collaborative mechanisms, including:

- **Strategic Plan**: Three-year strategic plan for 8NS.
- **Business plan**: Annual 8NS business plan.
- **Collaborative S&T mechanisms**: Research projects organized on FINE principles.
- **MOUs**: Formal arrangements with S&T organizations outside of government.
- **Expert committees**: Ad hoc committees of subject experts from inside and outside of government.
- **Peer review panels**: Committees of subject experts to review the results of research.
- **Interdepartmental staff cross-appointments**: Cross appointments of staff to two or more departments to work on horizontal files.
- **"Executives-at-large"**: Senior staff dedicated to managing horizontal files.
- **Policy councils**: Standing committee of senior science policy managers to oversee strategic planning.
- **Technology councils**: Standing committee of senior technology managers to oversee research and technology plans.
- **Board of directors**: A standing committee composed of senior government and non-government executives to oversee the strategic plan and business plan, and to review performance.

Making effective use of these mechanisms will require that any 5NR follow-on have its own small secretariat to manage the activity that is generated by these mechanisms.

8.0 FOLLOW-ON TO 5NR

There is a consensus among participants in 5NR that it was an important advance for its time, but has outlived its usefulness in its present form. At the same time, pressure is mounting to move to the next phase of federal S&T collaboration or "horizontality". This report concludes that natural science is one fundamental organizing theme for federal S&T[31]. New approaches to horizontality should be based, in part, around the theme of natural science.

The need for a collaborative federal approach to ongoing challenges and opportunities in related fields of natural science is growing. Examples of issues requiring interdepartmental collaboration include: Clean water, GMOs/Environmental effects of GMOs, Endocrine disrupting substances, Toxic substances in the environment, Invasive/exotic species, Emerging diseases (human, animal, plant), Bioterror, and Global warming/climate change adaptation.

Three missions - protecting society from nature, protecting nature from society, and developing nature in sustainable ways for the benefit of society - are as important challenges to federal S&T as ever - and possibly more so. These missions define a unique and important role for natural science S&T organizations within the federal government system.

8.1 8NS - A Virtual Natural Science Department

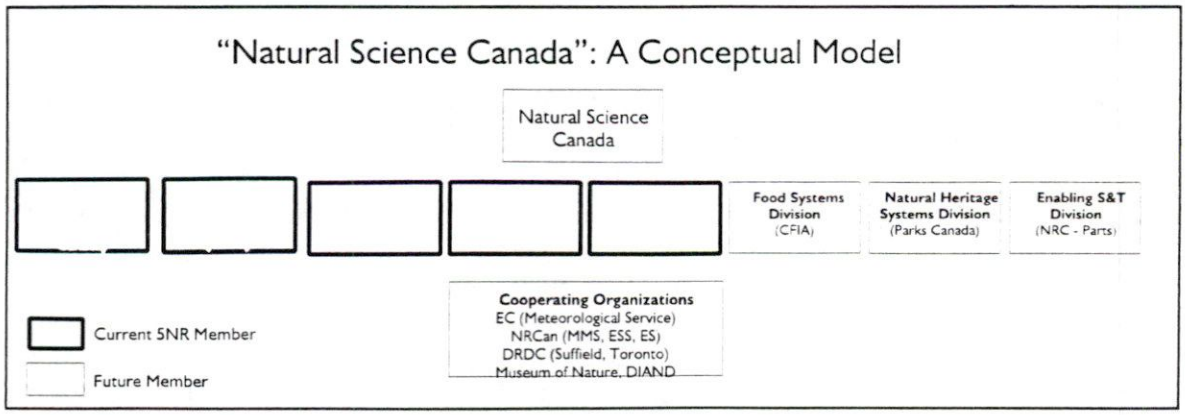
The 5NR departments constitute an immense natural science "safety net" for Canada. All 5 departments are centres of natural science expertise centred on biology, in its widest sense. In many respects, they perform the same function, using similar theories, tools and methods, but in different ecological systems. In effect, they constitute the core of what might be termed "Natural Science Canada" (see figure following).

Natural Science Canada is a model for thinking about the synergies in the missions of different natural science departments and agencies, by positing a single department to oversee all natural science S&T. Note: this is not an argument for creating such a super-department, rather it is an analytical tool for describing the similarity in roles.

From one perspective, the 5NR departments could be seen as different "divisions" of a hypothetical Natural Science Canada department. What differentiates them is that they apply their core biology competency to different natural systems - farms, forests, oceans, human populations, "wild" nature, etc. Each department fulfills the same mission - it protects society

[31] There may well be comparable organizing themes for other aspects of federal S&T.

from the undesirable aspects of its natural system, protects the natural system from society, and develops its system in sustainable ways for the benefit of society - but in a different domain of nature.



In addition to the original 5NR members, there are three other SBDAs that are significant natural science S&T performers and for whom biology is a core science competency. These include:

- Canadian Food Inspection Agency
- Parks Canada
- National Research Council (parts)

In addition, there are a number of SBDAs (or parts of departments) with complementary natural science interests and competencies that could be viewed as cooperating organizations:

- Environment Canada (Meteorological Service of Canada)
- NRCan (Mineral and Metal Sector, Earth Sciences Sector, Energy Sector)
- DRDC (Suffield, Toronto)
- Museum of Nature
- INAC

Cooperating departments and agencies have competencies and activities that intersect with those of the biology-based departments.

