Proceedings, Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Barry Wellar, Editor

**Papers from the Research Colloquium on
Using the Retrospective Approach
to Mine for GIS Nuggets**

**Colloquium held at
Esri International Headquarters
Redlands, California
February 13-14, 2015**

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PREFACE

The Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets is organized around a directive question:

> **How can looking back at what has been done, or not been done in the field of geographic information systems (GIS), contribute insights into why and how the field of GIS could and should evolve in the coming years?**

With that question providing an overall sense of purpose, the 2015 colloquium is an important first step in elaborating what we can learn from the past, and how we can learn from the past, to inform the futures of:

- GIS technology research, design, development, and implementation;

- GIScience methods, techniques, and operations; and,

- The uses of GIS technology and GIScience by government, business, academe, the media, and other organizations.

This production consists of two parts: background materials, and six papers.

The next several pages put the colloquium in context. It is anticipated that these materials will be instructive for those who want to relate the colloquium activity to other research activities and experiences. And, it occurs that the background materials may be informative for future inquiries into the rationale, purpose, objectives, etc., of the colloquium initiative.

As demonstrated by numerous postings about the colloquium, (http://www.wellar.ca/wellarconsulting/home.html), and a variety of industry, academic, association, and other reports over the past eight months, the event took place after extensive deliberations and communications, and yielded a substantial body of documentation. That the body of documentation could be assembled as part of the history on the GIS retro initiative.

In the interim, the why's and how's, and key contributors behind the colloquium, are outlined in the next several pages through the following background materials:

- Origins of the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets,
- Colloquium Announcement,
- Call for Presentations, and
- Acknowledgements.

ORIGINS OF THE RESEARCH COLLOQUIUM ON USING THE RETROSPECTIVE APPROACH TO MINE FOR GIS NUGGETS

The decision to organize a research colloquium on using the retrospective approach to mine the literature for GIS nuggets arose as a result of reviews of *AutoCarto Six Retrospective,* in which 37 authors re-visited papers written 30 years previously for the Sixth International Symposium on Automated Cartography in 1983. (http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf)

Four summary points appear sufficient to establish the rationale underlying the decision to proceed from *AutoCarto Six Retrospective* to the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets.

First, the general sense of the reviews was that the papers in *AutoCarto Six Retrospective* made an excellent case to significantly broaden the scope and function of the retrospective approach.

Using the retrospective approach to mine the literature for GIS nuggets was among the topics that came to mind when I thought of possible next steps.

Feedback on the article, Using the Retrospective Approach to Commemorate AutoCarto Six (published in *International Journal of Applied Geospatial Research (IJAGR).* 5(1), 93-99), confirmed my impression that this was an important but overlooked aspect of GIS and GIScience evolution, and that a colloquium would be an instructive way to further explore the challenges and opportunities of a GIS retrospective research agenda.

Second, contributors to *AutoCarto Six Retrospective* suggested that the retrospective research "model" initiated by the project warranted more attention and more discussion.

It was their view that with *AutoCarto Six Retrospective* providing a substantive link to many aspects of the original thinking behind GIS and GIScience, a directive body of material was in place to guide the design of a colloquium or similar gathering to explore the idea of using the retrospective approach to mine the literature (and other productions) for GIS nuggets.

Third, and continuing a pattern that began to be established *circa* a decade or more ago, the retrospective project led to another round of communications from Canada, the U.S., and abroad lamenting the lack of government support for research or science, applied or otherwise.

The general tenor of comments was that the retrospective initiative by the private sector was a needed and welcome contribution to GIS and GIScience development and expansion, and that it provided a substantive basis to elaborate and extend the ideas and expert opinions found in *AutoCarto Six Retrospective.*

Further, the idea of organizing a colloquium as a follow-on project was positively received, and especially if the presented materials would be digitally accessible and freely available.

Fourth, while there was support for organizing a conference as a major part of a GIS retrospective program, it became apparent after exchanges with potential contributors that a conference in the immediate future would be premature. Rather, a research colloquium emerged as a prudent, practical next step.

Specifically, in the absence of a well-developed body of published, precedent work on applying the retrospective approach to mine for GIS nuggets, the colloquium should emphasize presentations that identify likely sources of GIS nuggets, and suggest, outline, etc., how to design retrospective mining activities.

Then, depending upon the outcomes of the colloquium, an informed decision could be made about whether to take the conference route.

This is the long story short regarding the origins of the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets.

Readers seeking more details may find them in:

1. The papers which follow in the colloquium proceedings;

2. The colloquium slide decks, which can be viewed at http://www.wellar.ca/wellarconsulting/;

3. Colloquium-related materials which can be viewed at http://www.slideshare.net/wellarb/presentations; and,

4. Two journal articles by B. Wellar. Using the retrospective approach to commemorate AutoCarto Six. *International Journal of Applied Geospatial Research (IJAGR)*. 5(1), 93-99. 2014.; and, Review and implications of the AutoCarto Six retrospective project. *International Journal of Applied Geospatial Research (IJAGR)*. 6(3), 73-90. 2015.

Barry Wellar, Organizer
Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

COLLOQUIUM ANNOUNCEMENT

(Posted July 3, 2014 at http://wellar.ca/wellarconsulting/home.html)

Esri to Support and Host GIS Retro Colloquium

Dr. Barry Wellar received a grant from Esri International to support organizing the *Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets*. The Colloquium will be held February 13-14, 2015, at the Esri campus in Redlands, California.

In 1983, Prof. Wellar was director of the technical program committee and editor of the *Proceedings, Sixth International Symposium on Automated Cartography* (http://wellar.ca/wellarconsulting/home.html), which is widely regarded as one of the most influential international contributions to the evolution of automated cartography, geographic information systems, remote sensing, surveying, and related fields.

Then in 2013, to commemorate the 1983 conference he organized and edited *AutoCarto Six Retrospective,* in which 37 authors re-visited papers written 30 years previously. (http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf)

Topics discussed by these leading contributors to the literature include:

- Thoughts shaping the design of the 1983 papers;
- Derivative attributions;
- Original contributions to the literature;
- Impacts;
- What was new in the papers; and
- What was different in the papers.

Background documents which will be used to design the colloquium curriculum and the conference program include "Using the Retrospective Approach to Commemorate AutoCarto Six", which is published in the ***International Journal of Applied Geospatial Research*** (Volume 5, Issue 1, 93-99) and a second paper, "Review and Implications of the AutoCarto Six Retrospective Project" which also has been accepted for publication post-colloquium in the *International Journal of Applied Geospatial Research (IJAGR)*.

Don Albert, editor of *IJAGR*, has agreed that a pre-publication copy of "Review and Implications of the AutoCarto Six Retrospective Project" can be made available to colloquium participants.

CALL FOR PRESENTATIONS

(Posted August 15, 2014 at http://wellar.ca/wellarconsulting/home.html)

Esri-GIS Retro Research Colloquium: Using the Retrospective Approach to Mine for GIS Nuggets. February 13-14, 2015.

Topics

The 2015 Retrospective Research Colloquium is designed in conjunction with plans for a possible follow-on Conference in 2016. The focus of the Research Colloquium is on presentations which discuss why and how different kinds of literature and other sources could be mined for GIS nuggets serving one or more of the following missions:

- **M1.** Designing and developing geographic information systems technology;
- **M2.** Defining and elaborating geographic information science;
- **M3.** Using geographic information systems technology and/or geographic information science.

The kinds of literature to be discussed include:

- Learned Literature
- Popular (Media) Literature
- Legal Literature
- Regulatory Agency Literature
- Oversight Agency Literature
- Professional Literature
- Public Interest Literature
- Special Interest or Vested Interest Literature
- Corporate/Institutional-Public Literature
- Corporate/Institutional-Private Literature
- Other Productions

Presentation and Publication Options

Presentations can be given at the Colloquium, or remotely by means of WebEx.

Published works will be included in the Colloquium's video production, or as a paper in a digital proceedings.

Further Information

View materials at http://wellar.ca/wellarconsulting/home.html or contact Barry Wellar at: wellarb@uottawa.ca.

ACKNOWLEDGEMENTS

The closing words of acknowledgment recognize the founder and president of Esri International, <u>Jack Dangermond,</u> an internationally known leader in the GIS industry, with a distinguished track record.

Back in the day, so to speak, Jack participated in the AutoCarto Six Symposium in 1983, for which I was program chair.

At my request Jack agreed to give a keynote address on the topic "Science and Geographic Information Technology", which was one of the early occasions that the concepts of GIS technology and scientific methodology were combined in a high-profile international conference event.

Thirty years later in 2013, when asked to contribute to *AutoCarto Six Retrospective,* Jack responded by authoring the "Introduction", and arranged for Esri to financially support publishing the compilation of papers.

And, when presented with the idea of a colloquium on the topic of using the retrospective approach to mine for GIS nuggets, Jack offered financial assistance to organize the colloquium, and made facilities and staff available to hold the colloquium at the Esri campus in Redlands.

We are deeply indebted to Jack for his continued, enthusiastic support of research seeking to advance GIS technology, GIScience methodology, and the uses of GIS and GIScience.

As organizer of the colloquium, and editor of the proceedings and the deck of slide presentations which has been prepared as a companion production , I wish to conclude these brief remarks by emphasizing that the lead-up to the colloquium, the colloquium event itself, and this production are the results of a team effort.

I am deeply grateful for the assistance and encouragement received during the GIS retrospective initiative.

Barry Wellar, Editor
Proceedings, Research Colloquium on Using the Retrospective Approach
to Mine for GIS Nuggets

Ottawa, Ontario
February 20, 2015

**SUMMARIES OF PAPERS,
RESEARCH COLLOQUIUM ON USING THE
RETROSPECTIVE APPROACH TO MINE FOR GIS NUGGETS**

There are six papers in the proceedings, four of which are authored by Barry Wellar, and one each by Gordon Plunkett and Mike DeMers. The summaries overview how the papers represent an important first step in elaborating what we can learn from the past, and how we can learn from the past, to inform the futures of:

- GIS technology research, design, development, and implementation;

- GIScience methods, techniques, and operations; and,

- The uses of GIS technology and GIScience by government, business, academe, the media, and other organizations.

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Design and Module Considerations
Barry Wellar

The idea of a compendium of ideas arose as a means of illustrating the potential scope of the retrospective concept, and of broadening involvement in designing and applying the retrospective approach. The four idea-based compendium modules,

1. Ideas about "doing",
2. Ideas about objects of attention,
3. Principal GIS components as ideas, and
4. Ideas as questions and questions as ideas,

elaborated in the paper are substantive, directive "talking points" for further discussions and decisions about why and how to retrospectively mine the literature for GIS nuggets.

The discussion of modules 1, 2, and 3 suggest how the modules can be used as guides to mine the different literatures – corporate/institutional-private; corporate/institutional-public; learned legal; oversight agency; popular (media); professional; public interest; etc. – for nuggets such as: New or different ways to add to GIS technology: New or different reasons to add to geospatial information; and, New or different uses of GIScience research methods.

And, the discussion of module 4 demonstrates the value of questions as guides to mining the different literatures for nuggets such as: New or different reasons to adopt GIS technology; New or different ways to add to geospatial information; and, New or different uses of geospatial data.

Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to Retrospectively Mine the Popular Literature for GIS Nuggets

Barry Wellar

Organized around the concepts of the Doomsday Map and the Stewardship Map, this report documents, compares and contrasts, and analyses how media articles on the abuse versus care of land, water, and air resources over the 25 years between 1990 and 2015 provide a basis for questions to guide retrospectively mining the popular literature for GIS nuggets.

Key questions include: Who caused the change from abuse to care to occur? What caused the change from abuse to care to occur? Why did the change from abuse to care occur? When did the change from abuse to care occur? Where did the change occur? How did the change occur?

And, of critical importance to the GIS Retro initiative, for each of those questions, the really BIG question is,

<p align="center">Was GIS a factor?</p>

As emphasized throughout the report, the presence of geography in all the headlines and stories demonstrates the importance of giving the popular media literature its due regard as a significant, international source to mine for GIS nuggets involving GIS technology, GIScience methods and techniques, and the uses of GIS and GIScience in government, business, and academia.

Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development

Barry Wellar

Oversight agencies are key players in the processes of democratic governance.

This report reveals why more attention should be given to mining publications of federal, central, or national government oversight agencies which examine and evaluate federal government policies and programs that are geospatial in nature, and/or that use GIS technology, GIScience methods and techniques, or geospatial data in their oversight operations, and/or which recommend changes in why and how GIS technology, GIScience methodology, or geospatial data or information is used by line departments and agencies of federal, central, or national governments..

Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment

Barry Wellar

As the link or bridge between federal, central, or national governments and municipal governments, provincial and state governments have mandated responsibilities

affecting the commercial, cultural, economic, environmental, health, housing, industrial, legal, regional, social, transportation, urban, and other geographies of their jurisdictions.

By examining productions of the Environmental Commissioner of Ontario for illustrative purposes, this presentation outlines how mining oversight agencies at the provincial and state level could yield a bounty of GIS and GIScience nuggets.

Mining Open Data in Search of GIS Nuggets
Gordon Plunket

Many governments around the world have signed and are implementing the Open Data Charter that among other things encourages government-created data to be accessible and (re)useable by default. Because this is a global phenomenon which is facilitated by technology and led by governments, there is significant potential for the geospatial community to use open data for developing geographic innovations, and for helping improve the flow of spatial and non-spatial data within and between communities.

While governments collect a wide range of data for their own uses, they often do not share these data sets in ways that are easily discoverable, useable, or understandable by the public or sometimes even by the experts. By examining existing policies, sources and uses of open data, this paper demonstrates the potential value of open data for GIS and GIScience practitioners.

One of the potential roles of GIScience is to characterize and analyze the changes that have occurred to our planet over time.

To do this requires the use of historical geographic data collected by institutions and individuals. Absent documentation of procedures, specifications, instructions and guidelines, an institution's collective memory is encapsulated in the data produced by the institution. The data sets persist long after they were created.

Without an understanding and record of the context or process by which the data were collected, it is impossible to determine if the data are fit for a particular use, or if investigative results are scientifically valid.

Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research
Michael DeMers

This paper discusses the academic and professional roots of GIS, including the technical and conceptual aspects, and briefly overviews the role that historical land classification research might have had in the conceptual evolution of geography and in the development of GIS. Based on a retrospective examination of the literature, the paper suggests how land classification research adds the best of the descriptive and scientific approaches to enhance the development of GIS.

It is recalled and emphasized in closing that the colloquium body of documentation also includes 13 slide decks, which are in a companion publication that may be viewed at http://www.wellar.ca/wellarconsulting/.

Further, a recording of the closing session will posted In due course. Information about access to the recording will be posted at http://www.wellar.ca/wellarconsulting/.

Barry Wellar, Editor
Proceedings, Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Ottawa, Ontario
February 20, 2015

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Considerations

Barry Wellar

Professor Emeritus, University of Ottawa

Principal, Wellar Consulting Inc.

President, Information Research Board

ABSTRACT. This compendium of ideas on using the retrospective approach to mine for GIS nuggets addresses two needs: 1) It is a means to involve many more people in the GIS retrospective program; 2) It creates an initial compilation of ideas which directly contribute to mining the various literatures – corporate/institutional-private; corporate/institutional-public; learned legal; oversight agency; popular (media); professional; public interest; etc. – for nuggets such as: New or different ways to add to GIS technology: New or different reasons to add to geospatial information; and, New or different uses of GIScience research methods. Four design principles (Focus on connecting "ideas" and "nuggets" Use a modular approach; Limit the modules to those required to effectively and efficiently launch the project; and Make it easy for those with different interests to modify the content of modules) provide clear instructions and directions throughout the compendium-building process. And, each of the four idea-based compendium modules (Ideas about "doing"; Ideas about objects of attention; Principal GIS components as ideas and spawners of ideas; and Ideas as questions and questions as ideas) can readily be expanded, extended, contracted, re-oriented, etc., to accommodate general as well as particular interests affecting decisions about GIS technology and GIScience methodology that are deliberated, adopted, and implemented by governments, businesses, learning centres, research centres, and other users of GIS technology and GIScience methods, techniques, and operations.

1. Origins of the Idea of Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets

The idea of developing a compendium of ideas arose in part in response to two perceived needs involving the Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets in early 2015, and the Conference on Using the Retrospective Approach to Mine for GIS Nuggets which could be a follow-on event in 2016[1].

First, by design the colloquium is a small-scale vetting or pre-test project, and participation in the colloquium in 2015 is limited to 8 to 10 presentations and associated question-and-answer (Q&A) sessions. Similarly, plans for the one-day conference in 2016 presently call for six presentations and Q&A sessions.

On the one hand, these are reasonable numbers for initial meetings on a topic which to has received limited public attention from academia, business, governments, or professional and trade organizations.

On the other hand, however, investigations and communications since beginning the "GIS retrospective" dialogue in 2013 suggest that numerous potentially pertinent ideas would not be duly considered, and might not receive as much as a mention even if we tripled or quadrupled the number of presentations made at both meetings[2].

The idea of developing the compendium of ideas was therefore borne in part as a way of overcoming organizational and logistical constraints. In brief, circulation of ideas about colloquium and conference presentations had been largely limited to communications with members the *AutoCarto Six Retrospective* contact lists[3], a sounding board of a half-dozen GIS and GIScience researchers, and several dozen potential contributors[4].

Their exceptional experience and expertise notwithstanding, the fact remained that only a very small portion of the GIS and GIScience communities was involved in discussions about the colloquium and the conference.

Fortunately, a similar circumstance had been encountered several years ago in my role as Distinguished Research Fellow, Transport Action Canada (TAC), and it was resolved by introducing the idea of a Transport Research Topics (TRT) Compendium[5].

Constructive lessons learned from the TRT Compendium and adapted here are that developing a compendium which is digitally accessible serves an international audience, opens the door to more ideas being introduced to the discourse, and creates a "host" to which more ideas can be added.

Four tables in the following sections present initial thoughts on the contents of the GIS retrospective compendium, and are the basis for suggesting how the compendium could assist in identifying, prioritizing, and designing missions to mine the literature and other productions for GIS nuggets[6].

Second, there is the matter of time, which is of paramount importance in the fast-changing fields of GIS and GIScience, as well as in the research, education, training, management, and applications aspects of using GIS and GIScience.

In the case of the GIS retro program, a colloquium in 2015 and a conference a year later in 2016 means considerable downtime for persons not on the contacts list.

Moreover, a year between public meeting events, bridged only by irregular status or event reports, would significantly inhibit receiving feedback from the GIS and/or GIScience communities.

Fortunately, again, previous experience with the TRT Compendium revealed that once the design is complete, a preliminary, indicative body of contents can be compiled relatively quickly from a mix of keyword-based literature searches, list serve inquiries, and surveys of experts, and posted. Then, updates ranging between incremental and comprehensive can be prepared as need requires and resources permit.

The idea of a compendium of ideas has the significant feature, therefore, of being a means to:

1. Achieve continuing visibility of the GIS retro program between the colloquium and the conference; and

2. Enable interested parties to become involved in GIS retro matters as soon as the compendium is published, and to remain apprised of compendium developments, by subscribing to an email list maintained by B. Wellar, or monitoring the GIS Retro website (http://www.wellar.ca/wellarconsulting/).

In addition to the idea of a compendium of ideas arising in response to perceived needs involving colloquium and conference matters, stimulus for the compendium also came from members of the GIS and GIScience communities who had contributed to *AutoCarto Six Retrospective* (Wellar, 2013), and/or had reviewed the two related papers prepared for the *International Journal on Applied Geospatial Research* (Wellar, 2014, 2015).

Specifically, there is general agreement that a correction is needed to bring better questions and more rigour into research involving GIS technology, GIScience methodology, and the uses of GIS and GIScience. And, there are also suggestions that the materials in the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets* should be used for purposes beyond a specific conference. That is, the materials should be disseminated in a more general way to encourage broader engagement in examining why and how to use the retrospective approach to mine for GIS nuggets.

Serendipitously, perhaps, the decision to split the colloquium and the conference caused the *Guide* to be withdrawn, which in turn opened the door to the idea of re-casting the materials in the *Guide* as the core components of an initial compendium of ideas. However, before committing to the compendium approach, a final check involved

exchanges with several *éminences grises* of science in general, and GIS and GIScience in particular on a project design matter.

That is, since scarce resources require choices between options, and the perception of "too much information" can be a distraction, second opinions were sought about the value of producing the compendium as a bridge between the colloquium and the conference, and as a contribution to the GIS and GIScience literature.

The idea of the compendium of ideas was greeted as an innovative and useful way to advance using the retrospective approach to mine for GIS nuggets. Further, in addition to endorsing the idea of a compendium, it was suggested that publishing the initial version would likely be a catalyst for prompting additional entries in updates, revisions, etc. As a result of that "vote of confidence", the decision was made to proceed with the compendium.

2. Terms of Reference for the Compendium Design

Three broad terms of reference appear sufficient to put the compendium design in context, and to provide guidelines for additions to the present compendium, or to create a variation of the present version. The terms are:

2.1.   GIS Nuggets as Findings.

2.2.   Bodies of Literature and Other Productions to
        Mine for GIS Nuggets.

2.3.   Nuggets as Links in Chains that Tie Past,
        Present, and Future.

2.1. GIS Findings as Nuggets

GIS nuggets are findings from the literature or other sources which serve one or more of the three core missions expressed in Figure 1.

Figure 1. GIS nuggets defined

GIS nuggets are findings from the literature or other sources which serve three core, related missions:
- **M1**. Designing and developing geographic information systems technology;
- **M2**. Defining and elaborating geographic information science;
- **M3**. Using geographic information systems technology and/or geographic information science.

GIS nuggets of possible or probable value include those listed in Table 1. As indicated, each nugget serves one or more of M1, M2, or M3. The common feature among all entries in Table 1 is the phrase <u>new or different</u>, which   has a range of applicability from the general or universal, to the particular or individual for each of the 15 entries.

The objective of the compendium of ideas, therefore, is to provide suggestions, hypotheses, theories, impressions, pointers, clues, indications, hunches, concepts, notions, beliefs, inklings, perceptions, guesses, estimates, views etc., that support, encourage, and offer direction on mining the literature and other productions in the search for nuggets such as those listed in Table 1.