Integrating the original 5NR departments with the 3 other departments that have major natural science interests and a biology competency, would produce the 8NS Cluster - a grouping of the 8 Natural Science departments.

Integrating the original 5NR departments with the 3 other departments that have major natural science interests and a biology competency, would produce the 8NS Cluster - a grouping of the 8 Natural Science departments.

8.2 8NS Compared With Other Horizontal S&T Initiatives

5NR is one of many horizontal S&T initiatives that were put in place in the 1980s and 1990s (see table following). Twelve (12) of the better-known efforts (13 including 8NS) are noted below.

HORIZONTAL MANAGEMENT OF S&T - THE FEDERAL LANDSCAPE														
	Role				Governance			Operations				Funding		
S&T Mechanism	Coord. Role?	Policy Role?	R&D Role?	RSA Role?	Internal?	External?	Internal + External?	Rotating Secretariat?	Permanent Secretariat	Thematic Integration?	Structural Integration?	No Funding	Core Funding	Project Funding
A. Research-Oriented														
8NS	✓	✓	✓	✓			✓		✓	✓	✓		✓	✓
5NR	✓		✓	✓	✓			✓		✓				✓
Can. Biotech Strategy	✓	✓	✓	✓			✓		✓	✓				✓
PERD	✓		✓	✓	✓				✓	✓			✓	✓
CRTI	✓		✓	✓	✓				✓	✓			✓	✓
TSRI	✓		✓				✓		✓	✓				✓
FINE	✓		✓	✓	✓				✓	✓				✓
CCAF	✓		✓	✓										✓
B. Policy and Program-Oriented														
Science ADMs	✓				✓							✓		
Federal S&T Community Management Secretariat	✓	✓			✓				✓	✓				✓
Coord. Cttee. on Sustainable Devpt.	✓				✓									
FPTT	✓				✓				✓	✓		✓		
Industry Canada Portfolio Office	✓				✓				✓	✓		✓		

Of the 13 different initiatives, 8 have a primary research objective: that is, they are designed to support scientific research directed toward a specific (public policy) theme. Five others are principally aimed at policy or program development, but have no direct research output.

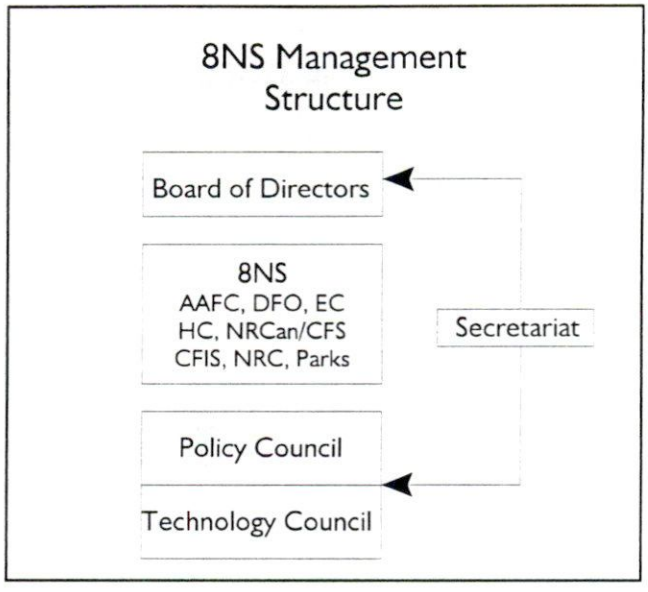
Several things are notable about past horizontal efforts:

- Most have a coordinating role; only a few have a policy development role.
- All the research-oriented activities have a direct role in supporting R&D or RSA.
- Most funding is project based, although a few initiatives also offer core (organizational) funding.
- Governance of the different initiatives is largely internal (to the federal government), although a few have a mis of internal and external governance.
- A number of initiatives do have permanent secretariats.
- All the initiatives are thematic - they are organized around research themes - rather than structural.

8NS would differ in several respects. First, it would aim at structural integration of federal S&T, as well as thematic integration. Secondly, it would have a mixed internal + external governance structure (board of directors). Thirdly, it would include an element of core funding, in addition to project funding.

8.3 Governance and Management

8NS would be a consortium of federal SBDAs that have a shared natural science mission and whose core science competency is biology. To overcome some of the barriers that constrained 5NR, 8NS would incorporate a number of new governance and management features.



8NS provides an opportunity for SBDAs to be innovative in how they organize and manage their collaborative affairs. For instance, one of the apparent barriers to the success of 5NR is that the organization had to rely exclusively on "volunteer labour"; 5NR had no employees of its own. Staff time was "donated" by partner departments, but individuals still reported to their home department and not to 5NR. No individuals were responsible for the success of 5NR or its projects. 8NS could change this by, for example, appointing "executives at large" who would report directly to the 8NS Board of Directors. These individuals would devote all their time to managing horizontal files. Another example is the use of cross-appointments of S&T personnel to two or more departments, in order to work on horizontal files. 8NS provides an opportunity to re-think many of the "stovepipe" practices that make it hard to manage horizontal files in government.

8.3.1 Board of Directors

8NS would be governed by a Board of directors. Depending on the preference of the 8NS members, the Board could include departmental executives (DMs or ADMs) and/or representatives of individual departmental S&T advisory committees[32]. The Board would have 3 primary responsibilities. It would:

1. Review the 8NS 3-year Strategic Plan
2. Review the annual Business Plan
3. Assess 8NS' progress on an annual basis

The Board would be served by a stand-alone Secretariat.

8.3.2 Secretariat

8NS would have a small, full-time Secretariat. The Secretariat could be staffed either by individuals seconded from 8NS members, or by staff specifically hired for the positions. The Secretariat would have a number of functions:

1. Under the guidance of the Board, prepare the 3-year Strategic Plan.
2. Under the guidance of the Policy Council and Technology Council, prepare the annual Business Plan.
3. Prepare an annual report of progress for the Board.
4. Provide a secretariat function for the Board.
5. Provide a secretariat function for the Policy Council and the Technology Council.
6. Manage certain 8NS corporate functions, such as communications, "investor relations", and interdepartmental coordination.

[32]As such, the Board would be a "mini-CSTA".

8.3.3 Policy Council

The Policy Council would consist of the DGs or Directors of each 8NS department responsible for S&T policy. The role of the council is to:

1. Guide the development of the policy component of the Strategic Plan and Business Plan.
2. Coordinate horizontal S&T policy initiatives.
3. Create a working relationship with the Technology Council to strengthen science-policy linkages.

The 8NS Secretariat would provide support to the Policy Council. The Chair of the Policy Council would serve as Vice-Chair of the Technology Council, to ensure close working relations between the two councils.

8.3.4 Technology Council

The Technology Council would consist of the DGs or Directors responsible for major laboratory groupings in each 8NS department. The role of the Technology Council is to:

1. Guide the development of the science and technology component of the Strategic Plan and Business plan.
2. Oversee specific 8NS research projects.
3. Create a working relationship with the Policy Council to strengthen science-policy linkages.

The 8NS Secretariat would provide support to the Technology Council. The Chair of the Technology Council would serve as Vice-Chair of the Technology Council, to promote close working relations between the two councils.

8.4 Financing

Like 5NR, 8NS will need financial resources to pay for its operations (e.g. the Board and Secretariat) and its research activities. 5NR never successfully came to grips with funding issues, and finally settled on a project-by-project (or pay-as-you-go) funding model. This proved less than satisfactory.

We believe that the funding issue at it was then regarded, was in fact something of a red herring. Most financial resources in government - 70% is a reasonable estimate - are devoted to staff salaries and benefits. Therefore, we would argue, a more useful "currency" for funding inter-departmental S&T activities is PYs, and not dollars. Once personnel are allocated to a project (organization) - usually on an in-kind basis - then it is easier to deal with the 30% of related costs

that may need to be paid for in the form of cash. For the majority of 8NS activities, participating departments should be primarily contributing staff time.

If, nominally, 20% of an SBDA's resources are devoted to collaborative activities through 8NS, then departments should make provision in their budgets, to devote 20% of staff time and 6% of O&M (30% of 20%) to 8NS. Practically speaking, it will take a couple of years for 8NS to gear up, providing a transition period to implement the new financing model. Thus, in Year 1, 8NS members might be prepared to allocate 10% of staff time and 3% of O&M to joint activities. In Year 2, they would allocate the remainder.

It would be prudent for 8NS to plan its financial affairs on the basis of having no new money to finance activities. Should circumstances change, then alternate arrangements can be made.

8.5 Priority Setting and Program Development

8NS will need to establish a process for (research) priority setting and program development. Its challenge will be to determine those aspects of federal S&T which will benefit from a horizontal management approach. (In our view, horizontality need not apply to each and every aspects of S&T[33].) Moreover, there will undoubtedly be areas where horizontality will need to be extended to collaboration with organizations outside of government - in particular universities and non-profit organizations.

Priority setting and program development are central outputs of the business planning approach which is recommended below (see Recommendation #4). The mechanism(s) which 8NS will want to use to formulate its priorities and plans will need to be determined at the time. Obviously, planning will involve a considerable amount of consultation among SBDAs and with the proposed Board of Directors (see Recommendation #2). Foresight work that is currently being led by NRC can also help. Delphi studies, stakeholder consultations, capacity studies and other mechanisms can also help 8NS to establish its collaborative research priorities. In addition, the proposed FINE initiative includes a mechanism for project selection. Should FINE be funded, then projects can be folded into the 8NS planning cycle.

[33]In fact, one of the pitfalls of horizontality is to assume that every aspect of S&T needs to be managed horizontally.

9.0 RECOMMENDATIONS

This report concludes that the time is right to move to the next phase of federal S&T "horizontality", and that natural science is a central organizing theme for future collaboration. The report identifies 8 SBDAs with significant natural science interests and associated biology competencies, and proposes that these organizations create "8NS" - a consortium of 8 natural science departments.