Table 1. Illustrative nuggets to be derived from using the retrospective approach to examine "the literature"

1. New or different reasons to add to GIS technology;
2. New or different ways to add to GIS technology;
3. New or different reasons to add to geospatial data;
4. New or different reasons to add to geospatial information;
5. New or different reasons to add to geospatial knowledge;
6. New or different ways to add to geospatial data;
7. New or different ways to add to geospatial information;
8. New or different ways to add to geospatial knowledge;
9. New or different uses of GIS technology;
10. New or different uses of geospatial data;
11. New or different uses of geospatial information;
12. New or different uses of geospatial knowledge;
13. New or different uses of GIScience research methods;
14. New or different uses of GIScience research techniques;
15. New or different uses of GIScience research operations.

2.2. Bodies of Literature and Other Productions to Mine for GIS Nuggets

Table 2 presents an illustrative selection of bodies of literature which are candidates to be mined for GIS nuggets, including those listed in Table 1 and summarized as missions **M1**, **M2**, and **M3** in Figure 1.

In addition, there is an entry labelled "Other productions",

This approach gives due recognition to materials that are generally perceived as conventional literature, and also has regard for works or entities which may seem to be outside the purview of what is conventionally regarded as "literature", but which could be sources of GIS nuggets.

As discussed in section 2.3, there is a macro-temporal aspect – past, present, future – to the evolution of GIS, GIScience, and the uses of GIS and GIScience The phrase 'Other productions' is an effective way of taking into account materials for which labels are still in progress.

**Table 2. Bodies of literature and other productions
to mine for GIS nuggets**

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

(After: Wellar, B. 2005. *Geography and the Media: Strengthening
the Relationship.* Ottawa: Canadian Association of Geographers,
Canadian Royal Geographical Society and the Canadian Council on
Geographic Education. http://www.ccge.ca)

The objective of the compendium of ideas is to provide suggestions, hypotheses, theories, impressions, pointers, clues, indications, hunches, concepts, notions, beliefs, inklings, perceptions, guesses, estimates, views, etc., that support, encourage, and offer direction on mining the bodies of literature (and other productions) listed in Table 2 in the search for nuggets such as those listed in Table 1.

2.3. Nuggets as Links in Chains that Tie Past, Present, and Future

The third nugget returns to the theme of time mentioned in section 1, but from a significantly different perspective, courtesy of a comment by Prof. W.L. Garrison on the proposed compendium.

Prof. Garrison has made many insightful comments since the beginning of the GIS retro program in 2013, and this one significantly expands both the scope and the implications of the compendium as a source of ideas on using the retrospective approach to mine for GIS nuggets[7]:

> *"You use the word nuggets in useful ways. Perhaps nuggets could be
> thought of as links in the chain that ties the past to the present.... and
> in important ways the present to the future. Is that a thought about
> using nuggets to achieve richer futures?"* W.L. Garrison.

A leader in bringing about the quantitative revolution in geography and regional science in the 1950s, a colleague of Edgar Horwood in the early days of defining the field of urban and regional information systems more than 50 years ago, and a pioneering advocate on behalf of small area data in the infancy days of GIS and GIScience, Prof.

Garrison has pretty well 'seen it all' when it comes thinking about GIS nuggets in any manner, shape, or form.

An important message to be derived from the Garrison communique, therefore, is that it is prudent to think past tense, present tense, and future tense in association with any and all of the entries in the compendium tables in sections 3.1, 3.2, 3.3, and 3.4.

Or, to re-phrase, since there is a macro-temporal aspect (past, present, future) to the evolution of GIS and GIScience, and the uses of GIS and GIScience, it follows that regard for the macro-temporal aspect also applies to entries in the compendium tables which follow in section 3.

3. Compendium Design: Initial Considerations

As noted in section 1 on the origins of the idea of developing a compendium of ideas on using the retrospective approach to mine for GIS nuggets, the retrospective colloquium in 2015 and the planned retrospective conference in 2016 are small-scale vetting or pre-test projects.

Therefore, since the compendium is a bridge between the colloquium and the conference, it is designed accordingly.

Reviews of other compendium projects and exchanges with members of the contact list suggest four primary design considerations for the initial phase;

1. Focus on connecting "ideas" and "nuggets";

2. Use a modular approach;

3. Limit the modules to those required to effectively and efficiently launch the project; and

4. Make it easy for those with different interests to modify the content of modules.

In addition to that brief background statement on initial considerations, the following comments introduce the four primary characteristics of compendium design which define the modules presented in sections 3.1, 3.2, 3.3, and 3.4.

1. Ideas about "doing". The applied aspect of the GIS retrospective program involves doing research and doing GIS to derive nuggets such as those listed in Table 1. Table 3 in section 3.1 lists a number of activities in which we engage while doing research and/or doing GIS. The terms in Table 3 serve both as ideas, and sources of ideas, for designing projects to retrospectively mine the literature and other productions for GIS nuggets.

2. Ideas about objects of attention. The activities of doing research and doing GIS by academic, government, business, trade association,

professional association, and other interests are driven by numerous objects of attention. For the purposes of the compendium, a limited quantity of proposed core objects of research and GIS attention are presented in Table 4, section 3.3 as ideas, and sources of ideas, which could guide retrospectively mining the literature and other productions for GIS nuggets.

3. Principal GIS components as ideas and sources of ideas. The term 'principal' is used to refer to GIS components which are also described as critical, vital, central, core, essential, fundamental, basic, etc., the implication being that principal components play key roles in achieving GIS research, education, training, applications, operations, and management objectives.

   Principal GIS components, such as those presented in Table 5, section 3.4, are the products of ideas on the one hand, and the spawners of further ideas on the other. As a result, they are included in the compendium as starting points in thinking about why and how to mine the literature and other productions for GIS nuggets.

4. Ideas as questions and questions as ideas. Questions about situations, issues, concerns, goals, policies, programs, plans, etc., for which we want or need answers, are frequently behind decisions to engage in research activities and/or to undertake GIS projects.

5. The questions in Table 6, for example, add a variety of perspectives to ideas from Tables 3, 4, and 5, with the net result being the potential generation of even more grounds to retrospectively mine the literature and other productions for GIS nuggets.

As for the order of the modules, several combinations were tried. The one chosen and presented above is the one that I found most conducive to designing and elaborating the initial version of the compendium.

However, I believe it is important to ascertain whether and how module selection affects the design or the outcome of retrospective mining experiences, and I look forward to receiving feedback in that regard.

In the following sub-sections, brief explanations accompany the tables used to express the compendium modules.

Detailed descriptions are not provided because they do not appear to be necessary for readers likely to be interested in this phase of the retrospective research program.

However, if feedback indicates that details are necessary, they can be added in a revision. Again, suggestions about need-to-know matters would be appreciated.

3.1. Ideas about Research and GIS Procedures, Actions, Efforts, Initiatives, or Other Kinds of Doing upon Which to Base Retrospective Mining for GIS Nuggets

The 104 terms in Table 3 represent a mix of "doing" types of activity in research in general, and in the applications, design, development, education, management, operations, research, and training aspects of GIS.

Table 3. Examples of research and GIS verb forms which are sources of ideas for <u>doing</u> research and/or <u>doing</u> GIS

adapting	disaggregating	incorporating	rating
adopting	displaying	indexing	recording
aggregating	disseminating	indicating	representing
analyzing	distributing	informing	researching
applying	educating	interpolating	reviewing
approximating	elaborating	locating	routing
ascertaining	engaging	managing	sampling
assessing	enhancing	mapping	scoping
buffering	envisioning	measuring	searching
calculating	estimating	mining	sectioning
calibrating	evaluating	modelling	selecting
cataloguing	examining	modifying	separating
certifying	expanding	monitoring	shaping
championing	experimenting	observing	simulating
classifying	explaining	organizing	structuring
combining	exploring	parameterizing	studying
computing	extrapolating	parcelling	supporting
confirming	forecasting	plotting	synthesizing
connecting	functioning	positioning	testing
constructing	generalizing	postulating	theorizing
deconstructing	generating	predicting	tracking
depicting	hypothesizing	projecting	training
describing	identifying	promoting	validating
designing	illustrating	prototyping	viewing
detecting	implementing	quantifying	visioning
directing	improving	ranking	visualizing

Given their prominent usage in analog and digital productions (textbooks, academic papers, industry reports, conference papers, list serve notices, videos, maps, media stories, images, software packages, manuals, workbooks, etc.), the terms and ideas associated with the terms are *de facto* part of the core language in the fields of GIS and research.

Further, the verb form of every term in Table 3 can be logically preceded by modifiers or qualifiers, such as "how to", as in how to adapt, how to adopt, how to aggregate, how to

analyse, how to apply, how to approximate, how to buffer, how to calculate, how to calibrate, how to catalogue, how to champion, etc.

As a result, each of the terms is a possible keyword for finding of one or more nuggets contained in previous work, and can be the basis of a project which investigates previous work searching for GIS nuggets on why or to how to adapt, how to adopt, how to aggregate, how to analyse, how to apply, how to approximate, how to buffer, how to calculate, how to calibrate, how to catalogue, how to champion, etc., when doing research and/or doing GIS.

And, of course, adding better or best to any of the verb forms likely increases the value of nuggets that are extracted from the mining operations.

With regard to other terms for doing research and doing GIS, I believe that an expanded list would be a welcome addition to the literature. Of particular interest to future retrospective work would be a more comprehensive compilation of <u>doing</u> terms from the early days of GIS origins and evolution, and especially contributions from international sources.

Finally, when developing the compendium of terms (verb forms) that represent doing research and doing GIS, it is instructive to recall the comment by Garrison in section 2.3 about the past-present-future connection.

Specifically, due to the dynamic nature of language where technology is involved, it is prudent idea to begin thinking now about how to maintain the compendium so that is can effectively support retrospectively mining for GIS nuggets in the face of rapidly-changing terminology.

3.2. Ideas about Objects of Research and GIS Attention

There are thousands of objects of attention that receive consideration when doing research or doing GIS. By way of brief elaboration, objects of attention are "entities" (targets, matrixes, platforms, obligations, mandates, laws, by-laws, contracts, accords, intended results, etc.) which motivate doing research or doing GIS by, for example, any of the activities listed in Table 3.

These entities may already exist in general or in a particular organization, and for various reasons are subject to one or more of the doing activities listed in Table 3. Or, they may not exist in general nor in a particular organization, and for various reasons are the object of attention involving one or more of the doing activities listed in Table 3.

For the purposes of this (initial) compendium of ideas on using retrospective research to mine for GIS nuggets, it appears prudent to focus on what I refer to as core or prescribed objects of attention.

Each of the items in Table 4 has an established track record, and appears to represent several to many ideas which are passwords to "good mining" for three reasons in particular.

Table 4. Core objects of attention for mining activities

algorithms	functions	orders	relationships
analyses	generalizations	organizations	reviews
applications	heuristics	overviews	routes
approaches	imagery	paths	routines
arcs	instruments	patterns	schemes
areas	links	plans	standards
attributes	maps	plots	structures
charts	means	polygons	styles
controls	methods	practices	syntheses
courses	methodologies	procedures	systems
designs	modes	processes	techniques
devices	models	programs	tools
frameworks	operations	protocols	ways

First, because they are core objects, entries in Table 4 are more likely to have benefitted from above-average documentation and archiving. As a result, mining for GIS nuggets among core objects of attention should be less difficult and less time-consuming than the proverbial downer of "searching for a needle in a haystack".

Second, because the objects of attention are in the core category, they are likely to have received consideration on multiple occasions in a variety of circumstances over an extended span of time. That being the case, it seems most probable that GIS nuggets associated with core objects of attention did not occur in isolation, and finding them in batches or clusters could be a matter of connecting the dots through doing research and/or doing GIS in the manners suggested in Table 3.

Third, preliminary examination suggests that many if not most of the doing terms in Table 3 are applicable to each of the objects of attention in Table 4. As a result, limiting the entries in Table 4 to core objects gives the compendium focus.

The focus reason notwithstanding, however, readers may want to pursue different objects of attention which are more pertinent due to historical, institutional, geographical, political, or other factors. The modular, table-based design of the compendium readily accommodates such choices.

Again, as noted above, there are thousands of objects of attention among which to choose. By way of illustration, numerous other objects of attention can be derived simply by using the noun forms of the verb forms listed in Table 3.

Examples of such objects of attention drawn from a small segment of Table 3 include: estimate, evaluation, examination, explanation, exploration, forecast, hypothesis, identifier, illustration, image, index, indicator, information, investigation, layer, list, location, map, mapper, measure, measurement, model, monitor, parameter, prediction, predictor, promotion, and prototype.

Separately, Table 3 and Table 4 contain terms which of themselves have little or no practical beginning or end. However, in combination they provide an insightful <u>indication</u> of the variety of things and activities – in essence, ideas – which are central to elaborating how to design and use retrospective research to mine for GIS nuggets. Further, the term indication is used advisedly, since the items listed in Table 4 are a small portion of the ideas that have been the focus of attention in previous research and/or GIS initiatives. Moreover, there are many doing activities beyond those in Table 3 which are pertinent to inquiries about previous research and/or GIS productions.

Of particular value to the elaboration of this module are suggestions from contributors to the doing research and doing GIS literature (and other productions) about objects of attention to add to Table 4. The initial list is an initial list, and additions are key to moving this module into subsequent phases of compendium evolution.

3.3. Principal GIS Components as Results of Ideas <u>and</u> Spawners of Ideas

The principal GIS components selected for Table 5 are culled from the literature and other productions by academic, government, business, trade, and professional organizations listed in Table 2, and represent of a variety of interests.

Table 5. Principal GIS components as initial targets for mining activities

GIS applications	GIS operations
GIS calls for proposals	GIS opportunities
GIS capabilities	GIS performance
GIS challenges	GIS plans
GIS decision systems	GIS policies
GIS education programs	GIS programs
Enterprise GIS	GIS protocols
GIS expressions of interest	GIS requests for proposals
GIS futures	GIS research activities
GIS implementation	GIS research gaps
GIS infrastructure	GIS research needs
GIS innovations	GIS research programs
GIS management practices	GIS research trends
GIS markets	GIS standards
GIS maxims	GIS training programs
GIS needs	GIS trends

*Although the entries in Table 5 represent many of the core terms of the GIS literature over the past 50 years, they represent only a very small portion of the principal topics which could be obtained by listing the combinations of GIS and core terms which have appeared in academic, business, government, media,

professional, and trade organization literature and other productions.

Moreover, and central to the retrospective initiative, most of the components date from the earliest days of GIS evolution. Consequently, in terms of track records all the presented components have been "works in progress" and potential GIS nugget generators for at least 30 years, to as many as 50 years or so for some, and counting.

The proposition underlying this module is that mining the literature on principal components for GIS nuggets involves perceiving the components as both the results of GIS ideas, and the spawners of GIS ideas in a complementary relationship of inputs-outputs-inputs…

I use the approach of "On the one hand, on the other hand" to illustrate this association.

On the one hand, with regard to the results aspect, each principal component is the derivation or result of a combination of ideas that are comprised of processes and products, which themselves are comprised of ideas.

However, because of varying degrees of influence by legislative, institutional, organizational, political, social, ideological, administrative, financial, technological, technical, financial, entrepreneurial, competency, etc., there are differences in GIS ideas.

And, as a consequence, there are differences in the principal GIS components that are identified, adopted, and implemented by governments, businesses, learning centres, research centres, and other users of GIS technology and GIScience methods, techniques, and operations.

In terms of mining the literature for GIS (and GIScience) nuggets, therefore, potential nuggets for the GIS user are all the <u>inputs</u> to principal components and, specifically, any ideas incorporated in a component that:

- ✦ Had not been identified by the GIS user;
- ✦ Had been identified by the GIS user but not adopted; and,
- ✦ Had been adopted but not implemented by the GIS user[8].

Or to re-phrase, whatever others did that was not done by a GIS user, from identify to adopt through to implementation of a principal component or parts thereof, represents nugget potential for that user[9].

On the other hand, however, once a component is in place it is subject to the same kinds of influences as those noted above, and the component becomes a spawner of questions, declarations, announcements, affirmations, rejections, doubts, concerns, convictions, positions, etc., that is, ideas, about whether and how to maintain or change that component.

In terms of mining the literature for GIS (and GIScience) nuggets, therefore, potential targets and nuggets for each GIS user are all the <u>outputs</u> from principal components and, specifically, again, any ideas (questions, declarations, announcements, affirmations, rejections, doubts, etc.) spawned by a principal component that:

- Were not identified by a GIS user;
- Were identified but not adopted by a GIS user; and,
- Were adopted but not implemented by a GIS user.

Or to re-phrase, whatever outputs from other governments, agencies of governments, businesses, etc., that were not shared by a GIS user, from identification through to adoption and implementation, represent nugget potential for that user[10].

And, on it goes, in a cycle of inputs-outputs-inputs-outputs ….

Of particular value to the elaboration of this module, I believe, would be suggestions from contributors to the doing research and the doing GIS literature (and other productions) about principal GIS components to add to Table 5. The initial list is just that, an initial list, and additions are key to moving this module (and the other modules) into phase two of compendium evolution.

3.4. Ideas as Questions, and Questions as Ideas

The decision to include a list of question-based topics in a table as a compendium element is driven by the following factors:

- It is an effective way for contact list members to participate in defining the content of the retrospective colloquium and planned conference;
- A tabular format is an easy-to-follow and easy-to-update means of tracking items which have been put out for consideration;
- Providing a list of topics through questions is an instructive and efficient way to illustrate to presenters, attendees, and interested parties the scope, objectives, goals, etc., of the colloquium and planned conference;
- Providing a list of topics through questions is an instructive, efficient, and inclusive way to illustrate possibilities for future retrospective research and GIS conferences, seminars, or other projects.

The questions in Table 6 are derived from multiple sources, including suggestions from members of the contact list. Several comments about the intent, derivation and organization of the questions may be instructive for follow-on researchers.
First, the focus of the majority of questions is on the <u>how</u> dimension, with the intention of leading to papers and presentations which contribute to our knowledge about <u>how to design</u> and <u>how to apply</u> the retrospective approach to mine for GIS nuggets. Examination of the GIS research publication record suggests that the how aspect is under-served relative to the who, what, where, and when aspects, so it is appropriate that the colloquium address that shortfall through the questions in Table 6.

Table 6. A List* of question-based topics** to advance the idea of using the retrospective approach to mine for GIS nuggets

1. **How can the 'retro approach' contribute to documenting the GIS field as science?**
2. **How can the 'retro approach' contribute to increased knowledge about the time-geospatial continuum?**
3. **How can the 'retro approach' contribute to increased public understanding of knowledge about the time-geospatial continuum?**
4. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in federal government programs?**
5. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in federal government policies?**
6. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in provincial/state government programs?**
7. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in provincial/state government policies?**
8. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in local government plans?**
9. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in local government programs?**
10. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in local government policies?**
11. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in school curricula?**
12. **How can the 'retro approach' contribute to more informed use of time-geospatial continuum knowledge in business?**
13. **How can the 'retro approach' contribute to reducing the hype in communications about "analytics"?**
14. **How can the 'retro approach' contribute to reducing the hype in communications about "Big Data"?**
15. **How can the 'retro approach' promote continuity among members of the GIS community?**
16. **How did best practice concepts affect GIS evolution?**
17. **How did client-driven research affect GIS evolution?**
18. **How did curiosity-driven research affect GIS evolution?**
19. **How did curiosity- and client-driven research combine to affect GIS evolution?**
20. **How did design-evaluation tools contribute to GIS adoption?**
21. **How did design-evaluation tools contribute to GIS implementation?**
22. **How did design-evaluation tools contribute to GIS use?**
23. **How did design-evaluation tools contribute to GIS acceptance?**
24. **How did enterprise GIS ideas arise and evolve?**
25. **How did GIS-based decision support systems arise and evolve?**
26. **How did GIS research methodologies arise and evolve?**
27. **How did ideas of a GIS 'Champion' evolve?**

28. **How did mission-driven research affect GIS evolution?**
29. **How did prognosticators derive GIS futures?**
30. **How did Special Interest Groups (SIGs) advance GIS?**
31. **How has GIS affected business?**
32. **How has GIS affected catastrophic event monitoring?**
33. **How has GIS affected catastrophic event predicting?**
34. **How has GIS affected corporate confidentiality?**
35. **How has GIS affected corporate privacy?**
36. **How has GIS affected 'Doomsday Mapping'?**
37. **How has GIS affected education?**
38. **How has GIS affected environmental protection?**
39. **How has GIS affected geo-politics?**
40. **How has GIS affected interoperability of information technology?**
41. **How has GIS affected interoperability of systems engineering?**
42. **How has GIS affected intersection level of service mapping?**
43. **How has GIS affected land use planning practices?**
44. **How has GIS affected news media?**
45. **How has GIS affected organization of local government?**
46. **How has GIS affected performance of local government?**
47. **How has GIS affected personal confidentiality?**
48. **How has GIS affected personal privacy?**
49. **How has GIS affected petroleum exploration?**
50. **How has GIS affected political strategies?**
51. **How has GIS affected public participation?**
52. **How has GIS affected public policy?**
53. **How has GIS affected public right-to-know practices?**
54. **How has GIS affected qualitative analysis?**
55. **How has GIS affected qualitative synthesis?**
56. **How has GIS affected quantitative analysis?**
57. **How has GIS affected quantitative synthesis?**
58. **How has GIS affected real estate?**
59. **How has GIS affected retailing?**
60. **How has GIS affected risk analysis?**
61. **How has GIS affected social media?**
62. **How has GIS affected species mapping?**
63. **How has GIS affected spatial cataloguing?**
64. **How has GIS affected spatial hypothesizing?**
65. **How has GIS affected spatial theorizing?**
66. **How has GIS affected sustainable transport?**
67. **How has GIS affected traffic engineering?**
68. **How has GIS affected transportation planning?**
69. **How has GIS affected urban planning and development?**
70. **How has GIS affected urban management?**
71. **How has GIS affected visualization analysis?**

72. **How has GIS affected visualization synthesis?**
73. **How has technology affected GIS evolution?**
74. **How have GIS and geo-based data added to processes examined in the medical sciences?**
75. **How have GIS and geo-based data added to processes examined in the natural sciences?**
76. **How have GIS and geo-based data added to processes examined in the social sciences?**
77. **How have GIS and geo-based data affected examination of built environment processes?**
78. **How have GIS and geo-based data affected examination of built environment structures?**
79. **How have GIS and geo-based data affected examination of natural environment processes?**
80. **How have GIS and geo-based data affected examination of natural environment structures?**
81. **How have GIS and geo-based data affected weather reporting?**
82. **How have GIS and geo-based data been used to assert claims of climate change?**
83. **How have GIS and geo-based data been used to counter claims of climate change?**
84. **How have GIS and geo-based data been used to demonstrate the cascading process which affects interdependent spatial infrastructures?**
85. **How have GIS and geo-based data been used to demonstrate degrees of urban traffic congestion?**
86. **How have GIS and geo-based data been used to demonstrate the concept of "traffic gridlock"?**
87. **How have GIS and geo-based data been used to examine the principle of integrating land use planning and transportation planning?**
88. **How have GIS and geo-data been used to examine the self- organization of urban structures and spaces?**
89. **How have GIS and geo-based data contributed to elaborating best practices in urban planning and development?**
90. **How have GIS and geo-based data contributed to elaborating the consequences of "building in harm's way"?**
91. **How have GIS and geo-based data contributed to indexes for measuring pedestrians' safety?**
92. **How have GIS and geo-based data contributed to measuring transportation system performance?**
93. **How have GIS and geo-based data contributed to measuring transportation system sustainability?**
94. **How have GIS and geo-based data contributed to modelling epidemiological processes?**
95. **How have GIS and geo-based data contributed to urban walkability analysis?**
96. **How have GIS and geo-based data enabled looking inside aggregates and**

examining spatial processes?