The next phase of collaborative S&T should emphasize a matrix management approach in which SBDAs align resources jointly with their traditional departmental mandates, and with emerging interdepartmental mandates. Future collaboration needs to retain the current thematic approach to horizontality - collaboration around specific S&T themes or issues - but move toward structural collaboration - integration of facilities, equipment and expertise. Following are a number of recommendations that would help to implement these changes.

Recommendation #1

Reformulate 5NR into 8NS - a consortium of 8 Natural Science departments and invite new partners to join:

- AAFC
- Canadian Food Inspection Agency
- NRCan - Canadian Forest Service
- Fisheries and Oceans Canada
- Environment Canada
- Health Canada
- NRC (biology/life science institutes)
- Parks Canada

Recommendation #2

Adopt a new governance and management structure with a:

- Board of Directors
- Full-time Secretariat
- Policy Council
- Technology Council

Recommendation #3

Initiate studies to investigate the potential and mechanisms for partial structural integration of 8NS departmental S&T capacity: integration of facilities, equipment, and expertise:

- A major facilities inventory and resource sharing analysis
- A major equipment inventory and resource sharing analysis
- An expertise inventory and expertise sharing analysis

Recommendation #4

Implement horizontal planning, by commissioning the 8NS Secretariat to develop a:

- 3-year 8NS Strategic Plan; and,
- Annual 8NS Business Plan

Recommendation #5 Significantly expand opportunities for S&T and planning personnel from different 8NS departments and agencies to meet one another and learn about their plans and priorities, and research capacities and interests, for example through:

- a bi-annual 8NS S&T summit and trade show

Recommendation #6 Adopt a new financing and management approach to 8NS that assumes that no new resources will be available to 8NS, and that prepares to allocate up to 20% of personnel and associated research costs, to 8NS collaborative S&T activities over a period of 2 years.

Recommendation #7 Annually evaluate and report to the Board of Directors on 8NS activities, outputs and impacts against Business Plan and Strategic Plan objectives.

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Appendix I
List of Interviews

Agriculture and Agri-Food Canada
Bruce Mitchell
Gordon Dorrell

Environment Canada
Ken Sato
Philip Enros
John Carey
Robert Slater
Marc Denis Everell
Karen Brown

Health Canada
Rod Raphael
Dann Michols
Kevin Keough

Fisheries and Oceans Canada
Kathleen Fischer
Wendy Watson-Wright

NRCan
Gordon Miller
Yvan Hardy
Richard Haworth

National Research Council
Richard Isnor
Peter Hackett

Defence Research and Development Canada
John Leggat

Appendix 2

MEMORANDUM OF UNDERSTANDING ON SCIENCE AND TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT IN THE NATURAL RESOURCES SECTOR

between

Agriculture and Agri-Food Canada,
Environment Canada,
Fisheries and Oceans Canada,
Health Canada,
and
Natural Resources Canada

WHEREAS the Government of Canada is committed to Sustainable Development; and,

WHEREAS the five Departments, the Parties to this Memorandum of Understanding, manage federal interests in their respective sectors; and,

WHEREAS the ongoing and future collaborative work under the Memorandum of Understanding in support of Sustainable Development has been outlined in the Appendix and the Annual Reports;

NOW THEREFORE, this Memorandum of Understanding sets out the understandings of the Parties for conducting collaborative science and technology (S&T) activities for Sustainable Development in the Natural Resources Sector, as follows:

1. PRINCIPLES

1.1 The Departments recognize that there is already within the Government a significant level of collaboration and coordination in S&T through a wide range of mechanisms. They will manage their existing mechanisms for cooperation and add new mechanisms, if necessary, using the following principles:

- that issues be led by the Department for which the issue is of primary interest;
- existing mechanisms be used as much as possible;
- flexible and responsive structures be maintained; and,
- that consideration be given to focus on a limited number of issues of strategic interest on areas of mutual importance to Departments.

2. ISSUES

2.1 A limited number of issues for common action by two or more Departments will be identified and addressed. Current and proposed issues for common action are presented in the Appendix and the Annual Reports.

3. MANAGEMENT

3.1 The responsibility for achieving an effective level of collaboration amongst the Departments will be exercised annually by the Deputy Ministers, to reach a consensus on issues and to assess progress on work to date.

3.2 Each Department will identify an Assistant Deputy Minister with S&T responsibilities to represent that Department in the context of this Memorandum of Understanding. Collaboration at an operational level will be achieved by the S&T Assistant Deputy Ministers, who will meet several times a year to raise and assess issues for potential collaboration, to assign responsibilities and strike joint working groups, to evaluate and report on progress of initiatives, and to review the direction and focus of the activities under the Memorandum of Understanding from time to time.

3.3 Responsibility for chairing meetings (referred to in paragraphs 3.1 and 3.2) will rotate amongst the five Departmental principals.

3.4 Collaborative mechanisms that could be used by the Parties to any joint projects include:

- ad hoc working groups
- joint science assessments
- national science fora
- joint science communications and promotions
- other mechanisms, as appropriate.

3.5 An annual report and a plan of joint work for the following year will be prepared for consideration by Deputy Ministers.

4. OWNERSHIP AND COMMERCIALIZATION OF RESEARCH RESULTS

4.1 All research pursuant to this Memorandum of Understanding shall be joint research. The Parties performing the joint research shall develop Joint Project Agreements which shall contain, as a minimum, principles in respect of the ownership, protection, publication and use of information and Intellectual Property to be furnished or created in the course of the joint research. These Joint Project Agreements shall be developed taking into account the relative contributions of the participants.

4.2 With respect to Intellectual Property Rights, the Joint Project Agreements will normally address, inter alia, arrangements for ownership and user rights for research and development purposes; protection, licensing and exploitation; dissemination, including joint publications, and disclosure of undisclosed information; the management of background and foreground Intellectual Property; the rights and obligations of visiting researchers (if applicable); and other factors deemed appropriate by the Parties.

4.3 Information of Intellectual Property created in the course of the joint research but not anticipated in a Joint Project Agreement shall be allocated following the principles set out in the applicable Joint Project Agreement.

5. EXCHANGE OF INFORMATION AND CONFIDENTIALITY

5.1 Subject to the restrictions set out in this section, the Departments will share information through the Assistant Deputy Minister Steering Committee to keep each other informed of progress and results from science activities, research and development and technology transfer in areas of joint interest.

5.2 The Departments recognize and acknowledge that by the nature of their respective operations, they will be involved, not only with each other, but also with various third parties (e.g. other government departments and agencies, industry, universities, provincial and international affiliates) in research, development and technology transfer in various areas, and that as result of such involvement, confidential information may by either generated or obtained from the third parties. Nothing in this Memorandum of Understanding requires the Departments to disclose to one another any confidential information that is proprietary to the Departments or to a third party.

5.3 Each Department may place restrictions, limitations, and conditions that it deems appropriate upon confidential information that is proprietary to it and that it elects to disclose to the other Party. Each Department will require permission from the other Parties before the release of confidential information originating with the other Parties.

5.4 The understandings in this section are subject to any specific provisions contained in any agreements entered into from time to time by any of the Departments.

6. TERM OF MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding, which is renewed effective January 19, 1998, will be renewable every three years with the mutual consent of the five collaborating Departments. Any Party may terminate its participation in this Memorandum of Understanding by giving three months written notice to the other Parties. The terms of the Memorandum of Understanding may be altered by written agreement of the five Departments.

IN WITNESS WHEREOF, the following Departments have duly executed this Memorandum of Understanding.

Agriculture and Agri-Food Canada

PER:_____

Frank Claydon
Deputy Minister
Agriculture and Agri-Food Canada

DATE:_____

Environment Canada

PER:_____

D. Ian Glen
Deputy Minister
Environment Canada

DATE:_____

Fisheries and Oceans Canada

PER:_____

Wayne Wouters
Deputy Minister
Fisheries and Oceans Canada

DATE:_____

Health Canada

PER:_____

Michèle Jean
Deputy Minister
Health Canada

DATE:_____

Natural Resources Canada

PER:_____

Jean McCloskey
Deputy Minister
Natural Resources Canada

DATE:_____

FRAMEWORK FOR A RENEWED MEMORANDUM OF UNDERSTANDING

Introduction

Natural resources are part of Canada's identity and key components of its economy. With the goal of wise use and sustainable management to help maintain economic growth comes the understanding that success also requires coordinated effort and teamwork among departments, with stakeholders, and across sectors. This understanding was firmly in mind when the original Memorandum of Understanding (MOU) was signed by the founding four departments.

With the renewal of the MOU also comes the recognition that environmental health is a key component of sustainable development in the natural resources sector. It was with this understanding, and the fact that health issues were already addressed in a number of joint initiatives, that Health Canada was invited to join the original member departments under the MOU.

Maintaining the course toward sustainable development takes on an added challenge as federal organizations rethink priorities, strategies, and new approaches to doing business. Doing the same with less, or doing more with less, means finding innovative ways to work together for common goals. This is a significant factor driving the MOU as it reaches out to other departments and agencies to help address issues and forge partnerships. For instance, Health Canada was a member of the working groups addressing metals in the environment and endocrine disruptors, and it was recognition of their role in addressing health issues in sustainable development of our natural resources that spurred the expansion to include a fifth department.

Another part of the MOU foundation, the federal science and technology (S&T) strategy, is evident in activities to date as departments are working together on priority S&T issues. Working groups have collaborated in various initiatives including research and development priority setting and the Internet, so as to demonstrate the use and value of information technology and information management strategies to increase awareness and support of sustainable development issues.

The main strength of the MOU is its ability to bring signatory departments together to address issues of common concern that are either current or beginning to emerge. The six original working groups have produced substantial reports, forged partnerships among the member departments and built bridges with other departments. With the success of this approach, other new working groups have been added to deal with a broad range of science and science management issues ranging from ways to value natural capital to creative ideas to improve cooperation and collaboration in the use of the Internet.

The value of the MOU can also be seen through links to other federal initiatives such as biotechnology, northern science, the implementation of Canada's new federal S&T strategy, and increased mobility of staff under the "Framework for the Human Resources Management of the Federal Science and Technology Community". Other related linkages include departmental sustainable development strategies, horizontal S&T issues, science policy for better program delivery, and the Auditor General's report on S&T.