97. How have GIS and geo-based data enabled looking inside aggregates and examining spatial structures?

98. How have GIS and geo-based data expanded the body of processes examined by academics?

99. How have GIS and geo-based data expanded the body of processes examined by business?

100. How have GIS and geo-based data expanded the body of processes examined by governments?

101. How have GIS and geo-based data expanded the body of processes examined by professionals?

102. How to backcast for GIS application nuggets?

103. How to backcast for GIS best practice nuggets?

104. How to backcast for GIS education nuggets?

105. How to backcast for GIS management nuggets?

106. How to backcast for GIS operations nuggets?

107. How to backcast for GIS research nuggets?

108. How to backcast for GIS technology nuggets?

109. How to backcast for GIS training nuggets?

110. How to design papers to make them "retro sensitive"?

111. How to design conference papers to make them "retro sensitive"?

112. How to design conference proceedings to make them "retro sensitive"?

113. How to design webinars to make them "retro sensitive"?

114. How to identify the foundations of GIS leadership and vision?

115. How to identify changes in the foundations of GIS leadership and vision?

116. How to identify changes in the evolution of GIS leadership and vision?

117. How to measure GIS return on investment?

118. How to search client-driven research for GIS nuggets?

119. How to search curiosity-driven research for GIS nuggets?

120. How to search for GIS nuggets in productions which combine client- and curiosity-driven research?

121. How to search mission-driven research for GIS nuggets?

122. How was GIS incorporated as a duty of care obligation?

123. How was GIS incorporated as a standard of care practice?

124. How were case studies used to promote GIS?

125. How were client- and curiosity-driven GIS research combined?

126. How were design-evaluation tools identified for GIS purposes?

127. How were design-evaluation tools adopted for GIS purposes?

128. How were design-evaluation tools implemented for GIS purposes?

129. How were design-evaluation tools used for GIS purposes?

130. How were elected officials engaged in GIS deliberations?

131. How were GIS and IT operations coordinated?

132. How were GIS and IT relations improved?

133. How were GIS and IT relations reconciled?

> **134. How were instructors selected for *Introduction to GIS* workshops?**
> **135. How were topics selected for *Introduction to GIS* workshops?**
> **136. What methods were used to derive GIS futures?**
> **137. What methods were used to forecast GIS futures?**
> **138. What methods were used to predict GIS futures?**
> **139. What methods were used to scope GIS futures?**
> **140. What methods were used to shape GIS futures?**
> **141. What were the innovation drivers behind GIS evolution?**
> **142. What were the origins of incorporating GIS in duty of care obligations?**
> **143. What were the origins of incorporating GIS in standard of care practice?**
> **144. Why was GIS incorporated as a duty of care obligation?**
> **145. Why was GIS incorporated as a standard of care practice?**

* Sources used to compile the list of potential topics include productions (journals, proceedings, newsletters, conference programs, workbooks, list serve comments, etc.) of professional, trade, and academic organizations, of government agencies, of businesses, of the popular media, and of websites such as slideshare.net. In addition, suggestions were received from members of a contact list created to assist with colloquium and conference planning, and interested parties responding to announcements about the colloquium and the conference.

** In the list of question-based topics it is frequently the case that two or more of applications, design, education, management, operations, research, or training can be interchanged with little or no loss of generality or pertinence. As a result, in the interests of flow, space, and the avoidance of mind-numbing repetition, the approach taken is to use one of the terms for illustrative purposes, with the expectation that presenters and other readers are fully capable of interchanging terms should they wish to produce a more detailed or more explicit listing. Further, and drawing on materials previously presented in Table 1, Table 2, Table 3, as well as those in Table 4 and Table 5, it is possible to create a listing of many, many hundreds of topics through interchanging related terms.

Second, the <u>focus on how</u> in the questions is consistent with serving the two primary goals of science, namely, to add to knowledge, and to add to ways of continuing to add to knowledge, neither of which happens at a non-trivial level without non-trivial, how-to-do-it methodology and robust empirical evidence.

I believe it is fair to say that answering the how to questions in Table 6, and similar how to questions in future versions of Table 6, will significantly contribute to firming up the science element of GIScience.

Third, due to the limited scope of the GIS retrospective program, it was not possible to employ a formal mail survey, focus group, Delphi, or other technique to assemble and prioritize the questions.

As a result, in large measure Table 6 represents my impression of questions to ask, and I am fortunate to be able to call on more than 40 years of professional engagement in teaching, research, GIS, GIScience, and the uses of GIS and GIScience, And, very importantly, I also have the benefit of interactions with hundreds of accomplished individuals, including those who contributed to *AutoCarto Six Retrospective*, and/or are participating in the GIS retrospective program.

Consequently, Table 6 is the product of a substantial body of expertise and experience in: GIS research and development, education, training, applications, management, and operations; and, hands-on experience in such fields as transportation, urban development, land use planning, surveying, applied geography, natural resources management, systems engineering, civil engineering, public safety and security, governance and inter-governmental relations, and social media.

Clearly, there is room to expand the scope and depth of Table 6, but the current compilation appears to be sufficient for the initial considerations stage.

A closing comment on Table 6 recalls the materials in section 2.3, and the advisory by Garrison about nuggets and past, present, and future linkages.

Feedback on Table 6 refers to it as a substantive contribution that will significantly increase in value as the GIS field matures. Moreover, comments on Table 6 agree that the "user-friendly" design will be a catalyst for more questions in the interim between the colloquium and the planned conference, and thereafter.

Table 6 will therefore be updated as circumstances dictate and professional conditions allow. Readers interested in learning about update activities are invited to visit my website, and/or to contact me by email[11].

It is appropriate to acknowledge before closing this section that it is highly likely some of the questions in Table 6, or variations thereof have been used in dissertations, theses, agency or installation reviews, research proposals, etc. I would appreciate having the source information brought to my attention for future reference.

Finally, of particular value to the elaboration of this module, I believe, would be suggestions about question-based topics to add to Table 6. The initial list is just that, an initial list, and additions are key to moving this module (and the other modules) into phase two of compendium evolution.

5. Conclusion

This paper pre-tests the idea of developing a compendium of ideas on using the retrospective approach to mine for GIS nuggets. The following findings support further work on the compendium model as presented in *Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Consideration*.

1. The compendium model invites various kinds and degrees of participation in elaborating a retrospective research and action program.

2. The four design principles (Focus on connecting "ideas" and "nuggets"; Use a modular approach; Limit the modules to those required to effectively and efficiently launch the project; and Make it easy for those with different interests to modify the content of modules.) used for the initial phase of compendium development provide clear instructions and directions throughout the compendium-building process.

3. Due to the flexibility of the modular approach, the compendium can readily be increased beyond the four modules specified for the pre-test.

4. Each of the four modules (Ideas about "doing"; Ideas about objects of attention; Principal GIS components as ideas and sources of ideas; and Ideas as questions and questions as ideas) selected for the initial representation of the compendium can readily be expanded, extended, contracted, re-oriented, etc., to accommodate general as well as particular needs, interests, etc. affecting decisions about mining for GIS nuggets.

For the closing remark, I recall the observation by Professor Bill Garrison regarding the time factor, and its essential significance in retrospective research, and research in general.

> *"You use the word nuggets in useful ways. Perhaps nuggets could be thought of as links in the chain that ties the past to the present.... and in important ways the present to the future. Is that a thought about using nuggets to achieve richer futures?"*

The short answer to that central question is "Yes, most definitely," and the long answer continues to unfold.

5. Endnotes

1. As stated in posted reports beginning in late 2014, the decision was made to separate the colloquium and the conference rather than hold them both during a three-day event in February 2015.

The current plan is to assess the value, impacts, and messages of the colloquium and, if appropriate, to proceed with a conference in 2016 in conjunction with the Esri Federal GIS User Conference in Washington DC.

2. To my knowledge, the GIS retrospective (or GIS retro) dialogue formally commenced publicly with *AutoCarto Six Retrospective* (Wellar 2013)*.* In the event of a preceding initiative, I would appreciate having it brought to my attention.

3. The contact lists include more than 100 contributors to the 1983 *AutoCarto Six Proceedings* (Wellar, 1983), 37 of whom also contributed to A*utoCarto Six Retrospective* (Wellar 2013) 30 years later. While not large numbers relative to the population of those engaged in GIS and GIScience activities, examination of the table of contents of both publications reveals the presence of many of the most influential contributors to the evolution of GIS, GIScience, and the uses of GIS and GIScience. I am most appreciative of their contributions to my thinking about compendium matters.

4. In anticipation of holding the conference in February 2015, the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets was* circulated in August for comment by members of the contacts list and the sounding board, and posted in September, 2014.

As a result of the decision to split the colloquium and the conference, the *Guide* was withdrawn from two websites where it had been posted for some months, http://www.wellar.ca/wellarconsulting/ and https://www.google.ca/#q=slideshare.net. A new guide for contributors which is based on the response to the colloquium and the compendium will be prepared for presentations at the planned 2016 conference

5. For details see *Transport Action Canada Compendium of Transportation Research Topics: A New Approach for New Thinking (*Wellar 2010). http://www.transport-action.ca/dc/TRTCompendium2010.pdf

6. The four tables were initially included in the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets,* and were designed to illustrate the mix of possible ideas -- themes, topics, issues, concerns, challenges, opportunities, etc., -- that could be considered as the bases, components, elements, and so on, of conference presentations. The proposal to re-purpose the tables and use them as the core of the compendium was endorsed by members of the contact lists, the sounding board, and potential conference contributors as a timely and productive use of the assembled materials.

7. The quoted text, and permission to use it in *Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Considerations* was received via email from W.L. Garrison, Professor Emeritus, Civil and Environmental Engineering, Institute of Transportation Studies, University of California, Berkeley, on December 26, 2014.

8. The three-stage process of identify, adopt, and implement was used in a study measuring the progress of Canadian municipalities in achieving sustainable transport objectives (Wellar 2009). This process proved to be a very effective and efficient way of ascertaining actions taken (and not taken) by municipal governments in regard to sustainable transport matters. It appears to be directly applicable to ascertaining and

tracking the state of principal GIS components in governments, businesses, academic institutions, etc.

9. At the risk of belabouring the obvious, all organizations do not identify, adopt, and implement GIS policies, programs, plans, technologies, applications, etc. at the same time. As a result, decisions and actions by some organizations to identify, adopt, and implement GIS, GIScience, or the uses of GIS and/or GIScience, create potential nuggets for organizations which have not yet done so.

10. The process of learning from both what is done and what is not done, aa well from both our successes and failures, has been the subject of numerous studies, reports, and papers since the 1960s on the evolution of principal GIS components. The several paragraphs in section 3.3 are a very brief account of the deep and significant documentation on this topic, and I encourage readers to examine the learned, professional, and other literatures which address this longstanding, core feature of methodologically designed research, including that employing the retrospective approach.

11. The website link is http://wellar.ca/wellarconsulting/home.html, and email address is wellarb@uottawa.ca.

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7. Acknowledgements

Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to Retrospectively Mine the Popular Literature for GIS Nuggets

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ABSTRACT. This paper encourages and supports mining the popular literature – newspapers, magazines, television, radio, and all other forms of media – for GIS nuggets, that is, GIS findings which serve three related functions: designing and developing geographic information systems technology; defining and elaborating geographic information science; and, using geographic information systems technology and geographic information science. Organized around the concepts of the Doomsday Map and the Stewardship Map, media articles on the abuse versus care of land, water, and air resources over the 25 years between 1990 and 2015 provide the basis for questions to guide retrospectively mining for GIS nuggets: Who caused the change from abuse to care to occur, or not? What caused the change from abuse to care to occur, or not? Why did the change from abuse to care occur, or not? When did the change from abuse to care occur, or not? Where did the change occur, or not? How did the change occur, or not? And, for each of those questions, <u>Was GIS a factor</u>? Media reports confirm that it is critically important to retrospectively mine this body of literature for GIS nuggets, and provide suggestions about how the mining process could be designed.

1. GIS Nuggets = Significant Findings from Retrospective Research

The definition of GIS nuggets was originally published in mid-2014 in the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets*[1] (Wellar 2014b), It was intended that the *Guide*, which provides the statement of problem and terms of

reference for the GIS retrospective program, would be incorporated in the proceedings as context for this and other conference presentations. However, and as summarized in Endnote 1, the *Guide* was withdrawn for research program design reasons, which requires a change in how information about the mining mission is provided.

That is, in the interests of completeness, self-containment, and convenience of readers, a selection of background materials from the *Guide* are reproduced and follow below.

In this paper I use headlines and stories in the popular literature as the vehicle for explaining why and how the retrospective approach could be, and in my opinion should be used to mine various kinds of literature for GIS nuggets. I begin by recalling what is meant by GIS nuggets, and thereby provide a context for making the connection between introducing the Doomsday Map Project at conferences *circa* 25 years ago, and re-visiting it for the present colloquium on using the retrospective approach to mine for GIS nuggets.

As stated in Figure 1, GIS nuggets are <u>findings</u> from the literature or other sources which serve one or more GIS purposes. The three core, related missions in Figure 1 which are served by GIS nuggets are designated **M1**, **M2**, and **M3.**

Figure 1. GIS nuggets defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve one or more of three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

The task of this paper, therefore, is to re-visit the Doomsday Map Project as a case-in-point for using the retrospective approach to mine the popular literature for nuggets which serve a purpose stated in Figure 1.

General nuggets of possible or probable value include those listed in Table 1. There does not appear to be any need to explain any of the entries in Table 1 since all of them are no doubt familiar to readers of this paper. However, the meaning of "the literature" which appears in the heading of Table 1 is of critical importance to this retrospective research project, and it is elaborated in Table 2.

As indicated by the source for Table 2, the list of <u>11 bodies of literature</u> is based on the commissioned report, *Geography and the Media: Strengthening the Relationship* (Wellar 2005).

The report was sponsored by the Canadian Association of Geographers, the Canadian Royal Geographical Society, and the Canadian Council on Geographic Education, and was prepared for the 2005 Symposium on Projecting Geography in the Public Domain in Canada.

Table 1. Possible nuggets derived from using the retrospective approach to examine "the literature"

1. New or different reasons to add to GIS technology;
2. New or different ways to add to GIS technology;
3. New or different reasons to add to geospatial data;
4. New or different reasons to add to geospatial information;
5. New or different reasons to add to geospatial knowledge;
6. New or different ways to add to geospatial data;
7. New or different ways to add to geospatial information;
8. New or different ways to add to geospatial knowledge;
9. New or different uses of GIS technology;
10. New or different uses of geospatial data;
11. New or different uses of geospatial information;
12. New or different uses of geospatial knowledge;
13. New or different uses of GIScience research methods;
14. New or different uses of GIScience research techniques;
15. New or different uses of GIScience research operations

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. **Popular (Media) Literature**
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

(After: Wellar, B. 2005. *Geography and the Media: Strengthening the Relationship*. Ottawa: Canadian Association of Geographers, Canadian Royal Geographical Society and the Canadian Council on Geographic Education. http://www.ccge.ca)

Geography and the Media: Strengthening the Relationship has been in the public domain for almost ten years, and comments of which I am aware from researchers, including those in library science, attest to the usefulness and completeness of the list in terms of identifying the <u>many different bodies of literature</u> which collectively comprise what is often simply referred to as *the literature*.

And, on the other hand, I have not located or been apprised of counter positions to my treatment of the literature issue, which suggests that it has a level of validity sufficient to support the idea of retrospectively mining *the literature* for GIS nuggets.

That is, and at the risk of belaboring the obvious, governments, business enterprises, academia, trade organizations, professional associations, public and vested interest groups, political parties, bloggers, journalists, and other entities produce "literature" broadly defined – books, maps, images, brochures, scans, cabinet documents, policy papers, white papers, green papers, comic strips, cartoons, test reports, PowerPoint slide decks, videos, manuals, Official Plans, State of the Union Addresses, etc., etc., etc., – and this retrospective project recognizes and respects those differences[2].

Hence, when reference is made in the remainder of this paper to the literature, with or without the quotes, or italics, that reference includes <u>all</u> the bodies of literature identified in Table 2 unless specified otherwise.

Popular (media) literature (body of literature # 6) is the focus of this paper, with emphasis on newspapers since they were the popular medium of primary interest when assembling materials and beginning to elaborate the Doomsday Map concept in the 1980s

2. Background of the Doomsday Map Project

The Doomsday Map Project was developed in the mid-1980s as an element in urban geography, urban and regional planning, GIS, and research methods courses that I taught at the University of Ottawa.

It was introduced into the broader public domain about 25 years ago in conference presentations, proceedings papers and media stories, a selection of which are included as references (MacGregor 1990; Wellar 1988, 1989, 1990a, 1990b; Wellar, Parr & Somers 1990).

Now, 25 years later, and with a great deal of hindsight from which to benefit, I am discussing why and how the Doomsday Map Project and, by extension, similar projects of years past for any body of literature, warrant retrospective examination as potential sources of the kinds of GIS nuggets identified in Table 1.

The thesis behind the Doomsday Map Project (DMP for short), and its pertinence to the Esri-GIS retro project, may be outlined as follows.

Numerous reports encountered during my stint (1972-1979) at the Ministry of State for Urban Affairs, Government of Canada, established that decisions made by governments at all levels, businesses, and individuals were having serious, negative impacts on land, water, and air resources[3].

However, few publicly-available reports established that sustained or targeted actions were being undertaken by governments at any level, by local, regional, or national businesses, or by individuals to mitigate, reduce, terminate, or otherwise effectively combat decades of serious abuse of Canada's land, water, and air resources.

Overall, the decisions taken, and actions not taken, in regard to land, water, and air abuses were enthusiastically and vigorously driven by political, economic, and financial ideologies, abetted by large dollops of self-interest and convenience.

Conversely, minimal consideration was given to long-term implications, or to the inclusion of geographic factors as decision variables, with the only exception of note that I recall being to provide assurances about the availability of sufficient quantities of zoned land for future residential and commercial development purposes (Wellar 1989).

During the post-1979 years when I returned to academe, the inclusion of newspaper-based assignments in my undergraduate and graduate courses yielded an unending supply of articles from across Canada (as well as from the U.S. and abroad) about the chronic, widespread, and seemingly wholesale abuse of land, water, and air resources,

This finding perpetuated and reinforced the record of federal government resource abuse observed during my involvement in research and policy at Urban Affairs. Moreover, while my appointments only spanned seven years, my research took into account the federal government record going back 10-15 years or more.as part of trend analysis research activities, so this was no "short-term aberration".

The triangulation of evidence was completed by participation in community-based transportation, planning, and development matters throughout the National Capital Region, and in other areas of Canada. That experience provided ground-level confirmation of the findings expressed above.

As I have noted in numerous publications, as well as in presentations to local government committees and councils, throughout the 1970s and 1980s the term "geography" (or any for synonym for geography) received little to no substantive consideration by local governments (Wellar 1989).

Further, inter-governmental dealings involving the disposition of resources at the local level, and hearings and rulings by quasi-judicial bodies such as the Ontario Municipal Board (OMB) which frequently intervened in local planning and development actions, did not fare any better.

In the face of such abject disregard for things geographic by governments, businesses, bodies such as the OMB, and seemingly a large portion of the Canadian public, the notion of the "Doomsday Map" was born.

In brief, as a working hypothesis it was my thinking that

> **If the argument was persuasively made that continued abuse of our land, water, and air resources would result in dire consequences in the near future, then responsible individuals and businesses, and eventually governments, would cease their resource-abusive ways.**

The persuasive word that came to mind was **doomsday**. I believed that on its face the notion of *doomsday* was sufficiently clear in its connotation to give reasonable individuals, business owners, executives, and shareholders, as well as government officials, cause to pause.

And, at the risk of being overly optimistic, there was always the hope that some serious thought would be given changing resource-abusive behaviours, with appropriate corrective actions to follow in a timely manner.

As for the word **map**, it met three critical criteria. First, land, water, and air resources are phenomena which readily lend themselves to being described in geographic terms and, hence, being mapped in various ways, many of which are readily understood by children, teens, and adults. To re-coin a phrase that no doubt has been stated many times "There is something for everybody, in a map".

Second, maps do not need to involve large quantities of numbers, which are anathema to many Canadians, including civil servants and, in my experience, an overwhelming majority of politicians at all levels. If the Doomsday Map minimized the use of numbers while conveying an important message, then its likely rate of acceptance would be considerably higher than if the story was told using ratios, expressions, equations, or tables of parameters and/or statistics from any field of science, including geography, engineering, ecology, economics, demography, hydrology, chemistry, physics, meteorology, glaciology, agronomy, oceanography, remote sensing, or geomorphology.

Third, maps can be made relatively self-explanatory, which minimizes the amount of text required to describe or explain the entities, relationships, themes, etc., represented on a map. As a bureaucrat whose assignments included reducing hundreds of pages of text to one-page briefing notes consisting of bullet points with no compound sentences, and a professor who heard more than a few laments about his 'heavy' reading lists, I was well aware of the general appeal of maps as visual alternatives to even several pages of dense text, much less many pages calling for sustained, focused attention.

Informal testing over several years suggested by the late 1980s that there was both need and merit in putting the concept of the **Doomsday Map** into the broader public domain. Further, significant advances in GIS technology and its increased usage in academia, government, and business supported such an initiative.

In the next two sections, I outline the approach taken to express the concept of the Doomsday Map**,** and to put a geographic foundation in place to map states of and changes in resource-abuse practices.

3. A Selection of *Circa*-1990 Newspaper Headlines Illustrating the Doomsday Map Scenario

Previous to and during the 1970s, 1980s, and 1990s it was commonplace for people of all stations and walks of life to read newspapers for local, national, and international news. And, as learned during my government, university, and community activist experiences, newspapers from across Canada and in many countries regularly carried stories about abuses of land, water, and air resources.