The future is firmly in mind with the first renewal of the MOU. Those involved are ensuring it matches the reality of today's federal government while they also look to the future. The MOU has proven to be an effective coordinating tool in its first three years, and it is expected to work well in meeting future challenges.

Moving Forward

The MOU has shown itself to be a catalyst in moving forward the sustainable development agenda, and its renewal will help to strengthen collaboration among its partners into the next century.

Some invaluable guiding principles have emerged from the experience of the first three years of the MOU. Continued success depends on

- achieving tangible results;
- clearly establishing itself as *the* way for delivering on pertinent topics for all work undertaken;
- involving activities of scientific and strategic interest to all departments, *but* each department need not have an active research or management role in each scientific topic;
- expanding the MOU working groups to include key players as issues emerge;
- being considered as an appropriate vehicle for proactive work on other government priorities while recognizing that the MOU will be primarily concerned with horizontal issues related to science for sustainable development.

As planning proceeds for the future, the ADM Steering Committee has the advantage of looking back on a record of considerable success. The working groups are completing their work, increasing collaborative efforts among participating departments and producing reports. More important, they are establishing new ways of working together and thinking about issues. Success has also meant the establishment of additional working groups. They are good examples of the response to new management issues, new areas of scientific concern, attempts to broaden the base of the MOU from headquarters to regions, and innovative ways to use new tools such as the Internet.

Major Issues

There has been extensive thought and planning invested by participants to determine the optimum future use of the MOU. It is anticipated that work will centre on three major issue areas:

1. *Science /Policy Issues*

By emphasizing specific sustainable development issues of interdepartmental interest, there will be more synergy for reaching an understanding, especially for issues that affect national policy. As some or all of the departments have to report periodically on water, air, and biodiversity, working groups may be established to address such issues. In other cases, new policy dimensions may be added to the work of current groups, such as those working on metals in the environment and climate change. Specific issues being considered for the immediate future include the following:

- Examining the role of science in establishing policies relating to sustainable development, since "sound science is central to sound policy and decision making".

- Developing the general principles for establishing the basis for a solid foundation of knowledge on issues such as soil, water, and air. This would allow for meeting a major future challenge, that of integrating insights from the social sciences into our work on sustainable development.

- Providing guidance on how future regional working groups should be organized and operated to function effectively in meeting the MOU objectives, based on experience gained from the Atlantic pilot.

- Using working groups as tools to allow the MOU to become the vehicle for government-wide strategic approaches on issues.

2. *Issues Related to the Federal S&T Strategy*

The MOU provides a vehicle to promote cooperation among the participating departments in implementing the federal S&T strategy.

- **Performance measurement**. The ADM Steering Committee will share experiences and principles underlying the measurement of performance in each of the departments, with respect to sustainable development.

- **Promotion of international S&T collaboration for the benefit of Canadian firms**. The departments will share best practices and make recommendations on the best approach to promote international S&T collaboration for the benefit of Canadian firms, including such options as membership in the international activities that can provide the greatest return to Canada through science, technology, and investment.

- **Promotion of partnership and collaborative S&T arrangements**. This is another area of interest to each of the departments. Experience in the results obtained from providing access for universities to research facilities, in the co-location of scientists with the provinces and universities, and in providing "small grant" support to research will be shared in an attempt to best address the objectives of the S&T strategy. Areas in which the provinces are expending significant scientific effort related to sustainable development will be sought out as a focus for increasing federal-provincial interaction.

3. *Management Issues*

The ADM Steering Committee and the DG Committee intend to share and implement best practices related to the management of S&T. Communicating the value of science related to sustainable development also represents another opportunity in which departments can learn from each other. Environment Canada's production of a series of science vignettes in conjunction with the Discovery Channel provides a valuable model for future work. Sponsorship of such public education materials could be among the joint opportunities for the participating departments to pursue in coming years.

With an expanded vision that includes association with other departments, Health Canada was invited to join as a new partner in MOU activities where appropriate. This move would help deal more effectively with integrating programs and issues, as now exists only in certain working groups. Provincial activity and potential input will be taken into account in addressing common challenges with these new partners. The proximity of the laboratories of different departments in some regions may facilitate reciprocity and sharing of services with each other, and with provincial counterparts.