From a practical standpoint, factors such as accessibility to materials, the immediacy of locating relevant articles at relatively low cost, and the ability of students to conduct newspaper surveys, made newspapers the means of choice to obtain inputs to the Doomsday Map chronicles[4]. And, as a further plus, there was the matter of credibility.

Based on my experience it seemed likely that newspapers were, and were perceived to be more credible than governments or corporations when it came to telling the truth about resource abuse. Moreover, stories could be checked by consulting other newspapers and/or radio and television sources. Or, for that matter, confirmation could be sought from colleagues at universities and professional organizations.

Figures 2, 3, 4, 5, 6, and 7 are from my Doomsday Map-related productions *circa* 1990. Although they represent only a small portion of the newspaper headlines assembled over the span of several years, they appear sufficient to demonstrate why I thought the term 'doomsday scenario' was an apt descriptor of the implications of pandemic abuse of land, water, and air resources.

Figure 2. 25 years ago, waste disposal headlines

MAKING CONNECTIONS:

GARBAGE? WHY JUST PUT IT...

Barges won't sovle the waste problem
New York Times

Stemming the tide of trash
Kansas City Star

Grier spurs "garbage apocalypse" council says
Toronto Star

Figure 3. 25 years ago, land conflict headlines
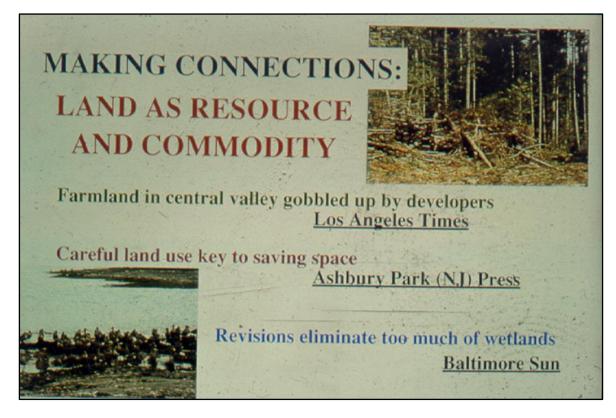
Figure 4. 25 years ago, water problem headlines
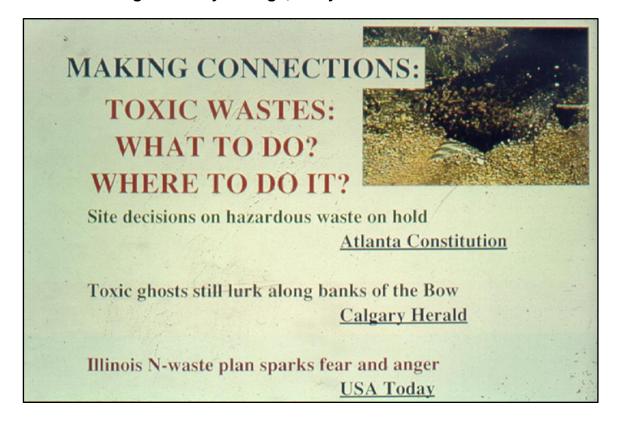
Figure 5. 25 years ago, global warming headlines

Figure 6. 25 years ago, nasty toxic waste headlines

Figure 7. 25 years ago, more nasty toxic waste headlines

Further, and the reason for their pertinence to this colloquium, is that <u>all the headlines dealt with concepts, things, decisions, actions, etc., that can be described or explained in geographic terms</u>, that is, for example,

- As geographic entities or attributes,
- As occupants of geographic spaces,
- As occupants of geographic locations,
- As occurrences at geographic places,
- As representations of geographic processes,
- As representations of spatial patterns,
- As representations of spatial interactions,
- As representations of spatial diffusion,
- As representations of spatial flows,
- As representations of clustered spatial distributions,
- As representations of ordered, regular, or uniform spatial distributions,
- As representations of random spatial distributions,
- As representations of source-sink spatial networks
- As representations of space-time confluence,
- As manifestations of geographic relationships,
- As inputs to spatial decision support systems, and
- As outcomes of spatial decision support systems.

Consequently, and providing the *raison d'être* for this paper, because the contents of the stories are of a geographic nature, they could potentially be mined for GIS nuggets.

The process of moving from the stories to the mining operation is outlined in Figure 8.

**Figure 8. Conditions for building files from news reports
about land, water, and air abuse or care practices
as potential resources to mine for GIS nuggets.**

If the stories about land, water, and air abuse or care practices can be

- Represented by geospatial data,
- Incorporated in a geographic information system (GIS), and
- Displayed in map form or other graphic representations,

Then they could be

- Mined for possible pointers, hints, indicators, suggestions, clues, etc., about where and how to discover, recover, or uncover GIS nuggets.

I return to the doomsday scenario in section 5, after briefly commenting on the *Geographer's Lament* which appeared in the original DMP presentations and papers.

It is my impression that such a comment may be instructive for those not familiar with the academic, scientific, institutional, political, and other obstacles, some self-inflicted, that confronted the field of geography several decades ago, and which continue to arise on frequent occasions.

4. Connecting the Doomsday Scenario and the Geographer's Lament

The Geographer's Lament (Figure 9) was included in DMP presentations and papers as an expression of concern derived from reading thousands of newspaper stories with a common theme.

That is, although the abuses of land, water, and air resources were of a seemingly obvious geographic nature, the geographic aspect of the abuses received little or no short-term much less long-term consideration by the perpetrators, or by many of the journalists writing the stories. Seemingly, it was as though geographic considerations *per se* simply did not matter to governments, to businesses, or to many individuals.

Drawing on my experience in government and academe, the Lament was designed to be brief and on point, but with an edge or twist so as to catch and hold attention. Leaving part of the Lament blank invited audience and reader involvement, and often led to "creative" language to put it politely, by students, conference or seminar attendees, and readers.

Figure 9.

The Geographer's Lament

With so many wrong things

In so many wrong places,

We have just about -----------

All our life-support spaces

For GIS Day 2009 at the University of Ottawa, presentations to elementary and secondary school students included slides about the Doomsday Map and the Lament (http://www.geomatics.uottawa.ca/gaw09/index.html).

I inserted "ruined" in the Lament, and demonstrated the day-to-day relevance of the Doomsday Map and the Lament by providing the following list of questions to illustrate the importance of knowing about and having respect for geography:

- Where are we to put our garbage?
- Where do we grow food?
- Where do we obtain clean water?
- Where do immigrants locate in Canada?
- Where do we intensify in order not to sprawl?
- Where do we locate the mass transit lines?
- Where are the most dangerous intersections?
- Where have the glaciers gone?
- Where are the sources of airborne pollutants?
- Where are residents to shop if the area loses its food store?
- Where should the new bridge be located?
- Where does the wildlife go if the wetland is drained?

Feedback on the presentations was gratifying, and gives me hope that the school-age generation is keenly interested in learning more about how geography affects their lives, and in using GIS to ensure that the doomsday scenario does not become their doomsday reality.

5. *Circa* 25 Years Later, How Well Are We Doing?

I sought assistance in answering this question by sending the message in Figure 10 to several list serves, and to a number of contacts in academe, government, business, NGOs such as community associations, and members of the media.

By way of a brief comment on the four classes of articles which are of interest at this time, articles in classes A and B are directly comparable to those presented in Figures 2, 3, 4, 5, 6, and 7. In short, they inform whether there has or has not been change

over the past 25 years in the content of popular literature articles reporting on the state of land, water, and air resources.

Figure 10. Request for inputs to an informal assessment of the current state of the Doomsday Map scenario

Seeking news stories about abuse or care of
land, water, and air resources.

In 1989-1990 I introduced the Doomsday Map and the Geographer's Lament to the literature (http://www.geomatics.uottawa.ca/gaw09/GISDAYWELLARPRES.pdf). 25 years later I am re-visiting both topics for a paper that I am preparing for the Conference on Using the Retrospective Approach to Mine for GIS Nuggets (http://wellar.ca/wellarconsulting/EsriGISRetroCallForPapers.pdf).

I welcome receiving information (links would be most appreciated) about stories in the news (newspapers, radio, television) in 2013-2015 that contribute to answering the question that I posed 25 years ago, "How well are we doing?" in regard to the treatment of land, water, and air resources in Canada and abroad.

Articles of particular interest at this time include those which discuss:

A. Lessening, cessation, etc., of previous abuses of land, water, or air resources;

B Continuation of previous abuses of land, water, or air resources;

C. Abuses of land, water, or air resources in ways that did not exist 20 to 30 years ago;

D. Abuses of land, water, or air resources that might have occurred post-1990, but were prevented or avoided due to interventions by governments, businesses, or individuals.

Thanks are given in advance, please send suggestions to wellarb@uottawa.ca.

Classes C and D, on the other hand, are similar to, yet quite different from A and B. That is, class C introduces the possibility of new kinds of land, water, and air abuses arising after the Doomsday Map scenario was conceived more than 25 years ago. And, class D raises the possibility that between 1990 and 2015 abuses known before 1990, and/or new ones arising after 1990, have been stopped, curtailed, terminated, cut-off, nipped in the bud, etc.

Each of A, B, C, or D is a challenging search topic, and a comprehensive compilation of news stories for any one of them is far beyond the scope of this paper[5]. However, the

headlines and stories in Figure 11 are sufficient to establish the significance of geography in considering the question,

How well are we doing in 2015 *vis-à-vis* 1990?

As for the content of Figure 11, questions may arise about the relatively limited attention given to climate change, and especially in view of the world-wide effort to move the issue of climate change beyond the talking stage and into the action stage on the parts of governments, businesses, and individuals. My reasoning for the prominent but limited attention given to climate change is summarized as follows.

When I was a teenager 60 years ago and a university student 50 years ago, there was general understanding of the meaning of climate, the meaning of weather, and the difference between the two concepts. Over the years, however, a great deal of mis-information, dis-information, and mis-representation by vested interests has seriously distorted the doomsday-stewardship discussion.

Under the circumstances, therefore, my approach in recent years is to briefly recognize climate change arguments, and to then quickly move away from that very broad concept to focus on readily definable, quantifiable variables whereby measures are used to cleave through the murk and cut to the chase in ascertaining whether the Doomsday Map is gaining or losing layers[6].

Figure 11 follows that design by beginning with several broad brush headlines about climate change in the Earth's various climatic regions and the planet as a whole, and then attention turns to such fact-oriented, climate-related variables as: rising or dropping temperatures; rising or dropping ocean levels; ice cap reductions or increases; wetland boundary expansions or contractions; desert boundary expansions or contractions; precipitation amount increases or decreases; forest cover increases or decreases; ozone layer thickening or thinning; growing season shifts in time and/or space; atmospheric pollution level increases or decreases; and other changes in the Earth's body of land, water, and air resources which are directly pertinent to examining changes in the status of Doomsday Map or Stewardship Map layers over the 25 years between *circa* 1990 and *circa* 2015.

With regard to the wisdom of that research design choice, it was emphatically confirmed on September 17, 2014 when White House Science Adviser Dr. John Holdren appeared at the hearing of the U.S. House of Representative's Science, Space, and Technology Committee on the Obama administration's plan to fight climate change.

It is my impression upon careful examination of the record that questions from several House Committee members' revealed an understanding of the science behind weather and climate which was considerably less than that of the elementary and secondary school students who attended my presentations during GIS Day 2009. Further, I hasten to add, the decision to focus on individual variables rather than "the big picture" of climate change has been ratified numerous times by members of Canadian

governments at all levels over the past decade, and most noticeably by elected officials at the federal level.

Figure 11. Another look at Doomsday Map headlines
***circa* 25 years later: How well are we doing now?**

National climate assessment: 15 arresting images of climate change now and in the pipeline. *The Washington Post*. **May 6, 2014.**

Climate and the civic race – Most candidates say city has a role to play. *Ottawa Citizen*. **September 27, 2014.**

Thousands march to draw attention to global warning. *Associated Press*. **September 9, 2014.**

Scientists trace extreme heat in Australia to climate change. *NY Times*. **September 29, 2014.**

Climate change threatens birds, pushes them north -- 314 North American bird species at risk due to climate change, report finds. CBC News **Posted: September 10, 2014.**

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Federal oil, gas rules kept secret – Canada will miss greenhouse gas target, environment czar says. *Ottawa Citizen.* **October 8, 2014.**

Just how far will American urban sprawl spread? Farmland, grasslands and forest are all expected to be converted to urban use as US cities sprawl over the next 50 years, reports Conservation Magazine. *The Guardian.* **August 05, 2014.**

Why haven't China's cities learned from America's mistakes? Faceless estates. Sprawling suburbs. Soulless financial districts. Discredited elsewhere as fostering the worst kind of urban angst, these are the vogue in China – but change could be afoot. *The Guardian.* **August 20, 2014. http://www.theguardian.com/uk**

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Since geography is at the core of each headline and story, each of them and numerous related stories published over the past 25 years are potential sources of GIS nuggets. The questions in Figure 12 are illustrative of those which could be the basis of GIS-related investigations of popular media articles labelled A, B, C, and D in Figure 10, and for several other bodies of literature including regulatory, oversight, professional group, public interest group, and corporate/institutional-public.

Figure 12. Questions investigating the role of GIS in decisions affecting the state of land, water, and air resources

QA. Was GIS a factor in lessening, mitigating, terminating etc., previous abuses of land, water, or air resources?

QB. Did GIS support or promote continuation of previous abuses of land, water, or air resources?

QC. Did GIS support or promote abuses of land, water, or air resources in ways that did not exist 25 to 30 years ago?

QD. For abuses of land, water, or air resources that might have occurred post-1990, but were prevented or avoided due to interventions by governments, businesses, or individuals, did GIS contribute to the interventions?

Questions QA and QB are directly applicable to the headlines and stories in Figure 11, which are a tiny portion of the thousands of related items published in 2014[7]. And, they are equally applicable to the many, many thousands of pertinent items published in the years between 1990 and 2014.

Moreover, at the risk of belabouring the obvious, the implications of these stories go far beyond the abuse of land, water, and air resources *per se*. That is, the vast majority of people and other creatures everywhere on Earth are directly and significantly affected by the abuse of land, water, and air resources.

Consequently, the headlines and stories in Figures 2, 3, 4, 5, 6, 7, and 11 are part of what I believe to be a prime and perhaps pre-eminent body of documentation pertinent to the question,

How Well Are We Doing?

As for questions QC and QD in Figure 12, both questions generate substantial amounts of significant results when applied to other types of literature. However, major challenges are encountered when it comes to searching the 2014 popular literature for class C articles on new or different abuses arising any year after 1990, and/or 2014 class D articles on abuses negated by interventions in any year after 1990.

In the next section, I outline the nature of the challenges in searching the popular literature for class C and D materials, and suggest a search design that could assist in accessing these potentially very valuable but also relatively hard-to-find sources of GIS nuggets.

6. Comments on Popular Literature Materials Regarding Oversight Agency Productions

As a rule, neither private sector corporations nor government line departments such as Agriculture, Commerce, Economic Development, Energy, Environment, Finance, Fisheries and Oceans, Forestry, Housing, Industry, Infrastructure, Interior, Land Management, Mining, Municipal Affairs, Natural Resources, Parks and Recreation, Planning and Development, Public Works, Regional Development, Transportation, Urban Affairs, Utilities, or Water/Wastewater rush to publicly admit to committing or aiding and abetting abuses of land, water, and air resources[8].

Consequently, in the case of class C situations, that is, abuses of land, water, and air resources arising since 1990, we tend to learn about them from oversight agencies which are (purportedly) independent of "political strings", and whose mandate is to inform about matters of public interest.

I suggest that there are three primary criteria to shape the search for popular literature materials which are derived from productions of oversight agencies.

First, it is advisable to start with the assumption that the search must be done at least every year. Several forays into oversight holdings indicate that tracking reports about

the state and disposition of abuses is most accurately and effectively done on an annual basis where possible, and the briefest timespan available if oversight reports are not produced on an annual basis.

As asked in QC, what we seek to ascertain is,

> Did <u>GIS</u> support or promote abuses of land, water, or air resources in ways that did not exist 25 to 30 years ago?

I believe that this kind of retrospective mining is best done from an evidentiary perspective by having an access design which is as temporally and spatially disaggregate as conditions permit.

A recommended approach is to obtain the report release schedules for the agency or agencies of interest, and then search (as appropriate) for local, national, and international headlines on the days and weeks after the releases, with emphasis on locating explicit or implicit statements about geography, geospatial information, and decisions or actions to address or not address the land, water, or air abuses.

Second, in my experience reports from oversight agencies are usually the most technically sophisticated of all documents published for public consumption by government agencies.

Evidence in that regard includes performances by elected officials, pundits, and others who demonstrate that they clearly do not grasp the methodology behind oversight productions.

The research colloquium program addresses this matter by discussing skill requirements and providing reference materials needed to understand the reports, and to appreciate whether the popular literature is accurately interpreting oversight agency materials[9].

Third, there are great variations among countries as to the numbers and roles of oversight agencies in general, and in particular those which have land, water, and air resources within their terms of reference.

For the purposes of this paper, I believe it is sufficient to provide an indicative list of oversight agencies which I encountered during my searches.

Again, not all oversight agency names are applicable in all countries, and names could change by February 2015, but in terms of mining for GIS nuggets the focus is on which oversight agencies are in place regardless of name or jurisdiction.

Since the list in Table 2 is indicative rather than comprehensive, for reasons of convenience and experience I begin with entries from Canada where oversight agencies are relatively popular[10].

Additions are then made for other jurisdictions to create a more illustrative list of names of oversight agencies[11].

Table 2. An indicative list of oversight agencies with responsibilities for informing about the state of land, water, and air resources

1. Alberta Environmental Monitoring, Evaluation and Reporting Agency (Canada)
2. Auditor (numerous countries and jurisdictions)
3. Auditor General (Canada)
4. Bureau of Land Management (USA)
5. California Department of Fish and Game (USA)
6. California Office of Spill Prevention and Response (USA)
7. California State Water Board (USA)
8. Canadian Environmental Assessment Agency
9. Canadian Food Inspection Agency
10. Climate and Pollution Agency (Norway)
11. Commissioner of the Environment and Sustainable Development (Canada)
12. Congressional Budget Office (USA)
13. Environment Pollution (Prevention and Control) Authority (India)
14. Environmental Protection Agency (USA)
15. Environmentally Sensitive Lands Oversight Committee (FL, USA)
16. European Environment Agency (EU)
17. Federal Environment Agency Soil Protection Commission (Germany)
18. Government Accountability Office (USA)
19. International Joint Commission (water) (Canada, USA)
20. Intergovernmental Panel on Climate Change (UN)
21. Managed Forest Council (B.C., Canada)
22. Mining and Petroleum Gateway Panel (NSW, Australia)
23. Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (Québec, Canada)
24. Ministry of Infrastructure and the Environment (Netherlands)
25. National Commission of the Environment (Chile)
26. National Energy Board (Canada)
27. National Institute of Health Sciences (Japan)
28. National Transportation Safety Board (Canada)
29. National Water Commission (Australia)
30. Northern Pipeline Agency (Canada)
31. Office of Management and Budget (USA)
32. Ohio Department of Natural Resources (USA)
33. Ontario Municipal Board (Canada)
34. Public Ministry (Brazil)
35. Remediation Monitoring Oversight Board (N.S., Canada)
36. Soil Conservation Service (Iceland)
37. Transportation Safety Board (Canada)
38. Virginia Department of Environmental Quality (USA)

The overriding message of Table 2 is that many aspects of abuse or stewardship of land, water, and air resources do fall, could fall, or should fall within the purview of oversight agencies.

Hence, it is most likely if not inevitable that the reports of these agencies contain a great deal of geographic data, geographic information, and/or geographic knowledge about the state of land, water, and air resources in their respective jurisdictions.

The qualifying question to be asked is whether the agencies were the sources for popular literature productions since 1990. And, the more specific question which follows the qualifying question is,

> Did <u>GIS</u> support or promote abuses of land, water, or air resources in ways that did not exist 25 to 30 years ago?

Further, for those who want to begin with 2014 or 2015 to get a sense of what might be found before the retrospective search to previous years unfolds, it might be useful to bear in mind that what is learned about the states of affairs in 2014 or 2015 could be the basis for prospective research as the future unfolds.

With regard to QD,

> For abuses of land, water, or air resources that might have occurred post-1990, but were prevented or avoided due to interventions by governments, businesses, or individuals, did <u>GIS</u> contribute to the interventions?,

it is my experience that for reasons of <u>candour</u> it is best to begin the search for potential GIS nuggets by examining the reports of oversight agencies.

In brief, I believe that since oversight agencies are more likely to play honest broker than politicians, heads of line departments, or heads of corporate or vested interests, it is prudent to give them highest priority consideration[12].

Then, after the oversight agencies have been searched for references to potential popular news items, or leads on actual items, it is appropriate to expand the search to line departments, businesses, and individuals or groups of individuals (e.g., public interest groups such as Sierra Club, Friends of the Rainforest, World Wildlife Fund, etc.) which are likely to have been the subjects of popular literature attention.

Clearly, searching for QC and QD materials via oversight agency reports is likely to be a far more difficult process than simply doing search engine operations by combining land, water, and air terms with abuse and care terms, and clicking.

However, GIS nuggets are not likely to be in the category of "low-hanging fruit" just waiting to be picked from the vast quantity of popular literature which is generated on a daily basis.

Rather, findings about GIS that arise from the retrospective approach will most likely involve difficult investigations, and enlisting the aid of oversight agency reports at the outset is one of the few means available to increase the prospects of productive media searches under challenging circumstances.

I close this section by mentioning the United Nations, which is an international body with huge oversight responsibilities, including those involving land, water, and air resources.

Based on a review of numerous oversight agency publications, including those along the lines of "United Nations: Poor data, weak agencies hamstring environmental oversight" (Groenwold 2009), it occurs that oversight agencies and the GIS community could mutually benefit from collaborating on how to use the retrospective approach to mine for both GIS nuggets and action-oriented environmental enlightenment.

In the next section I change the discussion from the doomsday and abuse perspective to that of stewardship care and a bright future perspective.

This line of thinking is from the counterfoil school of research design, and could be a catalyst for thinking about GIS nuggets in ways which are quite different from those discussed thus far in the paper.

7. Retrospective Mining for GIS Nuggets Includes Locating and Examining "Good News and Bright Futures" Stories

The Doomsday Map concept presented 25 or so years ago was designed to call attention to an asserted problem, and the headlines in Figure 11 demonstrate that many of the abuses identified then are still present today.

However, the headline search with its abuse orientation may not have done justice to the notion of stewardship of land, water, or air resources.

To compensate for such a possible limitation, and to give a fuller sense of the media literature which could, and if repeated for several years, most likely would remove layers from the Doomsday Map, or elaborate what might be termed the Stewardship Map, I created a number of illustratively caring headlines for Figure 13.

In brief, each of the illustrative headlines is

- Geography-based;
- Deals with a significant matter of public interest;
- Involves the care or stewardship of land, water, or air resources;
- Represents a general thought, hoped-for-future wish, election promise, letter-to-editor comment, etc., with a brighter future orientation;
- Represents a significant departure from past practices, which prompts questions about why and how the shift occurred,

And, most importantly for this project,

 ⬥ Represents a potential source to be mined for GIS nuggets.

**Figure 13. A short list of illustrative good news and
bright futures headlines* about the care (stewardship) of
land, water, and air resources**

Midwest aquifer recharging rate best in a decade

Algae blooms decrease across Mexico

Tailings dams in Australia checked, no leaks

Ottawa beaches now open after decades of run-off pollution

Another great salmon run for Washington's Pristine River

Strategic greening reduces urban flash flood impacts in India

Zoning now precludes building in Mississippi River flood plain

ATV group promotes saving Vermont's environmentally sensitive lands

World Bank allocates $50 billion in 3-year plan for rainforest preservation

Convictions on clear-cutting mean jail time for executives in Malaysia

U.N. congratulates Equatorial Africa for national forest reserve program

Soil erosion remedies working in Illinois and Wisconsin

Prime farmland designated sole highest and best land use in Finland

Japan's prime agricultural land reserves expanded

Natural habitat loss in Germany cut for third straight year

Loons returning to Minnesota

Critters now "roaming old stomping grounds" in the Maritimes

Urban sprawl thing of the past in more of China's metro regions

Smart intensification key to Nashville's sprawl turnaround

Agency uses geographic index to direct urban development in Brazil

Integrated land use and transit planning cuts demand for roads in B.C.

Worldwide, commuter vehicle use declines, air pollution levels drop

Paris leader in sustainable transport: Wins Challenge Cup

In landmark decision, New Mexico court accepts GIS standard of care evidence

Clear skies in Ontario signal drop in pollution from coal-burning plants In the U.S.

Vigorous enforcement of 3R policy extends NYC landfill life by 35 years

Glaciers and ice caps expanding, ocean levels lowering

Insurance companies impose new limits on building in harm's way

Republicans enthusiastically endorse Obama's *Green Initiative*

Renewable energy supply growing rapidly across Europe

Switzerland enshrines stewardship principle in law

Google hosts worldwide *Stewardship Map* program

Canada tops in providing citizens and media open access to scientists

*<u>It is emphasized that the stewardship headlines are created or imagined for the purposes of this paper</u>. I searched for such headlines or lists of such headlines on various websites, including those which reject arguments about climate change and global warning, but without success[12]. I welcome learning of any websites or other accessible sources which maintain lists of real, (*i.e.*, verifiable) good news and bright futures headlines about care (stewardship) of land, water, and air resource practices which could be the basis of a list similar to the one presented as Figure 13.

For the purposes of this paper, several comments arise concerning the headlines in Figure 13, regardless of whether the headlines are real or imagined.

That is, if a headline refers to an actual situation, then the task is a matter of obtaining the details which respond to the questions in Table 3. And, if the headline is imaginary, then a hypothetical situation exists and the task becomes one of creating a scenario, vision, narrative, account, story, etc., which "creates" a connection between the headlines and the questions in Table 3.

**Table 3. Questions for ascertaining the reasons behind
the change from abuse to care of land, water, and
air resources, and the role of GIS**

1. Who caused the change from abuse to care to occur?
   Was GIS a factor?

2. What caused the change from abuse to care to occur?
   Was GIS a factor?

3. Why did the change from abuse to care occur?
   Was GIS a factor?

4. When did the change from abuse to care occur?
   Was GIS a factor?

5. Where did the change occur?
   Was GIS a factor?

6. How did the change occur?
   Was GIS a factor?

Published responses to the questions in Table 3, whether representing actual or imagined situations, are important contributions to the literature on changes from abuse to care of land, water, and air resources, and the role of GIS in effecting that change.

Further, they will likely be instructive in shaping subsequent questions in the process of retrospectively mining for GIS nuggets, as well as in the process of designing questions for prospective mining expeditions.

In the next section I outline why the doomsday and stewardship headlines representing land, water, and air resource situations invite applying the retrospective approach to mine the stories behind these headlines for GIS nuggets.

8. Suggested Core Questions to Guide Using the Retrospective Approach to Mine the Doomsday and Stewardship Headlines/Stories for GIS Nuggets

Figure 1 and Table 1 from Section 1 provide context for what I suggest are core questions to guide mining the popular literature for GIS nuggets.

Figure 1 establishes that nuggets are findings, and that the findings may serve three missions, that is, GIS technology, GIScience, and uses of the technology and/or the science. I hasten to add there are other terms which can be used instead of "serve", and there could be missions other than M1, M2, and M3, but I suggest that kind of detailing is best done as part of an actual mining experience involving the popular literature or any body of literature.

Figure 1. GIS nuggets defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Table 1 then provides a number of examples of nuggets which could be obtained through mining the literature.

**Table 1. Possible nuggets derived from using the
retrospective approach to examine "the literature***

1. New or different reasons to add to GIS technology;
2. New or different ways to add to GIS technology;
3. New or different reasons to add to geospatial data;
4. New or different reasons to add to geospatial information;
5. New or different reasons to add to geospatial knowledge;
6. New or different ways to add to geospatial data;
7. New or different ways to add to geospatial information;
8. New or different ways to add to geospatial knowledge;
9. New or different uses of GIS technology;
10. New or different uses of geospatial data;
11. New or different uses of geospatial information;
12. New or different uses of geospatial knowledge;
13. New or different uses of GIScience research methods;
14. New or different uses of GIScience research techniques;
15. New or different uses of GIScience research operations.

Following from Figure 1, the nuggets may serve three missions, that is, GIS technology, GIScience, and uses of the technology and/or the science.

And, similar to the comment about Figure 1, there could be other questions in Table 1, or other ways of phrasing questions.

However, it appears that kind of detailing is best done as part of an actual mining experience involving the popular literature or any body of literature.

With Figure 1 and Table 1 providing context, the quest for GIS nuggets begins with statements and questions about abuse and care relationships between 1990 and 2015.

Table 4 presents four basic statements about situations and patterns derived from the doomsday and stewardship headlines, which are labelled R1, R2, R3, and R4. Each relationship statement is accompanied by several associated questions, which I suggest serve as initial guides to retrospectively search the popular literature for GIS nuggets.

**Table 4. Basic land, water, or air abuse and care relationships,
1990- 2015, and associated questions to use
in mining for GIS nuggets**

R1. There was apparent land, water, or air <u>abuse in 1990</u>, and there is apparent land, water, or air <u>abuse now</u>. Over the years,

> Was GIS used?

> If yes, did GIS fail?

Why did GIS fail?

If GIS was not used, why not?

In the mining for nuggets process, what we want to know is whether GIS had anything to do with what happened in R1 and the resultant effect on M1, M2, or M3 from Figure 1.

R2. There was apparent land, water, or air <u>abuse in 1990</u>, and there is apparent land, water, or air <u>care now</u>. Over the years,

Was GIS used?

Did it support the abuse-to-care change?

If yes, how?

In the mining for nuggets process, what we want to know is whether GIS had anything to do with what happened in R2 and the resultant effect on M1, M2, or M3 from Figure1.

R3. There was apparent land, water, or air <u>care in 1990</u>, and there is apparent land, water, or air <u>abuse now</u>. Over the years,

Was GIS used?

Did it fail?

Why did GIS fail?

In the mining for nuggets process, what we want to know is whether GIS had anything to do with what happened in R3 and the resultant effect on M1, M2, or M3 from Figure1.

R4. There was apparent land, water, or air <u>care in 1990</u>, and there is apparent land, water, or air <u>care now</u>. Over the years,

Was GIS used?

If yes, how was it used?

In the mining for nuggets process, what we want to know is whether GIS had anything to do with what happened in R4 and the resultant effect on M1, M2, or M3 from Figure1.

Figure 4 summarizes the basic abuse-care relationships, and provides an opening set of associated GIS questions for land, water, and air media headlines and stories on or about 1989-1990 and 2014-2015, and over the 25 or so intervening years.

Further, because of their general nature, relationships R1, R2, R3, and R4 and the associated questions can apply to single jurisdictions or to multiple jurisdictions.

Moreover, R1, R2, R3, and R4 can be used without loss of generality in whatever timeframe is supported by the popular literature, that is, from days, weeks, months, and years, to decades.

Finally, there is a forward-looking aspect to Figure 4. In brief, because of the general design of the relationships connecting 1990 and 2015, in principle they can be used to examine connections between headlines and stories in 2015 and those published in years beyond 2015.

9. Conclusion

This paper responds to feedback from contributors to the *AutoCarto Six Retrospective* project, and from reviewers of the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets.*

In brief, it was suggested that illustrative papers may be needed to provide guidance for potential contributors to the Conference on Using the Retrospective Approach to Mine for GIS Nuggets, and especially for contributors who are new to or have limited experience with the retrospective line of inquiry. I chose the popular literature as the basis of the first Research Colloquium paper, and organized the paper around the Doomsday Map concept which was conceived in the 1980s.

The Doomsday Map concept, which was introduced to the GIS community 25 years ago, was one of the early, widely-circulated commentaries on the negative aspects of global warming, and land, water, air abuse[14]. It is used in this paper in combination with the concept of a Stewardship Map to illustrate why and how headlines and stories in the popular literature about the abuse or care of land, water, and air resources could be used to retrospectively mine for GIS nuggets.

With GIS nuggets defined as findings which serve three important functions,

- o Designing and developing geographic information systems technology,
- o Defining and elaborating geographic information science, and,
- o Using geographic information systems technology and/or geographic information science,

the paper presents a selection of GIS nuggets that could be obtained by retrospectively mining the literature in search of such findings as:**:**

- o New or different reasons to add to GIS technology;
- o New or different ways to add to GIS technology;
- o New or different reasons to add to geospatial data;
- o New or different reasons to add to geospatial information;
- o New or different reasons to add to geospatial knowledge;
- o New or different ways to add to geospatial data;
- o New or different ways to add to geospatial information;

- New or different ways to add to geospatial knowledge;
- New or different uses of GIS technology;
- New or different uses of geospatial data;
- New or different uses of geospatial information;
- New or different uses of geospatial knowledge;
- New or different uses of GIScience research methods;
- New or different uses of GIScience research techniques;
- New or different uses of GIScience research operations.

In the case of mining the popular literature for GIS nuggets, the paper emphasizes that the land, water, and air resources which are featured in media headlines and stories are intrinsically geographic.

It follows, therefore, that if the contents of thousands of stories every year about land, water, and air abuse or care practices could be represented by geospatial data, incorporated in a geographic information system (GIS), and displayed in map form or other graphic representations, then they could be mined for possible pointers, hints, indicators, suggestions, clues, etc., about where and how to discover, recover, or uncover GIS nuggets.

After presenting doomsday and stewardship headlines for 1989-1990 and 2014-2015, the paper then presents four basic land, water, or air abuse and care relationships, and associated questions, to use in mining for GIS nuggets.

R1. There was apparent land, water, or air abuse in 1990, and there is apparent land, water, or air abuse now. Over the years,

Was GIS used?

If yes, did GIS fail?

Why did GIS fail?

If GIS was not used, why not?

R2. There was apparent land, water, or air abuse in 1990, and there is apparent land, water, or air care now. Over the years,

Was GIS used?

Did it support the abuse-to-care change?

If yes, how?

R3. There was apparent land, water, or air care in 1990, and there is apparent land, water, or air abuse now. Over the years,

Was GIS used?

Did it fail?

Why did GIS fail?

R4. There was apparent land, water, or air <u>care in 1990</u>, and there is apparent land, water, or air <u>care now</u>. Over the years,

Was GIS used?

If yes, how was it used?

In the mining for nuggets process, what we want to know is whether GIS had anything to do with the situations described in R1, R2, R3, or R4, and, ultimately, the resultant effect on GIS technology, GIScience methods, techniques, or operations, and the uses of GIS and GIScience.

This paper outlines why I believe it is critically important to retrospectively mine the popular literature for GIS nuggets, and provides suggestions about how the mining process could be designed.

10. Endnotes

1. As stated in posted reports beginning in late 2014, the decision was made to separate the colloquium and the conference rather than hold them both during a three-day event in February 2015. The current plan is to assess the value, impacts, and messages of the colloquium and, if appropriate, to proceed with a conference in 2016 in conjunction with the Esri Federal GIS User Conference in Washington DC.

2. http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf

3. Between 1972 and 1979 my positions at Urban Affairs included Senior Research Officer, Urban Information Theme Coordinator, Assistant Director of Data Processing Services, Director of Non-Metropolitan Community Development, and Senior Policy Advisor. I served on numerous inter-departmental and inter-governmental committees, including an eco-development group that did basic research in advance of the U.N. sustainable development work (WCED, 1987), and represented the Ministry and the Government of Canada at many meetings across Canada, as well as on OECD panels, U.N. projects, U.S. projects, and professional organizations.

For those not familiar with "government speak", I learned early and often that damage, degradation, destruction, and other forms of abuse of water, land, and air resources were regularly referred to by mushy terms such as issues, concerns, situations, worries, problems, challenges, or difficulties but, simply put, they were abuses. Four decades later, not much has changed.

4. Just to be clear, high-speed electronic search engines did not exist in the public domain 25 years ago, so back in that day if we wanted news we had three choices: obtain and read written texts; get access to and listen to radio broadcasts; and get access to and listen to/watch television programs. Since e-access to any of the mediums was a non-starter, newspapers were the relatively more operational choice, and especially for class projects.

5. Each of A, B, C, and D holds potential as a rich field of inquiry, and I suggest that they be considered as class assignment projects, thesis and dissertation topics, and research proposals.

6. As discussed in subsequent sections, layers could be added to or subtracted from the Stewardship Map instead of the Doomsday Map if one prefers the caring perspective.

7. Some land, water, and air resources receiving attention today could be new or different relative to those included in the searches *circa* 1990. To the extent that is in fact the case, the universe of potential Doomsday Map or Stewardship Map headlines and stories, and GIS nuggets, expands accordingly.

8. The reader may be aware of government interventions which are termed "political decisions". On the evidence, and admissions made by politicians upon hard and/or persistent questioning through the media, including social media, these decisions have nothing to do with preventing land, water, or air abuses; rather, they have everything to do with cultivating the electorate or a segment of the electorate for the express purposes of the party in power. Parties in opposition make similar "political decisions".

9. Generally speaking, different skill sets are required for different oversight agencies. However, it appears appropriate for this meeting on retrospective research to focus on universals related to GIS and GIScience and, as time permits, the Research Colloquium can venture into subject-, profession-, or discipline-related specifics.

10. There are similar central, federal, state, provincial, regional, and local government offices and agencies in countries around the world, and I expect that a comparative analysis would be very revealing as to the kinds of activities undertaken by the respective oversight offices and agencies, and their effectiveness.

11. This list is for 2014, and there may well be differences between the current situation and those of earlier years in most if not all countries. However, reporting on the history of oversight agencies with land, water, and air abuse responsibilities is a task for another day.

12. I believe that this would be an excellent research project for students in geography, earth sciences, environmental studies, etc., who are inquiring into the pros and cons of climate change discourse.

13. At the time of this writing in October 2014, the Government of Canada is confronted by the recently-released report of the Federal Commissioner of the Environment and Sustainable Development, which is critical of the government's lack of progress (eight years and counting) in implementing regulations to reduce greenhouse gas emissions. A media scan and a scan of public interest communications bear out my position that the credible source in the discourse is the Commissioner of the oversight agency,

14. The Doomsday Map scenario was presented as part of the opening keynote session at the 1990 GIS/LIS conference in Anaheim, California. With 4,000 attendees at

the meeting, and sponsorship by six organizations (American Congress on Surveying and Mapping, the American Society for Photogrammetry and Remote Sensing, AM/FM International, the Association of American Geographers, and the Urban and Regional Information Systems Association), the matter of land, water, and air abuse or care as the case may be, was explicitly "put out there" 25 years ago for the international community of individuals, agencies, firms, etc., engaged in the evolution and use of geographic information systems, automated cartography, remote sensing, and related technologies.

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Searching for GIS Nuggets:
Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development

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ABSTRACT. The Commissioner of Environment and Sustainable Development (CESD) is a Government of Canada oversight agency. CESD reviews and evaluates federal department and agency progress in developing and implementing strategies to serve and promote sustainable development (which applies to both the built and the natural environments); and, CESD also oversees the environmental petitions process involving citizens. This paper discusses CESD's mandate, its annual Reports to Parliament, and the focus of the Reports on the importance of <u>information</u> which is to be collected and processed by federal departments and agencies, and then used to monitor and analyze environmental and sustainable situations and processes, as well as to direct and support policy, program, and strategy decisions, and to communicate with citizens on environmental and sustainable development challenges, opportunities, issues, options, and initiatives. The paper concludes that CESD Reports to Parliament are an important body of literature to be mined for GIS nuggets.

KEYWORDS. Applied Research, Audits, *AutoCarto Six Retrospective*, Built Environment, CESD, Commissioner of Environment and Sustainable Development, Content Analysis, Decision Processes, Decision Variables, Doomsday Map, Earth Summit, Environmental Assessment, Environmental Petitions, Esri, Evaluation Methods, Federal Departments, Federal Sustainable Development Strategy, Geo-factor, Geographic Information Science, Geographic Information Systems, Geographic Variables, Geography, Geospatial Data, Geospatial Information, Geospatial Knowledge, GIS, GIS Applications, GIS Findings, GIS Nuggets, GIS Technology, GIS Uses, GISc, GIScience Methods, GIScience Operations, GIScience Techniques, Government, Impact Assessment, Literature Mining Processes, Minister of the Environment, Natural Environment, News Media, Oversight Agencies, Parliament, Performance Audit, Policy Research, Research Colloquium, Research Design, Research Methodology, Research Mission, Resource Abuse Practices, Resource Care Practices, Retrospective Approach, Retrospective Research Design, Spatial Trend Line Analysis, Stewardship Map, Strategies, Sustainable Development, United Nations.

1. Background of the GIS Mining Mission

The definition of GIS nuggets was originally published in mid-2014 in the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets*, It was intended that the *Guide*, which provided the statement of problem and terms of reference for the

GIS retrospective program, would be incorporated in the proceedings as context for this and other conference presentations. However, and as summarized in Endnote 1, the *Guide* was withdrawn for research program design reasons, which requires a change in how information about the mining mission is provided[1].

That is, in the interests of completeness, self-containment, and convenience of readers, a selection of background materials from the *Guide* are reproduced, and follow below.

As stated in Figure 1, GIS nuggets are <u>findings</u> from the literature or other sources which serve one or more GIS purposes. The three core, related missions in Figure 1 which are served by GIS nuggets are designated **M1**, **M2**, and **M3.**

Figure 1. GIS nuggets defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve three core, related missions:

> **M1**. Designing and developing geographic information systems technology;
>
> **M2**. Defining and elaborating geographic information science;
>
> **M3**. Using geographic information systems technology and/or geographic information science.

Two remaining pieces of background information about the GIS mining mission are examples of GIS nuggets pertinent to M1, M2, and M3 in Figure 1, and a context for oversight agency literature *vis-à-vis* other bodies of literature. Examples of nuggets and the literature context are summarized as follows.

GIS nuggets of possible or probable value include those listed in Table 1. As indicated, each nugget serves one or more of M1, M2, or M3.

Table 1. Illustrative nuggets derived from using the retrospective approach to examine "the literature"

1. New or different reasons to add to GIS technology;
2. New or different ways to add to GIS technology;
3. New or different reasons to add to geospatial data;
4. New or different reasons to add to geospatial information;
5. New or different reasons to add to geospatial knowledge;
6. New or different ways to add to geospatial data;
7. New or different ways to add to geospatial information;
8. New or different ways to add to geospatial knowledge;
9. New or different uses of GIS technology;
10. New or different uses of geospatial data;
11. New or different uses of geospatial information;

12. New or different uses of geospatial knowledge;
13. New or different uses of GIScience research methods;
14. New or different uses of GIScience research techniques;
15. New or different uses of GIScience research operations.

The common feature among all entries in Table 1 is the phrase "new or different", but it comes with a twist, so to speak.

That is, the phrase "new or different" has a range of applicability, from the general or universal to the particular or individual for each of the 15 entries, so Table 1 may have more inherent breadth and depth than immediately gleaned upon first glance.

Preliminary investigations suggest that findings about the new or different ways, reasons, and uses derived from retrospective searches are only in part a function of the literature or other sources(s) being mined. More significant, it appears, are the expertise, experience, and motivations of the person(s) doing the mining.

However, research that I have undertaken to date, and the information provided by participants in the AutoCarto Six Retrospective project (Wellar, 2013), establish that investigations of this nature are still in the early, exploratory, and informal stages. Looking ahead, it is expected that future presentations will begin to provide confirmatory information about the yields from the respective literatures. And, it is anticipated that as a valuable by-product of such research, there will be changes to the entries in Table 1.

Table 2 presents the bodies of literature which have been identified as materials to be mined in the search for GIS nuggets, and also includes an entry labelled 'Other Productions'.

This approach takes into account work(s) which may be or may seem to be outside the purview of what is conventionally regarded as 'literature', and also avoids the frustration of unnecessarily becoming hung up on semantics.

The focus of this paper is on body of literature 5, Oversight Agency Literature, and specifically that of the Commissioner of Environment and Sustainable Development (CESD), Office of the Auditor General (OAG), Government of Canada[2].

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. **Oversight Agency Literature**
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature

10   Special Interest Literature
11.   Vested Interest Literature
12.   Other Productions

(After: Wellar, B. 2005. ***Geography and the Media: Strengthening the Relationship***. Ottawa: Canadian Association of Geographers, Canadian Royal Geographical Society and the Canadian Council on Geographic Education. http://www.ccge.ca)

The reasons for selecting oversight agency literature for a colloquium topic arose while writing the paper, Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map Concept as a Compelling Argument to Retrospectively Mine the Popular Literature for GIS Nuggets (Wellar, 2015).

Two paragraphs from section 6 of that paper are repeated here to illustrate the basis of my thinking about the connection between popular literature and oversight agency literature.