APPENDIX 3. 5NR WORKING GROUP ACTIVITY		
Sustainable Management of Natural Resources		
Working Group	**Objective**	**Activities & Achievements**
• Nutrients in the Environment	To further understanding of the impact of nutrients on the environment. More specifically, its task is to consider if certain nutrients, rather than nutrients as a class, are creating problems.	The first compiled draft of the 5NR Nutrient Science Assessment was completed in March 2000
• Nutrients Science and Policy	To produce a policy analysis of the 5NR Nutrients Science Assessment and other policy-relevant information so that a federal agenda for action on nutrients can be recommended.	An analysis of federal nutrient-related programs and policies will identify key areas where further action and/or policy is needed to address major nutrient impacts identified in the science assessment. A multi-stakeholder National Nutrients Workshop held in Ottawa on March 19-20, 2001 had as objectives: discussion of conclusions of the science assessment, to share information on current actions and initiatives, and to recommend next steps in addressing nutrient impacts in the Canadian environment. The goals of the workshop were the sharing of knowledge and expertise on issues; recommendations for future directions for dealing with impacts; and identification of opportunities for cooperative actions and partnerships.
• Integrated Coastal Zone Management	Under the Oceans Act, the Government of Canada is committed to the development of an Oceans Management Strategy, and it depends on the collaborative development and implementation of plans that will integrate the management of activities in and near Canada's estuarine, coastal and marine waters. The objective of the ICZM Working Group is to identify and promote collaborative S&T efforts in support of ICZM across Canada.	Improved departmental representation, improved information sharing, and the establishment of basic standards and operating practices to maximize program delivery are highlights of ICZM achievements. An internet-based information clearinghouse has been developed in support of Canada's National Programme of Action (NPA) for the Protection of the Marine Environment from Land-based Activities. As well, an internet-based mapping and information system is on-line, designed to track, share and display details on coastal and ocean use activities and management regimes. A review of existing frameworks is underway.

Working Group	Objective	Activities & Achievements
• Climate Change and Variability	To ensure that the latest research-based information is available is a key objective, along with ensuring that the requirements for future research are understood. One of the first groups formed under the MOU, the Working Group's activities are designed to support the federal government priority on the climate change issue, and address the enormous need for co-ordination among all the federal partners.	The Working Group identified gaps and priorities in all facets of climate change research including physical science, impacts and adaptation. The Working Group determined that some focus was required on the question of its impact on ecosystems, and a task team was sponsored to address this particular issue. Over the past few years the Working Group has examined the priorities identified in the 1997 5NR workshop on the Science of Climate Change. Gaps in need of attention included climate system monitoring; research in climate system science and impacts; and enhancing the visibility of the 5NR research community. A major achievement included the creation of a list of scientific experts, including topics of expertise, contact information and language capabilities.
• Biota of Canada Information Network	A functioning national network of biodiversity databases linked through a taxonomic core containing all named species of interest to Canadians will, after implementation, permit anyone with the correct name of a species to gain access to authoritative and current information on its classification, distribution, ecology, status, genetics, and uses.	A national workshop in March of 2000 was mounted with financial support from all participating departments, and hosted by AAFC. The workshop was successful in explaining and discussing the rationale for the BCIN project with representatives of the 5NR and their business partners; validating the objective and goals of the BCIN; securing partnerships to resource specific activities under the BCIN goals; and activating a three-year business plan for the BCIN. There have also been working relationships established with relevant regional and international initiatives such as the North American Integrated Taxonomic Information System, the North American Biodiversity Information Network and the Global Biodiversity Information Facility. Working Groups are pursuing specific modules under BCIN goals. For instance, they are improving the Canadian content of the Integrated Taxonomic Information System; completing the Butterflies of Canada distributed database; initiating the Birds of Canada distributed database; and testing Species Analyst technology for developing applications for primary species data. Opportunities for securing additional resources are being pursued through networking and participation in partnerships.

Working Group	Objective	Activities & Achievements
Human Health and the Environment		
• Metals in the Environment	To identify priority tasks for collaborative metals in the environment research on common issues of importance to sustainable development, and to encourage research co-operation among scientists of the five departments.	The Working Group delivered a report in December, 2000, entitled, "Retrospect, Review and Prospect - 2000." The report set out the history of the group and its securing of funding for MITE process-related research in both government and universities. The question posed in the report was what next to best meet the needs for MITE science in the 5NR framework. Various options were provided. Current areas of research are providing the building blocks to resolve issues identified in the October 1996 industry-university-government multi-stakeholder multi-disciplinary Val Morin meeting, and in a EC-NRCan bilateral meeting in February 1997.
• Toxics Working Group	To address the Commissioners report. It is responsible for developing a co-ordinated federal response to the recommendations and facilitate interdepartmental implementation of the Government commitments made in that response.	The Toxics Working Group was formed (including representatives from AAFC, DFO, EC, HC, NRCan and PMRA), and Terms of Reference and a four-year business plan developed. A key milestone was the development and finalization of a Government Response to the Commissioner's report. This response was subsequently consolidated with that of another chapter and sent to the Standing Committee on Environment and Sustainable Development. The Toxics Working Group has prepared a draft action plan timeline and developed a proposal towards a 5NR agenda on toxics science. Work has begun on the 5NR toxics science agenda, and several individual departments are preparing (or have recently prepared) research agendas and/or strategies that include research, monitoring and related science assessment activities and plans for toxics and other substances of concern.