"6. Comments on Popular Literature Materials Regarding Oversight Agency Productions

As a rule, neither private sector corporations nor government line departments such as Agriculture, Commerce, Defence, Economic Development, Energy, Environment, Finance, Fisheries and Oceans, Forestry, Housing, Industry, Infrastructure, Interior, Land Management, Mining, Municipal Affairs, Natural Resources, Parks and Recreation, Planning and Development, Public Works, Regional Development, Transportation, Urban Affairs, Utilities, or Water/Wastewater rush to publicly admit to committing or aiding and abetting abuses of land, water, and air resources.

Consequently, in the case of case of abuses of land, water, and air resources arising since 1990, we tend to learn about them from oversight agencies which are (purportedly) independent of "political strings", and whose mandate is to inform about matters of public interest."

In addition to establishing the popular literature and oversight literature connection, research into oversight agencies in Canada and other countries revealed that the mandates of a number of them extend over many aspects of abuse or stewardship of land, water, and air resources.

Consequently, the reports of these agencies contain a great deal of geographic data, geographic information, and/or geographic knowledge about the state of land, water, and air resources in their respective jurisdictions, and the literature of oversight agencies is therefore a prime body of material to mine for GIS nuggets.

In section 2, I provide an introduction to the Office of Commissioner of Environment and Sustainable Development (CESD), Government of Canada, which authored the oversight agency literature of interest in this presentation.

2. Background on Canada's Commissioner of Environment and Sustainable Development (CESD)

The following exhibits from the website of the Office of the Auditor General (OAG) provide the details about CESD which are sufficient for the purposes of this paper.

While excerpts are used here, it is recommended that all pertinent postings about CESD be reviewed prior to commencing the mining process. I return to this topic in section 3 to re-confirm the expertise aspect of CESD which is discussed in the Doomsday Map and Stewardship Map paper, and to emphasize the advisability of being fully prepared when reviewing materials produced by oversight agencies.

The first exhibit provides the basic terms of reference for CESD activities.

Exhibit 1. Statement describing the Commissioner of the Environment and Sustainable Development

On behalf of the Auditor General of Canada, the Commissioner of the Environment and Sustainable Development provides parliamentarians with objective, independent analysis and recommendations on the federal government's efforts to protect the environment and foster sustainable development.

The Commissioner conducts performance audits, and is responsible for assessing whether federal government departments are meeting their sustainable development objectives, and overseeing the environmental petitions process.

Appointed by the Auditor General, the Commissioner of the Environment and Sustainable Development is an Assistant Auditor General who leads a group of auditors specialized in environment and sustainable development.

Source: http://www.oag-bvg.gc.ca/internet/English/cesd_fs_e_921.html

The second exhibit describes the origins of CESD, with emphasis on the sustainable development component.

It may be instructive to note that the unfolding of sustainable development concepts and strategies in the Government of Canada began in the 1970s. The Ministry of State for Urban Affairs was one of several agencies which took the lead on a series of inter-departmental, eco-development meetings, *circa* 1977-78. That work ultimately provided fundamental inputs to the 1992 Earth Summit in Rio de Janeiro, which popularized the concept of sustainable development. I return to time line and trend line matters in

section 4, and the discussion about using GIS to measure the Government of Canada's performance in identifying, adopting, and implementing sustainable development strategies[3].

Exhibit 2. Sustainable development strategies

At the 1992 Earth Summit in Rio de Janeiro, Canada and numerous other participants committed to developing national strategies for sustainable development. Canada chose to make selected federal departments and agencies responsible for sustainable development within the sphere of their mandates. The aim was to ensure that environmental, economic, and social considerations would be systematically taken into account in their decision making, and lead to changes in policies, programs and operations that would further sustainable development.

Departmental Sustainable Development Strategies

Since 1995, designated departments and agencies have been required by law to prepare sustainable development strategies, then update them and present them to Parliament every three years. These strategies are meant to be the main vehicle to drive responsible management, from an environmental and sustainable development perspective, throughout the federal government.

Requirements for departmental strategies are detailed in the federal government publication *A Guide to Green Government*. The Commissioner of the Environment and Sustainable Development has also established certain expectations. The sustainable development strategies of federal departments and agencies are available on their websites, which can be accessed through links in the Government of Canada website. These documents are not published by the Office of the Auditor General of Canada, and are the responsibility of each department.

The Commissioner of the Environment and Sustainable Development assesses the quality of departmental sustainable development strategies and whether the plans set out in the strategies have been implemented. The results are presented in various reports of the Office of the Auditor General of Canada, including the Commissioner's reports to the House of Commons.

Federal Sustainable Development Strategy

The *Federal Sustainable Development Act*, which was passed in 2008, requires the Minister of the Environment to develop an overarching federal sustainable development strategy that includes sustainable development goals and targets as well as an implementation plan for meeting each target. The strategy will also identify the minister responsible for meeting each target. Departmental sustainable development strategies must now include

plans and objectives that comply with and contribute to the new Federal Sustainable Development Strategy.

The Commissioner of the Environment and Sustainable Development provided comments to the Minister of the Environment on whether the targets and goals in the draft strategy can be assessed. He will monitor and report on how well federal departments and agencies meet the targets and goals that will be set out in the Federal Sustainable Development Strategy. The Commissioner will also report to Parliament on the fairness of the information in the progress report that the federal government will provide on the strategy.

- Review of the Draft 2013–2016 Federal Sustainable Development Strategy (June 2013)
  - o Response from Environment Canada (June 2013)

- Comments on the Draft Federal Sustainable Development Strategy (June 2010)

Source: http://www.oag-bvg.gc.ca/internet/English/sds_fs_e_920.html

The clickable links provide access to a wealth of background information which is pertinent to the mission of mining for GIS nuggets involving each of M1, M2, and M3 in Figure 1. One link which is of particular importance to the search for GIS nuggets is departments and agencies, and a brief note of explanation is needed.

That is, and as shown in Table 3, 27 departments and agencies of the federal government are required to prepare a sustainable development strategy, and respond to environmental petitions. In view of the fact that each of them has responsibility for some geographically distributed element of the natural or built environment, including the core resources (land, water, and air), each of the 27 departments or agencies is a potential source of GIS nuggets which serve one or more of the M1, M2, or M3 missions identified in Figure 1.

**Table 3. Federal departments and agencies required
to prepare a sustainable development strategy
and respond to environmental petitions**

1. Agriculture and Agri-Food Canada
2. Atlantic Canada Opportunities Agency
3. Canada Border Services Agency
4. Canada Economic Development for Quebec Regions
5. Canada Revenue Agency
6. Canadian Heritage
7. Canadian International Development Agency
8. Citizenship and Immigration Canada

9. [Environment Canada](#)
10. [Finance Canada, Department of](#)
11. [Fisheries and Oceans Canada](#)
12. [Foreign Affairs and International Trade Canada](#)
13. [Health Canada](#)
14. [Human Resources and Skills Development Canada](#)
15. [Indian and Northern Affairs Canada](#)
16. [Industry Canada](#)
17. [Justice Canada, Department of](#)
18. [National Defence](#)
19. [Natural Resources Canada](#)
20. [Parks Canada](#)
21. [Public Health Agency of Canada](#)
22. [Public Safety Canada](#)
23. [Public Works and Government Services Canada](#)
24. [Transport Canada](#)
25. [Treasury Board of Canada Secretariat](#)
26. [Veterans Affairs Canada](#)
27. [Western Economic Diversification Canada](#)

The third exhibit is pertinent to everyone in the information field, including those with an interest in GIS and GIScience, and all the more so because of a recent report released by the non-profit group Evidence for Democracy, in association with researchers at Simon Fraser University (Evidence for Democracy 2014). The report assessed the media policies of 16 federal departments, and found them seriously wanting when it comes to open and free communication between scientists and the public through the media. I return to this topic later in section 4.2, Exhibit 14.

Exhibit 3. Environmental petitions

The petitions process was established by Parliament to make sure Canadians can get answers from federal ministers on specific environmental and sustainable development issues that involve federal jurisdiction. In addition to providing information to petitioners, petitions have prompted such action by federal departments as new environmental projects, follow-up on alleged violations, and changes or clarifications in policies and practices. The Commissioner of the Environment and Sustainable Development reports annually to Parliament on the petitions process.

The Office of the Auditor General of Canada has prepared a guide to the environmental petitions process. The guide, called [Getting Answers](#) ([PDF](#)), explains the purpose and mechanics of the petitions process, describes the kinds of requests that can be made, and provides advice on how to prepare a petition.

The full text of most petitions and responses can be found in the petitions catalogue, which currently contains petitions received before 31 December 2013. The catalogue is a useful resource for preparing a petition. Other Canadians may have already raised similar issues. The responses to those petitions may have addressed the concern or they could form a useful basis for a more focused petition.

Source: http://www.oag-bvg.gc.ca/internet/English/pet_fs_e_919.html

The final exhibit is a list of the documents which comprise the oversight agency literature – Reports to Parliament – which is the focus of this paper on mining for GIS nuggets.

**Exhibit 4: Reports to Parliament by the
Commissioner of the Environment and Sustainable Development**

- 2014 Fall Report of the Commissioner of the Environment and Sustainable Development

- 2013 Fall Report of the Commissioner of the Environment and Sustainable Development

- 2012 Fall Report of the Commissioner of the Environment and Sustainable Development

- 2012 Spring Report of the Commissioner of the Environment and Sustainable Development

- 2011 December Report of the Commissioner of the Environment and Sustainable Development

- 2011 October Report of the Commissioner of the Environment and Sustainable Development

- 2010 Fall Report of the Commissioner of the Environment and Sustainable Development

- 2009 November Report of the Commissioner of the Environment and Sustainable Development
2009 Fall Report of the Commissioner of the Environment and Sustainable Development

- 2009 Spring Report of the Commissioner of the Environment and Sustainable Development

- 2009 March Report of the Commissioner of the Environment and Sustainable Development
2009 March Status Report of the Commissioner of the Environment and Sustainable Development

- 2008 December Report of the Commissioner of the Environment and Sustainable Development

- 2008 March Report of the Commissioner of the Environment and Sustainable Development
2008 March Status Report of the Commissioner of the Environment and Sustainable Development

- 2007 October Report of the Commissioner of the Environment and Sustainable Development

- [2006 September Report of the Commissioner of the Environment and Sustainable Development](#)

- [2005 September Report of the Commissioner of the Environment and Sustainable Development](#)

- [2004 October Report of the Commissioner of the Environment and Sustainable Development](#)

- [2003 October Report of the Commissioner of the Environment and Sustainable Development](#)

- [2002 October Report of the Commissioner of the Environment and Sustainable Development](#)

- [2001 October Report of the Commissioner of the Environment and Sustainable Development](#)

- [2000 May Report of the Commissioner of the Environment and Sustainable Development](#)

- [1999 May Report of the Commissioner of the Environment and Sustainable Development](#)

These pages have been archived on the Web

- [2014 Fall Report of the Commissioner of the Environment and Sustainable Development](#)

- [2013 Fall Report of the Commissioner of the Environment and Sustainable Development](#)

- [2012 Fall Report of the Commissioner of the Environment and Sustainable Development](#)

- [2012 Spring Report of the Commissioner of the Environment and Sustainable Development](#)

- [2011 December Report of the Commissioner of the Environment and Sustainable Development](#)

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- [2010 Fall Report of the Commissioner of the Environment and Sustainable Development](#)

- [2009 November Report of the Commissioner of the Environment and Sustainable Development](#)

- [2009 Spring Report of the Commissioner of the Environment and Sustainable Development](#)

- [2009 March Report of the Commissioner of the Environment and Sustainable Development](#)

- [2008 December Report of the Commissioner of the Environment and Sustainable Development](#)

- [2008 March Report of the Commissioner of the Environment and Sustainable Development](#)

- [2007 October Report of the Commissioner of the Environment and Sustainable Development](#)

- [2006 September Report of the Commissioner of the Environment and Sustainable Development](#)
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- [2003 October Report of the Commissioner of the Environment and Sustainable Development](#)
- [2002 October Report of the Commissioner of the Environment and Sustainable Development](#)
- [2001 October Report of the Commissioner of the Environment and Sustainable Development](#)
- [2000 May Report of the Commissioner of the Environment and Sustainable Development](#)
- [1999 May Report of the Commissioner of the Environment and Sustainable Development](#)

Source: http://www.oag-bvg.gc.ca/internet/English/parl_lp_e_901.html

There is much more which could be presented as background material about CESD. However, I believe that the essentials are included in exhibits 1-4. Further, it is my expectation that the reader is fully capable of following the links of interest which are presented in the exhibits, as well as checking out media/popular literature items about CESD. As a heads up in the latter regard, it is my experience that CESD receives most of its media coverage within several weeks of the release of a Report to Parliament.

In the paper, Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to Retrospectively Mine the Popular Literature for GIS Nuggets (Wellar 2015), I make several comments about the skill levels associated with oversight agencies in general. In the next section I recall those comments, and add several more about the skill levels required to properly mine CESD reports for GIS nuggets.

3. An Advisory on Skills Required to Mine Oversight Agency and CESD Reports

Section 5 of the Abuse v. Care paper (Wellar 2015), discusses the degree of difficulty, level of expertise, demanding nature, and other measures of the technical challenge of oversight agency reports:

> "…in my experience reports from oversight agencies are usually the most technically sophisticated of all documents published for public consumption by government agencies. Evidence in that regard includes performances by elected officials, pundits, and others who demonstrate that they clearly do not grasp the methodology behind oversight productions. The research

colloquium [in 2015] preceding the conference [in 2016] addresses this matter by discussing skill requirements and providing reference materials needed to understand the reports, and to appreciate whether the popular literature is accurately interpreting oversight agency materials."

The finding from reviews of Canadian federal and provincial oversight agency reports is that in terms of methodology, many of them are high-quality documents on a par with such productions as: top-notch research proposals and reports to NSERC and SHHRC; peer-reviewed journal articles; outstanding conference presentations; master's theses in the natural sciences, library and information sciences, management science and operations research, engineering, and mathematics and statistics; and; doctoral-level research papers across the sciences and engineering[4].

Whether slightly generous or grudging in my findings, the point made is that these reports are far from being pieces of fluff. As indicated above, many elected officials (including cabinet ministers), vested interests, ideologues, etc., have been "taken to school" when their remarks reveal a diminished understanding or perversely biased view of oversight agency reports. Consistent with the comparable productions noted in the preceding paragraph, oversight agencies are widely respected for their sound work, and are known to vigorously defend that work, thereby giving credence to the label of "watchdog" which is often applied to them.

In the case of CESD, members of the Commission who participate in writing Reports to Parliament have Master's degrees and/or professional accreditation as a minimum; their degrees are from a variety of fields, including accounting, biology, economics, engineering, environmental design, geography, geology, law, planning, public administration, and zoology; the agency uses a very rigorous document, the *Performance Audit Manual* (OAG 2014) to direct audit activities; and external advisors are engaged and external experts retained as needed to assist with financial and performance audits or special projects.

All in all, this is a highly-credentialed applied research and policy research group, and CESD Reports reflect a high level of expertise, discipline, tight editing, and, for want of a better word, intensity, in that there are no wasted words or sentences, much less throwaway paragraphs or pages.

In the case of CESD, therefore, mining for GIS nuggets is a particularly apt turn of phrase, since thorough examination of CESD Reports is more likely to involve methodologically designed deep digging than simply picking off "low-hanging fruit".

This is not to say, of course, that CESD reports are beyond improvement. Indeed, the agency itself strives to better its own performance. Rather, the objective is to alert or remind those mining these reports for GIS nuggets that, relatively speaking and in comparison to other federal government productions, CESD materials are not of the skimming variety[5]. They tend to be very carefully written, and are technically solid, which calls for attentive, analytical examination in order to fully appreciate the contents and their GIS nugget possibilities.

On the matter of skill level, then, it appears that in addition to having expertise in GIS and GIScience, mining CESD reports for GIS nuggets is likely to be more profitable for researchers whose credentials include a combination of: graduate-level courses in research methodology; experience in both client-driven and curiosity-driven research; a stint in a federal or provincial agency that involved participation in program or policy activities; experience in evaluating research proposals; and an education and training background in the subject matter domain of the CESD production being mined for GIS nuggets.

4. A Suggested Methodology for Mining CESD Reports in Search of GIS Nuggets

The agency was created in 1995, and in 1999 it submitted a Report to Parliament that could be construed as a baseline document against which to measure progress of the Government of Canada in stating and achieving its environmental and sustainable development objectives.

Drawing on the informative experience of using *circa* 1989-1990 as the base timeline for the Doomsday Map, and subsequently asking the question, "How well are we doing?" over time and up to 2015, I use the same approach for this paper about oversight agency literature.

The primary difference, of course, is that of time span, namely, 25 years (1989/1990-2014/2015) for the Doomsday Map-Stewardship Map, and 15 years (1999-2014) for CESD.

In this case, paragraphs are selected from the 1999 CESD Report to Parliament, and they are accompanied by comments which could be used to think about why and how to mine the 1999 CESD report for GIS nuggets[6].

I then move to the 2014 Report to Parliament, and again provide comments which could be used to think about why and how to mine CESD reports for every year after 1999, and for every combination of years between 1999 and 2014.

However, in this case the search does not involve headlines. Instead, the focus is on trend lines, which could be mined for GIS nuggets serving one or more of the three core, related missions identified in Figure 1.

4.1. Exhibits from the 1999 CESD Report to Parliament

In the next several pages, I discuss a selection of paragraphs from The Commissioner's Observations—1999. I hasten to recall my observation above, however, about the high quality of CESD documents, and suggest that most if not all paragraphs in CESD Reports to Parliament bear careful scrutiny for GIS nugget possibilities.

To assist in tracking who wrote what, materials from the 1999 Report to Parliament are black and italicized, and my comments are red, bold, and plain text.

**1999 May Report of the Commissioner of
the Environment and Sustainable Development**

http://www.oag-bvg.gc.ca/internet/English/parl_cesd_199905_00_e_10166.html#0.2.
2Z141Z1.8HM2LO.RR2LBF.LB

Exhibit 6. Federal-provincial agreements to protect the environment

The federal government has entered into environmental partnership agreements with the provinces to reduce overlap and duplication. The seven agreements we audited cover activities such as inspection, enforcement, monitoring and reporting …

Before entering into these agreements, the federal government did not formally analyze and document the potential for failure, including whether both parties could do what they were agreeing to do. There is no ongoing analysis of the impact of the agreements on environmental performance or on the industries involved. The federal government does not have a documented plan in the event that a province is unable to carry out its assigned responsibilities or an agreement is terminated.

Comment. Spatial data files, maps, or other spatial records were possibly part-and-parcel of every federal-provincial agreement. If so, they are a pertinent basis for measuring progress in subsequent years, and could be models for other countries considering such agreements. If not, what was the thinking about how impact assessments would be done without a spatial data base to record spatial phenomena, and to monitor and analyze changes to spatial distributions over time?

It is noted that the literature on impact assessment began more than 30 years prior to 1999, so this Report raises important questions about the state of GIS technology and GIScience, and their uses, across all federal agencies considered in the1999 Report.

Exhibit 7. A work in progress

Departments are now in the early stages of turning their strategies into action. They are making progress in delivering on their commitments. However, the quality of the information they have provided varies widely among departments. Departments are also just beginning to establish practices to support the delivery of their strategies, and gaps exist in key areas. Departments need to accelerate their plans to put appropriate management systems in place, paying particular attention to staff training and continual improvement practices.

Comment. Canada began down the environmental assessment and sustainable development paths in the 1970s, or more than 20 years prior to the 1999 Report. Further, and as demonstrated by the AuoCarto Six Symposium (Wellar 1983), Canada was an international leader in the design, development, and use of

geographic information systems technology and GIScience methods, techniques and operations well before 1999.

I believe that a variety of GIS nuggets could reside in hard questions put directly to CESD as well as to federal departments and agencies about the kinds of spatial data files, maps, and other spatial records, as well as GIS technologies and GIScience capabilities that the departments put in place in 1999. Or, for that matter, were thinking about putting in place to create the data, information, and knowledge foundations upon which to base departmental decisions and actions involved in operationalizing or delivering strategies.

For anyone who is new to contacting federal departments for public information on public matters, it is my experience that not all federal departments are as cooperative and forthcoming as one might like, even when doing research which is arguably in the national interest. It is therefore my suggestion that the electronic (email) paper trail begin with the original communication being addressed to the Deputy Minister or counterpart agency head and copied to various parties, including Ministers with political responsibilities for the respective agencies, CESD, the Clerk of the Privy Council Office, and members of the media with an interest in CESD matters.

And, as a closing observation about Exhibit 7, CESD could be a critically important source of GIS nuggets if it pursues the information theme in future reports. Again, to be perfectly clear, what we are after here as part of the GIS mining operation is learning whether, when, and how CESD pursued the GIS technology and GIScience dimensions, with what impacts on federal departments and on CESD.

Exhibit 8. Sustainable development challenges

Last year I presented the conclusions from the 1997 special session of the United Nations General Assembly, where Canada had joined more than 165 countries to assess progress toward sustainable development and to set future priorities. The international community expressed deep concern that overall global trends had worsened in the five years since the Rio Earth Summit. Greenhouse gas emissions, toxic pollution and solid waste were increasing; renewable resources like fresh water, forests, topsoil and fisheries were being overused; and the gap between the rich and the poor was growing.

All of these were signs of unsustainable development at the global level - an inability to care for people and, at the same time, the environment that supports them. Canada joined other countries in committing to ensuring that by 2002 - ten years after the Earth Summit - they would demonstrate measurable progress toward sustainable development. We have three years to go.

Comment. There is a high degree of correspondence between the messages presented in the 1989-1990 Doomsday Map headlines of land, water, and air

abuses, the unsustainability themes of the Earth Summit in 1992, the concerns about global trends expressed at the special session of the UN General Assembly 1997, and the gap between abusing and caring for land, water, and air resources that was identified in Figure 11, Another look at Doomsday Map headlines *circa 25 years later: How well are we doing now?*, which appears in the Doomsday Map-Stewardship Map paper (Wellar 2015).

And, most significant with regard to mining for GIS nuggets, there is a high degree of correspondence in the variables used to define and measure sustainability, as well as in the awareness that <u>geography</u> is a central part of defining, measuring, and representing sustainability situations and processes, including the shifts from abusing to caring for land, water, and air resources.

It therefore seems necessary that in order to "demonstrate measurable progress toward sustainable development", federal departments and agencies would have incorporated GIS technology and GIScience methodology in their data, information, and knowledge development and reporting procedures. If so, then the 1999 Report to Parliament points to federal departments and agencies as highly likely rather than just potential sources of GIS nuggets. And, CESD could also be a continuing source of GIS nuggets if it pursues this theme in future reports.

Exhibit 9. This year's Report

This Report maintains our focus on the challenges the federal government faces in dealing with environmental and sustainable development issues. It illustrates that unsustainable development is not simply a distant global problem: it affects us where we live and where we work. How we manage sustainable development issues has important economic, social and environmental consequences.

Comment. The key word in Exhibit 9 for the purposes of this paper is "where", as in the statement "…*unsustainable development is not simply a distant global problem: it … affects us where we live and where we work*".

Recalling Exhibit 8, the concepts of sustainable development or unsustainable development are expressed by variables, and those of a geographic nature can be dependent or independent variables, depending upon the research design, reporting design, etc. This statement in the 1999 Report could be a catalyst for federal initiatives that produced nuggets pertinent to missions M1, M2, and/or M3 in Figure 1. And, CESD could also be a continuing source of GIS nuggets if it pursues this theme in future reports.

Exhibit 10. The Arctic - A Barometer of Global Environmental Change

31. To meet Canada's environmental commitments in the Arctic, scientists and program managers have been struggling with many of the same challenges discussed elsewhere

in this report: building a solid information base through scientific research and monitoring, managing jurisdictional complexity, developing a strong domestic regime for implementing the agreements and contending with budget cuts. Managers in other program areas could learn from this experience.

Comment. The general theme of particular interest to this paper is expressed by the statement, "*… building a solid information base through scientific research and monitoring ….*"

Given that the Arctic accounts for 40 per cent of Canada's land mass and 2/3 of the country's coastline, it appears that departmental efforts to build and maintain geospatial data bases and undertake scientific research, policy research, geopolitical research, etc., would necessarily tie in with missions M1, M2, and M3 in Figure 1. It therefore follows that departments would be highly likely sources of GIS nuggets, and CESD would also be a highly likely and continuing source of GIS nuggets if it pursues this theme in future reports.

Exhibit 11. Implementing sustainable development strategies

38. Monitoring and reporting on federal progress toward sustainable development is a key part of my mandate. Last year, I provided our first assessment of the sustainable development strategies tabled in the House of Commons on behalf of 28 federal government departments and agencies. Through those strategies, departments are being challenged to take environmental, economic and social considerations into account more systematically across the board - in their policies, their programs and their day-to-day operations.

Comment. The word "geography" is notable by its absence from Exhibit 11, and especially because in the real world "*environmental, economic, and social considerations***" do not exist in a vacuum. Rather, they are a function of real-world situations and circumstances which are often affected directly or indirectly by such geographic factors, functions, and structures as: accessibility, adjacency, barriers, boundaries, buffers, closeness, clusters, compactness, concentration, congestion, connectivity, contiguity, density, diffusion, dispersion, distance, elevation, encroachment, intensification, interaction, isolation, location, migration, mobility, morphology, movement, nearness, networks, patterns, proximity, scale, segregation, separation, shape, sprawl, spread, territory, and topography.**

Moreover, with regard to the broader statement, *Through those strategies, departments are being challenged to take environmental, economic and social considerations into account more systematically across the board - in their policies, their programs and their day-to-day operations,* **the implementation challenge can only be met, I suggest, by intense, sustained recourse to GIS technology and GIScience methods, techniques, and operations.**

Consequently, that statement from Exhibit 11 could be the catalyst for a number of GIS nuggets resident in productions by MPs from across Canada, including cabinet ministers, as well as those created by federal departments, and CESD itself, <u>in 1999 and in subsequent years</u>.

As illustrated, the 1999 Report to Parliament by CESD is a potentially rich source of GIS nuggets, and it also points to other sources of GIS nuggets, including Members of Parliament and federal departments.

In closing this section, it is emphasized that the paper is illustrative rather than comprehensive by design, and hence the choice of the 1999 and 2014 Annual Reports to Parliament by CESD. The 1999 Report provides baseline information on the one hand and, on the other, that of 2014 provides the most recent CESD views on federal strategies and actions affecting Canada's environment and sustainable development situations, processes, and prospects. I hasten to add that if this design decision caused me to miss significant developments between 1999 and 2014, then I welcome them being brought to my attention in conference presentations in 2016.

Following the same design for comparability purposes, I use an indicative selection of statements from the 2014 Report to Parliament to expand on suggestions about why and how to mine the annual reports by Canada's Commissioner of Environment and Sustainable Development.

4.2. Exhibits from the 2014 CESD Report to Parliament

In the next several pages, I discuss a selection of paragraphs from The Commissioner's Perspective which are pertinent to this paper on oversight agency literature. I hasten to recall my observation above, however, about the high quality of CESD documents, and suggest that most if not all paragraphs in CESD Reports to Parliament warrant careful scrutiny for GIS nugget possibilities.

To assist in tracking who wrote what, materials from the 2014 Report to Parliament are black and italicized, and my comments are red, bold, and plain text.

**2014 Fall Report of the Commissioner of
the Environment and Sustainable Development**

http://www.oag-bvg.gc.ca/internet/English/parl_cesd_201410_e_39845.html

Exhibit 12. Some progress has been made

Our audits found that the federal government is making progress on some of these issues. For example, the federal government is working with the province of Alberta to lay the groundwork for more comprehensive monitoring of the environmental effects of oil sands development. If this program, which is industry-funded, is fully implemented as planned, it will result in more frequent monitoring of more environmental parameters over a greater <u>geographic</u> [underline added] area. These results are important because

oil sands development has been proceeding rapidly, a situation that has raised numerous environmental concerns, particularly about cumulative impacts.

Comment. The oil sands development situation in Alberta is only one of many federal actions across Canada with a geographic dimension. Questions such as the following arise about the methodology employed by CESD to monitor and evaluate progress by the federal government:

- **Does CESD maintain a geographic database or require that the federal government maintain such a database informing staff, MPs, and the Canadian public, including the media, about the extent of federal interest in matters geographic?**

- **Do CESD Reports and/or communications to departments and agencies include references to GIS technology and GIScience use by CESD and/or federal agencies in order to meet their respective information and informing requirements?**

Exhibit 13. Information for decision making

We need sound information to ensure that the resources developed today yield lasting social and economic benefits without imposing unacceptable environmental costs in the future…. However, the criteria that were applied to determine which projects should be subject to the Act are not well-documented, nor are they comprehensive. As a result, some projects with potentially significant environmental effects may be excluded from federal assessment without an explicitly stated rationale. I am concerned that, as a consequence, some significant projects will not be adequately assessed and that decision makers will therefore lack the information they require to mitigate environmental impacts.

Comment. The situation described by the Commissioner may well be regarded as appalling by those experienced in the matter of achieving better decisions through better information[7]. Indeed, they may regard it as inconceivable that the federal government in general or any of its departments or agencies in particular would not want to know "which end is up" when it comes to inflicting less abuse and taking better care of Canada's built and natural environments, including its land, water, and air resources[8].

It therefore strikes me that the Commissioner is making an excellent case for specifying and implementing highest order, all-that-is-needed GIS technology and GIScience across all federal departments and agencies having any association with CESD terms of reference.

However, it also strikes me that the critical nature of this connection is not made as explicitly nor as frequently as it could be and, in my opinion, should be.

In brief, it is now more than 15 years since the CESD operation began, and it is unsettling to say the least that after all those years, not months but years, some federal departments or agencies still need to be pushed and prodded by CESD to get up to speed on the matter of information for decision making.

Clearly, something is seriously wrong when one of the world's leading countries in information technology and geographic information systems is having such apparent difficulty implementing the results of its own federal R&D programs, <u>some of which were launched more than 35 years ago.</u>

Exhibit 14. Engaging Canadians

The best decisions are made when people with various perspectives sit at the same table, listening to each other, learning, and coming to consensus where possible.

Comment. For the vast majority of Canadians, concepts such as the environment and sustainable development are best described and most readily understood through maps and graphic images, as opposed to text and numeric representations.

Simply put, many people, including Cabinet Ministers who insist on one-page, no compound sentence summaries of Cabinet Documents, are not willing to wade through dozens of pages of text much less hundreds of pages. Moreover, rare indeed are Canadians, including Deputy Ministers, who relish pages of linear or non-linear functions and equations, or table after table of population parameters or sample statistics on the hundreds of variables pertinent to analyses of environmental and sustainable development situations, processes, relationships, and futures.

Under the circumstances, the absence of any mention of GIS and GIScience in this section is puzzling to say the least. However, it is anticipated that at least a dozen of the 27 federal departments and agencies reporting to CESD will have looked into this matter, and their files are likely sources of a number of GIS nuggets applicable to M1, M2, and especially M3 in Figure 1.

I know from experience the benefits of reconciling different perspectives on an issue: a more thorough analysis of relevant factors, better decisions, and greater public support for these decisions.

Comment. As a community activist involved in environmental, sustainable development, planning, land use, transportation, and other matters of a geographic nature for more than 40 years, I observe without the slightest fear of contradiction that the above statement contains a considerable amount of truth, but with a hook.

That is, reconciling different perspectives about natural and built resources must be based on <u>analysis and synthesis</u> **that is grounded in geography, and is represented by analogue and/or digital maps and other spatial representations. When that is not the case, citizen participation levels quickly move to low and lower.**

One important challenge to CESD is to persuade federal departments and agencies to incorporate the geo-factor in their policies and programs, and to express the geo-factor in ways that have due regard for GIS technology and GIScience methods, techniques, and operations. If this was not done in Reports to Parliament between 2000 and 2013, then perhaps questions could be raised and recommendations made to CESD about incorporating and emphasizing their presence in the 2015 Report to Parliament.

Federal policies and legislation recognize the importance of stakeholder engagement in principle*, but* in practice *the issues we audited this year show that the government could do better in this important area. For example, many stakeholders have noted that they can no longer participate meaningfully in federal environmental assessments because they lack the capacity to respond.*

Comment. GIS technology in combination with the Internet brings the Government of Canada virtually close to every Canadian with access to a computer or other electronic communication device, which means that there is no technological or technical reason for most Canadians in much of the country to be precluded from participating in environmental assessments.

Unfortunately, It appears that some federal departments and agencies which are subject to CESD review are sorely in need of marching orders from the Commissioner, supported by Parliament, to get their acts together and create the kind of "information society" that federal politicians, including Prime Ministers, have boasted about for at least 25 years to my recollection. Perhaps a forceful push in the direction of GIS technology and GIScience could yield a bounty of GIS nuggets that serve missions M1, M2, and M3, and would also support millions of Canadians becoming actively engaged in federal government deliberations involving the environment and sustainable development.

To make the best decisions, the government needs to engage citizens and share information. In several of the activities we audited this year, I note that the government consulted only narrowly (for example, on its proposed oil and gas GHG regulations) and did not explain its decisions (for example, on how it developed the list of projects that would be subject to environmental assessment under the Canadian Environmental Assessment Act, 2012).

Comment. Following from the position taken in several preceding comments, the failure of the federal government to effectively communicate with Canadians on any matter is here perceived to be a function of incompetence. Fortunately, in the

event that incompetence is either the only cause or the main cause for the problems noted in Exhibit 14, help is at hand and simply needs to be brought to bear.

That is, over the years there has been steady progress in advancing GIS technology and GIScience, leading to major strides in accelerating the data->information->knowledge transform process.

As a result, since *circa* the mid-1990s there appear to be few if any technical or technological reasons for federal departments or agencies with a spatial aspect in their mandates to not use GIS technology and GIScience methods, techniques, and operations to provide timely, comprehensive CESD-related analogue and digital data and information to Canadians from coast-to-coast-to-coast.

It is therefore anticipated that mining CESD materials and associated federal government documents for GIS nuggets will be a catalyst to accelerate a collective federal response that fully addresses the shortcomings identified in Exhibit 14.

Without sufficient information and engagement, Canadians have fewer opportunities to communicate their concerns to decision makers and fewer opportunities to legitimize future resource development decisions.

Comment. The theme, "lack of sufficient information and engagement" is a common denominator among CESD Reports to Parliament, beginning in 1999 and appearing again in 2014. Moreover, that theme has a history which goes back at least to the 1970s when I was Urban Information Coordinator at the federal Ministry of State for Urban Affairs, and had its origins more than 50 years ago in the creation of organizations such as the Urban and Regional Information Systems Association.

However, over the years there has been steady progress in advancing GIS technology and GIScience, leading to impressive strides in accelerating the data->information->knowledge transform process. As a result, since the mid-1990s there appear to be few if any technical or technological reasons for federal departments or agencies with a spatial aspect in their mandates to not use GIS technology and GIScience methods, techniques, and operations to provide timely, comprehensive CESD-related analogue and digital data and information to Canadians from coast-to-coast-to-coast.

And that situation prompts such questions as:

> If there are no technical or technological constraints to meeting a mandated obligation, why is the information and engagement obligation not being fully met?

And,

> **What, exactly, are the failing federal departments and agencies doing to fix the failed information access and engagement problem?**

Of particular interest, I hasten to add and emphasize, is a detailed account of the use made of GIS technology and GIScience methods, techniques, and operations in all government units, but especially in the failing departments and agencies, since this could be a factor in their failed performances.

It seems most likely that questions along those lines, and others of that nature, could be a recipe for productively mining past, present, and future CESD Reports to Parliament for GIS nuggets.

And, in the process, it appears advisable to check and/or ask about federal department and agency responses to every CESD comment or question that can be tied to the entries in Table 1, which lists a number of possible nuggets to be derived from using the retrospective approach to examine "the literature".

The preceding exhibits from the 1999 and 2014 CESD Reports to Parliament are suggested to be more than sufficient to establish the value of mining them and other CESD Reports, for GIS nuggets.

Further, all the Reports to Parliament include links to additional, relevant materials, which substantially increases and enriches the CESD body of literature as a source of GIS nuggets.

5. Conclusion

It is my recommendation that each Report to Parliament by the Commissioner of Environment and Sustainable Development, from 1999 to 2014 (and in future years) be mined for GIS nuggets.

To recall some of the observations made about the relevance of the Reports to this project, and as demonstrated by comments on the Reports for 1999 (baseline) and 2014 (most recent), the Reports:

- ✦ Comprise an exceedingly rich body of literature on geographic phenomena (represented by the terms environment and sustainable development);

- ✦ Involve 27 federal departments and agencies;

- ✦ Review and evaluate federal government progress in developing and implementing strategies to serve and promote sustainable development (which applies to both the built and the natural environments); and, central to the task of mining for GIS nuggets,

✦ The Reports maintain a core theme about the importance of <u>information</u> which is to be collected and processed by federal departments and agencies, and is to then be used to: monitor and analyze environmental and sustainable situations and processes; direct and support policy, program, and strategy decisions; and communicate with citizens on environmental and sustainable development challenges, opportunities, issues, options, and initiatives.

Connecting the dots leads to a compelling argument, I suggest, about the merits of mining CESD Reports to Parliament.

That is, the information topic which is repeatedly referred to in the Reports is directly affected by the extent to which GIS technology and GIScience are incorporated in the day-to-day operating procedures of most if not all the 27 federal departments and agencies listed in Table 3, and within CESD as well since it needs a similar capability to review and evaluate the geographic information submitted by departments and agencies.

Further, and this point cannot be over-emphasized, the named federal departments and agencies are <u>required</u> to prepare a sustainable development strategy and respond to environmental petitions.

It therefore appears most likely, if not inevitable, that mining CESD literature for GIS nuggets will also provide directions about where and how to mine federal department and agency literature for GIS nuggets that directly contribute to M11, M2, and M3 in Figure 1, which is repeated for the convenience of the reader.

Figure 1. GIS nuggets defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information
systems technology;

M2. Defining and elaborating geographic information
science;

M3. Using geographic information systems technology and/or
geographic information science.

6. Endnotes

1. As stated in posted reports beginning in late 2014, the decision was made to separate the colloquium and the conference rather than hold them both during a three-day event in February 2015. The current plan is to assess the value, impacts, and

messages of the colloquium and, if appropriate, to proceed with a conference in 2016 in conjunction with the Esri Federal GIS User Conference in Washington DC.

2. The primary reasons for selecting the Commissioner of Environment and Sustainable Development (CESD) as a producer of oversight agency literature are presented in the paper. In addition, however, I have a longstanding professional interest in CESD as a result of public service publications (e.g. *Sustainable Transport Practices in Canada: Exhortation Overwhelms Demonstration;* Wellar 2006); consulting assignment reports (e.g. *Results of an Inquiry into the Methodologies, Methods, and Techniques Used to Make Decisions about Sustainable Transport Practices;* Wellar 2009*);* and public service presentations (e.g. *Transportation: Inspiring a Sustainability Action Agenda*; Wellar 2011) on topics within the purview of CESD. Selecting CESD for this project provides an opportunity to continue my involvement in those lines of research, and to present ideas about GIS technology and GIScience methods, techniques, and operations which could be instructive to CESD as it evaluates the progress of federal departments and agencies in using environmental and sustainable development information, and in making it available to Canadians in a timely and accessible manner.

3.. At the time of writing I had not located any publication which formally graded, rated, evaluated, etc., oversight agency reports, or which provided substantive comments about the relative quality of the methodology employed in the various oversight agency reports. I welcome information in that regard being brought to my attention by email to: wellarb@uottawa.ca.

4. To be clear about the basis of my assessment, it is driven by methodology, with more emphasis on methods than on techniques, for good reason. CESD Reports to Parliament are not being sent to proverbial "rocket scientists". Rather, they are submitted to Parliament, which consists of appointed Senators in the Senate and elected Members (MPs) in the House of Commons, very, very few of whom in either institution appear to have earned credentials – via higher education, specialist training, methodologically designed and supervised practical experience – involving either the environmental sciences or the economics, geography, engineering, planning or other discipline-related aspects of sustainable development. (Note: I stand ready to be corrected in that regard, and upon receipt of pertinent evidence I will revise the paper accordingly.)

Further, as the author of a number of reports to the management or executive functions of government over the past four decades, I am well aware of the actual significance of the KISS principle when sending policy papers "upstairs", and/or to elected officials at any level of government, including the federal level.

It is my perception that the CESD Reports to Parliament are near the limit for some MPs and Senators, and over the limit for others in terms of complexity, and that any additional complexity would negatively affect Report reliability and/or utility in the minds of MPs and Senators. A case in point is illustrated in reported media comments (e.g., Aglukkaq lashes out at watchdog – Minister slams new environment commissioner's report, Ottawa Citizen, October 9, 2014), which suggest to me that the Minister did not

understand the Report, or, perhaps, rather than attempt the difficult task of rebutting an evidence-based report with evidence, and having to answer questions about her statement in the House of Commons, she simply chose to engage in political posturing, rhetoric, etc., much along the lines of "Blame the messenger" when one cannot cope with the message.

5. Based on a number of direct experiences, it is my belief that CESD reports are comparable to materials produced for or by Canadian federal research-oriented agencies such as the Natural Sciences and Engineering Research Council, and the Social Sciences and Humanities Research Council. CESD reports are also becoming increasingly comparable in robustness to the best of those released by federal line departments, in part because (as suggested by my network of contacts across Canada in various fields), there has been a serious decline in the quality and quantity of scientific reports entering the public domain over the past 6-8 years.

Summarizing the situation, it appears fair to say that productions by federal departments and agencies which are allowed into the public domain are increasingly perceived to be more show than substance, and relatively few productions are deemed to be of a deep-think nature. An indicative comment along these lines which appeared in print at the time of this writing is a letter to the editor titled "Government treats scientists as fools – Re: Health Canada 'vanity press' peer review questioned", Ottawa Citizen, Oct. 31, 2014.

6. The comments and questions could also be used to mine documents submitted to CESD by federal departments and agencies, but that is a topic for a different body of literature, namely, Corporate/Institutional-Public Literature in Table 2.

7. Variations of the observation by the Commissioner that "*We need sound information to ensure that the resources developed today yield lasting social and economic benefits without imposing unacceptable environmental costs in the future*" were around in principle in the mid-1960s during my graduate school days at Northwestern University. And, as I learned from Prof. William Garrison, currently Professor Emeritus at Berkeley and one of my professors at Northwestern, the purported need for sound information has been around since the onset of bringing computers into government more than 50 years ago.

As learned over the years, however, the claim of waiting for more or better information before making decisions is often used as an excuse to do nothing, or, to re-phrase, having information is one thing and acting on it quite something else. The CESD Reports to Parliament may therefore need to sharpen the distinction between having sound information and acting on it, in order to more definitively identify federal departments and agencies that are willfully not meeting their duty of care obligations and standard of care responsibilities on environmental and sustainable development matters.

8. Decisions by governments are affected by various considerations, including ideological biases or inclinations that have more to do with serving special or vested

interests, including political parties, than the public interest. However, exploring that issue is outside the purview of a paper about mining oversight agency literature for GIS nuggets. The premise of the mining for GIS nuggets exercise is that government decisions are based on competence supported by information, and our task is to identify ways to improve the geographic information available to competent decision makers, and the use of that information in the public interest.

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Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment

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ABSTRACT. The Environmental Commissioner of Ontario (ECO) is the province's independent environmental "watchdog". The Commissioner is tasked with monitoring and reporting on compliance with Ontario's *Environmental Bill of Rights,* and the government's success in reducing greenhouse gas emissions and achieving greater energy conservation in Ontario. In addition, citizens can submit complaints to the ECO concerning environmental degradation and pollution. Examination of annual reports and other productions reveal that this provincial oversight agency is a rich lode of actual and potential GIS nuggets involving GIS technology, GIScience methods, techniques and operations, and the use of GIS technology and GIScience.

KEYWORDS. Aggregates, Applied Research, Built Environment, CESD, Decision Processes, Decision Variables, Doomsday Map, Environmental Assessment, Environmental Petitions, Esri, Evaluation Methods, Geo-factor, Geography, Geographic Information Systems (GIS), Geographic Variables, Geospatial Data, Geospatial Information, Geospatial Knowledge, GIS Applications, GIS Findings, GIS Nuggets, GIS Technology, GIS Uses, Geographic Information Science (GISc), GIScience Methods, GIScience Techniques, Government, Impact Assessment, Land Use Planning, Literature Mining Processes, Natural Environment, News Media, Ontario Commissioner of Environment (ECO), Ontario Municipal board, *Ontario Planned*, Oversight Agencies, Policy Research, Research Colloquium, Research Design, Research Methodology, Research Mission, Retrospective Approach, Retrospective Research Design, Zoning.