Working Group	Objective	Activities & Achievements
• Endocrine Disrupting Substances	To ensure sound scientific input into Canadian policy and regulatory activities, through co-operation among government departments. This is accomplished by reviewing and identifying the information needs and knowledge gaps, creating and maintaining an inventory of related departmental activities and promoting the communication of scientific information and developments on the endocrine disrupting issues among departments and to the public.	In 2000, the Working Group held a multi-departmental, multi-stakeholder workshop to establish a federal agenda on scientific assessment of endocrine disrupting substances in Canada. The proceedings and conclusions of the workshop have been published and distributed to the workshop participants, senior management of the 5NR departments and an executive summary has been made available to the general public. Based on the conclusions, the Working Group has proposed a list of research priorities and recommended a course of action for the 5NR departments. Communication of the issue was enhanced with the establishment of a web site on Environment Canada's Green Lane to help transfer information on this issue to the public.
• Children's Environmental Health	To promote co-ordinated action among the 5NR departments on S&T projects addressing environmental concerns with a specific view to ensuring the health of children.	During the last year, the Working Group on Children's Environmental Health undertook an initial analysis of gaps in the protection of children's environmental health. Building on the gaps analysis, the Working Group also organized the workshop Our Children, our Health: Towards a Federal Agenda on Children's Environmental Health. It was held in Ottawa on May 8-9, 2000 and was attended by 100 participants from the 5NR, other government departments, provincial and municipal governments, non-profit organizations as well as industry representatives. Proceedings of the workshop were translated and published during the Fall of 2000.

Working Group	Objective	Activities & Achievements
Risk Assessment and Management		
• Science and Implementation of the Precautionary Approach	To provide the risk analyses presupposed when applying a precautionary approach are a key objective, and communicating the resulting alternatives and probabilities in ways that are understood by both those making and those affected by policies and decisions.	As a result of the launch of a Privy Council Office-led initiative to develop a Canadian government position on the Precautionary Principle, the Working Group suspended its activities. However, most of the members participated in the PCO initiative through their respective departments. The Working Group will reconsider its objective and business plan when the PCO work has set the government reference point for the Federal Framework for Precautionary Approach / Precautionary Principle (PA/PP).
Efficient and Effective Delivery		
• Valuing Natural Capital	To provide a Canadian perspective on the work of the World Bank, the OECD, and other international agencies on valuing natural capital. The current focus is on valuing Canada's water resources, and is linked to work by Statistics Canada to develop satellite or green national accounts.	The Working Group collaborated on a preliminary assessment of water uses and values in Canada. Water is valued by summing numerous uses and functions, such as irrigation, fishing, municipal drinking water and industry draws. The collaborating departments in this Working Group conducted the searches for the data matrix using respective areas of expertise. In 1998, the Working Group, led by Environment Canada and Statistics Canada, submitted a successful proposal for a pilot project on valuing Canada's water resources to the Policy Research Data Group of the federal governments Policy Research Secretariat. Funding for this project is $200,000 over a three-year period (1999-2002). A memorandum of understanding (MOU) was signed between Environment Canada and Statistics Canada in 1999, and outlines the two main objectives of this project: to derive an estimate of the national value of Canada's water resources, and to develop a monetary national water resource account that could be integrated in a satellite account for natural resources. For the first phase of this project, a framework study, was completed by two of Canada's leading water analysts, and presented during a day-long workshop sponsored by the natural capital Working Group in June, 2000.

Working Group	Objective	Activities & Achievements
• Knowledge Integration	To investigate the broader information aspects of knowledge integration and opportunities. This included increased access to and the use of all sustainable development information for 5NR priorities. The objectives are to increase information and knowledge flows, enhance search for scientific information within the 5NR departments and provide better access to 5NR information by external clients. The 5NR Working Group on Knowledge Integration focuses on integrating S&T data, information and knowledge to help the federal government meet its priorities.	Setting strategic intent and development of a business plan activities were integrated with establishing partnerships and identifying resources as activities. Activities have not yet begun. Other areas of activity involve the identification of barriers to sharing information, and making recommendations on steps to eliminate those barriers. A proposal from NRCan to lead in the development of the Sustainable Development/Science and Technology Portal will focus initially on 5NR departments. In addition, a priority initiative of the Strategic Alliance of Federal Science and Technology Libraries includes the development of simultaneous, seamless searching of Federal Sci-Tech library catalogues through a single Web interface, and the 5NR Libraries of the Alliance will develop a prototype gateway for the sci-tech libraries to facilitate the sharing, integrating and harvesting of federal government scientific information.

Working Group	Objective	Activities & Achievements
Communication and Outreach		
• Communications	To develop communications initiatives that serve to support a higher level of scientific awareness among Canadians, to help make scientific results more useful to society, and to give a clear and credible accounting for the investment by the public in federal S&T.	The Working Group focuses its efforts on external audiences (decisions makers, youth interested in science, public interested in influencing science policy, science media, and scientists serving as spokespeople). Achievements include: Discovery Channel vignettes aired over the past four years featuring 5NR scientists shown in the news magazine @discovery.ca, each episode reaching 500,000 viewers, and radio spots spun off and distributed to 600 stations across Canada; exhibits produced to showcase 5NR research achievements in sustainable development, presented over the past two years at more than 15 events; and a brochure on sustainability with a complimentary poster (17,000 posters distributed to schools across Canada; 15,000 brochures distributed to Members of Parliament, Senators, industry clients, government decision-makers, and the public at science events). There were a number of other achievements as well, including the promotion of the 5NR web site; courses developed and presented to train scientists in the policies and the techniques related to communicating science to the public; and a national program of awards and showcases developed to recognize excellence in research and development, to be implemented over the next two years.

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