1. Background of the GIS Mining Mission

The definition of GIS nuggets was originally published in mid-2014 in the *Guide for Papers on Using the Retrospective Approach to Mine for GIS Nuggets.*

It was intended that the entire *Guide*, which provided the statement of problem and terms of reference for the GIS retrospective program, would be incorporated in the proceedings as context for a series of conference presentations.

However, and as summarized in Endnote 1, the *Guide* was withdrawn for research program design reasons, which requires a change in how to provide background information about the mining mission for colloquium purpses[1].

The choice made in the interests of completeness, self-containment, and convenience of readers, is to reproduce a selection of background materials from the *Guide*, including Figure 1, Table 1 in this section, and Table 2 in section 2.

Figure 1. GIS nuggets defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information Science;

M3. Using geographic information systems technology and/or geographic information science.

The two other pieces of background information about the GIS mining mission to be recalled are the examples of GIS nuggets pertinent to M1, M2, and M3, and the context for considering oversight agency literature *vis-à-vis* other bodies of literature.

Examples of GIS nuggets pertinent to M1, M2, and M3 include those listed in Table 1. It is emphasized that our intention for the purposes of the colloquium is to be indicative and illustrative, rather than comprehensive. The 15 entries in Table 1 are deemed sufficient for that purpose. The relationship between oversight and other bodies of literature or productions are discussed in the following section.

General GIS nuggets of possible or probable value include those listed in Table 1. As indicated, each nugget serves one or more of M1, M2, or M3.

Table 1. Illustrative nuggets derived from using the retrospective approach to examine "the literature"

1. New or different reasons to add to GIS technology;
2. New or different ways to add to GIS technology;
3. New or different reasons to add to geospatial data;
4. New or different reasons to add to geospatial information;
5. New or different reasons to add to geospatial knowledge;
6. New or different ways to add to geospatial data;
7. New or different ways to add to geospatial information;
8. New or different ways to add to geospatial knowledge;
9. New or different uses of GIS technology;
10. New or different uses of geospatial data;
11. New or different uses of geospatial information;
12. New or different uses of geospatial knowledge;
13. New or different uses of GIScience research methods;
14. New or different uses of GIScience research techniques;
15. New or different uses of GIScience research operations.

As shown in Table 1, the phrase "new or different" appears in each entry in the list of possible nuggets.

Preliminary investigations suggest that findings about the new or different ways, reasons, and uses derived from retrospective searches are only in part a function of the literature or other sources(s) being mined. More significant, it appears, are the expertise, experience, and motivations of the person(s) doing the mining.

However, research that I have undertaken to date, and the information provided by participants in the AutoCarto Six Retrospective project (Wellar 2014d, 2015), establishes that investigations of this nature are still in the early, exploratory, and informal stages. Looking ahead, it is expected that future presentations will begin to provide confirmatory information about the yields from the respective literatures. And, it is anticipated that as a valuable by-product of such research, there will be changes to the entries in Table 1.

2. Why Propose Oversight Literature and the Environmental Commissioner of Ontario (ECO) for GIS Mining Purposes?

Table 2 presents the bodies of literature which have been identified as materials to be mined in the search for GIS nuggets, and also includes an entry labelled 'Other Productions'. The entry 'Other Productions takes into account work(s) which may be or may seem to be outside the purview of what is conventionally regarded as 'literature', and also avoids the frustration of unnecessarily becoming hung up on semantics.

The focus of this paper is on body of literature 5, Oversight Agency Literature, and specifically that of the Environmental Commissioner of Ontario (ECO).

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. **Oversight Agency Literature**
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

After: Wellar, B. 2005. *Geography and the Media: Strengthening the Relationship.* Ottawa: Canadian Association of Geographers, Canadian Royal Geographical Society and the Canadian Council on Geographic Education. http://www.ccge.ca

Four reasons account for selecting oversight agency literature, and that of the Environmental Commissioner of Ontario (ECO) in particular, for a colloquium topic.

First and as previously discussed in the companion paper, Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development (CESD), (Wellar 2014c), there is one feature in particular that I believe sets oversight agencies apart from other government departments or agencies, as well as from corporations in the private sector, and thereby makes oversight productions critically significant to retrospective research.

Further, I believe this feature should be sufficient to persuade all thinking Canadians to want to know more about and have more interaction with oversight agencies[2]:

> "As a rule, neither private sector corporations nor government line departments such as Agriculture, Commerce, Economic Development, Energy, Environment, Finance, Fisheries and Oceans, Forestry, Housing, Industry, Infrastructure, Interior, Land Management, Mining, Municipal Affairs, Natural Resources, Parks and Recreation, Planning and Development, Public Works, Regional Development, Transportation, Urban Affairs, Utilities, or Water/Wastewater rush to publicly admit to committing or aiding and abetting abuses of land, water, and air resources.
>
> Consequently, in the case of case of abuses of land, water, and air resources arising since 1990, we tend to learn about them from <u>oversight agencies</u> which are (purportedly) independent of "political strings", and whose mandate is to inform about matters of public interest." (Wellar 2015b)

Second, and as also noted in the companion paper,

> "… research into oversight agencies in Canada and other countries revealed that the mandates of a number of them extend over many aspects of abuse or stewardship of land, water, and air resources. Consequently, the reports of these agencies contain a great deal of geographic data, geographic information, and/or geographic knowledge about the state of land, water, and air resources in their respective jurisdictions, and the literature of oversight agencies is therefore a prime body of material to mine for GIS nuggets." (Wellar 2015b)

Third, local governments are creatures of the provinces In Canada, a division of powers decision recorded in the British North America Act of 1867 (Section 92).

As a result, provincial governments pretty much decide what local governments are going to do with regard to functions such as: land use planning and development; environmental protection; water and wastewater treatment; infrastructure maintenance and expansion; quarrying; preservation of open space; transportation networks involving major roads (e.g., 400 series); transit; freight rail and passenger service; subdivision planning approvals; waste disposal; intensification; densification; sprawl; land zoning

and/or rezoning; energy sources and their locations, and just about any other matter of significance in the managing, financing, and operations of local governments, and the social, economic, etc., well-being of their citizens, institutions, businesses, and so on.

Consequently, provincial oversight agencies such as the ECO have what amount to expanded responsibilities. That is, in the first and immediate instance, their monitoring, reporting, and other tasks apply directly to provincial departments, ministries, agencies, etc.

However, courtesy of Section 92 of the British North America Act which became the 'law of the land" almost 150 years ago, because provincial policies, plans, programs, and "political decisions" impact on local governments, oversight agencies similar to the ECO by definition are obliged to broaden or extend their scope to include what is happening or not happening within the geographical boundaries of local governments across the respective provinces[3].

On the one hand, then, there are similarities between CESD and ECO-type agencies with regard to with their common focus on environmental matters. And, on the other hand, there are major institutional differences.

In brief, CESD deals primarily with other federal departments or agencies, whereas provincial oversight bodies are involved with other provincial departments or agencies, and are also involved with local governments due to the day-to-day connections between provincial governments and their local government "creatures of the province".

How provincial governments deal with achieving horizontal information flows within departments, and vertical information flows involving local governments, is a computer-based information systems issue with a history that began more than 50 years ago. And, in most if not all provincial jurisdictions, it continues to be a challenge to this day.

The addition of oversight agencies to the body of provincial departments and agencies therefore creates a wrinkle of particular importance to the search for GIS nuggets.

That is, questions arise about how geographic data, GIS technology, and GIScience methods, techniques, and operations are used by provincial oversight agencies to examine what provincial departments and agencies are doing in regard to environmental matters.

And, further questions arise about how geographic data, GIS technology, and GIScience methods, techniques, and operations are used to carry out the mandates, duties, obligations, etc., of any provincial ministry, department, and agency that involve local governments in the task of implementing, delivering, enforcing, etc., provincial legislation, policies, programs, plans, or other instruments of provincial governance.

As for choosing the ECO as the oversight agency to examine for this paper, I have a lengthy, professional connection with the workings of the ECO as a result of my involvement with:

- Local governments across Ontario;

- The Ontario Federation of Urban Neighbourhoods;

- Public interest groups such the Coalition for Algoma Passenger Trains and various walkability and sustainable transport organizations;

- Ontario Premiers, Opposition Party Leaders; and Cabinet Ministers;

- A number of provincial ministries (e.g., Agriculture, Energy, Environment, Municipal Affairs and Housing, Natural Resources, Northern Development and Mines, and Transportation);

- The Ontario Municipal Board; and,

- The office of the Environment Commissioner of Ontario.

It is my experience that the ECO deserves far more attention than it is accorded from citizens, academics, students, elected and appointed officials at the municipal as well as provincial levels, the business community, and the media.

I am therefore pleased to have this opportunity to give reasons as to why the GIS community in particular should take an intensive and sustained look at the ECO as a source of GIS nuggets.

Moreover, this professional connection has frequently revolved around oversight issues, including: information flows and the lack thereof; the use and non-use of GIScience methods, techniques, and operations to arrive at policy, program, plan, and political decisions; and the general regard or disregard for methodologically-derived evidence, geo-based and otherwise, when environment-related decisions are being made at either the provincial or municipal level of government in Ontario[4].

Finally, my professional experience with governance in Ontario began to be assembled in the early 1970s, and the ECO was created in 1993, so my body of experience predates the establishment of the ECO by more than 20 years.

That experience with governance in Ontario prior to the arrival of the ECO provides an instructive, comparative context in which to perceive geo-based, GIS-related, and GIScience-related positions of the ECO, and the responses of elected and appointed provincial officials to geo-based, GIS-related, and GIScience-related findings, admonishments, etc., flowing from the ECO reports.

In section 3, I provide an introduction to the Environment Commissioner of Ontario (ECO), whose office authored the oversight agency literature of interest in this presentation.

3. Background on the Environment Commissioner of Ontario (ECO)

The following exhibits from the website of the Environment Commissioner of Ontario (ECO) provide the details about the ECO which are sufficient for the purposes of this paper.

While excerpts are used here, it is recommended that all pertinent postings about the ECO be reviewed prior to commencing the mining process.

The reason for the emphasis on paying full and careful attention to the ECO literature is that, in my experience, only specialized attention is given to oversight agencies in university or college courses, or in professional training sessions or workshops.

Consequently, since general exposure to oversight agency literature is relatively limited *vis-à-vis* other government materials, it therefore seems prudent to advise an immersion approach when mining the ECO literature for GIS nuggets.

The first exhibit provides the basic terms of reference for ECO activities. Italics are used in Exhibit 1 and throughout the remainder of the paper to identify materials produced by the ECO.

Exhibit 1. Statement describing the Environment Commissioner of Ontario

The Environmental Bill of Rights, 1993 (EBR) states that there shall be an Environmental Commissioner of Ontario (ECO or "Commissioner"), an independent officer of the Legislative Assembly who is responsible for reviewing and reporting on the government's compliance with the EBR.

The ECO, often referred to as Ontario's "environmental watchdog," reports to the Legislative Assembly – not to a political party or to a ministry. The ECO is appointed for a five-year term and may be reappointed for additional terms.

- *Monitors and reports annually on Ontario environmental issues and government compliance with the Environmental Bill of Rights.*

- *Monitors and reports annually on the government's success in reducing greenhouse gas emissions and in achieving greater energy conservation in Ontario.*

- *Periodically produces Special Reports.*

- *Helps you use and understand your rights under the EBR.*

- *Serves as a clearinghouse for Applications for Review and Applications for Investigation made under the EBR.*

- *Helps you access the Environmental Registry, which gives you information about the environmentally significant proposals and decisions made by Ontario ministries.*

◆ *Supports a [resource centre reference library](), which features a large and growing collection of environmental resource materials.*

Source: http://www.eco.on.ca/index.php/en_US/environmental-bill-of-rights/role-of-the-eco

Exhibit 2 lists the categories used to organize the searchable database of materials contained in reports of the ECO. As revealed by even a cursory examination of materials, there is a geographical aspect to all the database categories. Consequently, in principle each of them is a candidate to be mined for GIS nuggets which serve one or more of the core missions identified in Figure 1, that is:

◆ Designing and developing geographic information systems technology (M1);

◆ Defining and elaborating geographic information science (M2); and,

◆ Using geographic information systems technology and/or geographic information science (M3).

Exhibit 2. ECO Issues: A searchable database for reports of the Environmental Commissioner of Ontario (ECO)

Database Categories

Aggregate Resources Act	Planning Act
Climate Change Policies in Ontario	Protected Areas
Energy	Provincial Policy Statement
Environmental Assessment Act	Species At Risk
Biodiversity in Ontario	Transportation
Green Energy Act	Water Quality
Land Use Planning	Wetlands
Northern Ontario	Great Lakes
Waste Management	Forestry
Oak Ridges Moraine Conservation Act	Air Quality
Ontario Municipal Board	

Source: http://www.ecoissues.ca/index.php?title=Main_Page

4. An Advisory on Skills Required to Mine Oversight Agency and ECO Reports

The skills issue involving oversight agencies was initially discussed at a preliminary level in section 5 of the Abuse v. Care paper (Wellar 2014a).

The intent was to provide a "heads up" for those who might be encountering this higher order literature for the first time. The issue was then addressed in detail in section 3 of Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development (Wellar 2014c), where I discuss degree of difficulty, level of expertise, the wide range of disciplinary competence, and other measures that affect the content and, hence, the challenge of fully appreciating oversight agency reports:

A preliminary comparison suggests considerable similarity between CESD and ECO productions.

As a result, it follows that the mining process is likely to be significantly more productive for researchers whose credentials include a combination of: graduate-level courses in research methodology; experience in both client-driven and curiosity-driven research; a stint in a federal or provincial agency that involved participation in program or policy activities; experience in evaluating research proposals; and an education and training background in the subject matter domain of the ECO report being mined for GIS nuggets.

And, similar to the CESD discussion, it also follows that the level of expertise and experience attained in applying GIScience, methods, techniques, and operations will significantly affect the productivity of the mining process.

5. Methodology for Mining ECO reports in Search of GIS Nuggets

The ECO was created in 1993, and has published yearly reports on a variety of topics, (as illustrated by the 21 database categories in Table 2), all of which have a spatial aspect.

There are various research design options which are available to mine the ECO reports, and require taking into account such factors as; the skills and interests of "GIS miners"; their numbers and affiliations; whether the quest for nuggets is client-driven or curiosity-driven; the intended use of findings; available resources to conduct the mining operation; and the urgency of the mining activity. I present three hypothetical situations to illustrate the mix of mining possibilities.

Situation A. Individuals new to ECO activities, and looking for guidance, could begin by examining media releases, announcements, and bulletins sent out by the ECO, as well as stories in the media about ECO reports and/or public remarks by the Commissioner.

For reasons of currency and pertinence, I suggest that tracking back from present or recent reports to prior reports is an appropriate way to proceed.

This approach follows the lead of the ECO as to issues, problems, concerns, objectives, etc., warranting attention.

Situation B. Individuals who are familiar with ECO activities could take a category-oriented approach.

For reasons of currency and pertinence, I suggest that tracking back from present or recent reports to prior reports is an appropriate way to proceed.

Situation C. In those circumstances where a group project could be undertaken, such as for a class assignment, or a seminar, workshop, or colloquium, I expect that it would be productive to deal with a category over time, as well as to deal with multiple categories for a given year, or for sets of comparative years.

Again, for reasons of currency and pertinence, I suggest that tracking back from present or recent reports to prior reports is an appropriate way to proceed.

In all cases, whether situation A, B, or C, the core elements in terms of objectives are M1, M2, and/or M3 from Figure 1, and one or more of the 15 entries in Table 1.

In the next section I provide comments on a selection of exhibits from ECO reports. I believe that the comments could assist in decisions about a research design to mine the ECO reports for GIS nuggets.

5.1. Comments on Exhibits from Environmental Commissioner of Ontario Reports

The next several pages contain comments on a selection of extracts from reports of the ECO to illustrate the relevance of mining these reports for GIS nuggets.

Links to documents are provided in some cases, and in others urls are used.

Similar to the observation made about CESD and federal departments and agencies, the nuggets could be resident in the ECO documents *per se*, and/or in:

- Productions of the provincial Legislature which are referred to in the ECO reports;

- All the other government-based materials referred to in the ECO reports, including legislative, policy, program, plan, research, communications, and other productions emanating from the Premier's office or provincial ministries, departments, boards, and agencies.

- Any non-government-based materials referred to in ECO reports.

For the convenience of the reader, materials from the ECO are in italics, and my comments are in **bold**.

Exhibit 3. Aggregate Resources Act

Background

The Ministry of Natural Resources (MNR) has overall responsibility for managing aggregates under the Aggregate Resources Act (ARA). Despite an array of laws, regulations, policies and approvals that outline requirements for planning, permitting and managing aggregate operations, the ECO and others have raised a number of concerns including:

* *a lack of capacity at MNR to fulfil its obligations;*
* *siting of aggregate operations near urbanized areas and sensitive natural areas;*
* *a lack of compliance with approvals by aggregate producers and enforcement of approvals by the province;*
* *a low rate of rehabilitation of pits and quarries;*
* *inadequate long-term planning; and*
* *the geographic scope of the ARA.*

While some positive steps have been made by the province, many of the concerns raised by the ECO since the mid-1990s and discussed in detail in our 2002/2003 Annual Report, Thinking Beyond the Near and Now, remain as relevant today [May 2012] as then.

MNR has issued approximately 2,800 licences for pits and quarries on private lands, mostly in southern Ontario, and 3,200 permits for pits and quarries on Crown land. The Ministry of Transportation (MTO), a large user of aggregates, has issued approximately 500 permits to producers that supply aggregates for provincial road projects, under delegated authority from MNR.

Source: http://www.ecoissues.ca/index.php?title=Category:Aggregate_Resources_Act

Comment. Four of the six concerns identified by the ECO –

* **siting of aggregate operations near urbanized areas and sensitive natural areas;**
* **a low rate of rehabilitation of pits and quarries;**
* **inadequate long-term planning; and**
* **the geographic scope of the *ARA* –**

have explicit geographic implications, and the two other concerns –

* **a lack of capacity at MNR to fulfil its obligations; and**

- **a lack of compliance with approvals by aggregate producers and enforcement of approvals by the province;**

could be directly related to limitations/failures by MNR in the use made of GIS technology and GIScience[5].

As noted by the ECO, these concerns were previously identified in the mid-1990s by the ECO, and again in the 2002/2003 Annual Report, so about 20 years have gone by without corrective action being taken. Among the questions that arise as a result of failed corrective action are those regarding the role that geo-based decision support systems played, could have played, or should have played in this matter.

Geographic Scope of the ARA

Although aggregate operations throughout southern Ontario are subject to the ARA, aggregate operations in only very limited areas of northern Ontario are subject to the ARA. In 1998, two applicants used their EBR review rights to explain that unregulated aggregate extraction in their northern community was causing environmental harm. As discussed in our 1998 Annual Report, Open Doors, MNR denied their request noting that it already has a policy of designating all areas with significant aggregate resources. In fact, several years later MNR quickly designated a different area, the Michipicoten area of Lake Superior, in response to numerous concerns about a proposed quarry. MNR's handling of these concerns was described in our 2004/2005 Annual Report, Planning our Landscape.

Comment. The logic behind different regimes being employed by MNR in applying the Aggregate Resources Act in southern Ontario versus northern Ontario is problematic, and is cause for questioning why this is the case. And, of particular interest when it comes to mining for GIS nuggets, questions arise as to why advances in the availability of spatial data, the capabilities of GIS technology, and the robustness of GIScience were not sufficient to bring about equitable regulation of aggregate extraction throughout the province.

Exhibit 4. Land Use Planning in Ontario, Primer and Recommendations of the Environmental Commissioner of Ontario

Over the past decade, there have been dramatic changes in land use planning in Ontario, due to the shifting balance between the provincial and municipal roles in land use decisions, the creation of regionally based land use plans such as the Greenbelt Plan, and the introduction of growth plans to encourage urban intensification.

During this time, the Environmental Commissioner of Ontario (ECO) has documented, reviewed and analyzed the significant changes in land use planning law and policy and made many recommendations, some of which have prompted further action by the provincial government.

[This primer](#) *(click to download PDF) pulls together and synthesizes the most significant articles on land use planning that have been written in the ECO's annual reports from 1999 to the present (updated October, 2012). However, it is not intended to assess the government's response, or lack thereof, to these recommendations.*

This primer covers a range of planning laws, policies and issues that include:

- *the Planning Act and Provincial Policy Statement (PPS);*
- *the Ontario Municipal Board (OMB);*
- *regional plans for the Oak Ridges Moraine, Greenbelt and Lake Simcoe;*
- *planning for growth, transportation and aggregate extraction; and,*
- *natural heritage protection in planning. (p. 2)*

Comment. In view of how long it takes for impacts of land use planning decisions to be identified, measured, analyzed, assessed, and accepted or not accepted, it is appropriate to put this ECO document in context. I therefore recommend a careful reading or re-reading as the case may be, of *Ontario Planned?*, a special issue on planning in Ontario, 1966-1975, published by Plan Canada (Richardson 1984).

I used this document in planning and in geography and environmental studies courses until 2005, while I was on faculty at the University of Ottawa. One of my points of emphasis was on how spatial data, information, and knowledge were critical to arriving at sound land use planning and development decisions at both the provincial and the municipal levels.

Thirty years after the publication of *Ontario Planned?*, the Environmental Commissioner of Ontario raises a number of the same concerns that I regularly raised in my classes, and in conference presentations as well as in reports regarding official plans, provincial policy statements, and Ontario Municipal Board hearings and rulings on planning and zoning matters.

Appreciation of how long some of these issues, problems, concerns, etc., have been around without corrective action being taken could "sharpen the senses" while looking through ECO oversight materials in the search for GIS nuggets.

Further, a better understanding of the foot-dragging that occurs in government, when action in the public interest is urgently called for, might assist in sharpening how and to whom the GIS nuggets are presented.

That is, finding GIS nuggets is one thing, but having them adopted and implemented is frequently quite something else. A careful examination of *Ontario Planned?*, possibly both before and after reading the ECO report on land use planning, could suggest how to present found GIS nuggets in such a way that they are very difficult for elected and appointed government officials to reject.

In the next several pages I comment on selected, illustrative sections from <u>Land Use Planning in Ontario -- Primer and Recommendations of the Environmental Commissioner of Ontario</u>, For the convenience of the reader, a Primer page number follows each excerpt. And, as noted above, materials from the ECO report are italicized for ease of identification.

The existing "development-first, environment-second" approach to planning has spawned a confusing mix of legislation and provincial plans. Rather than viewing an ecological feature, such as a provincially significant wetland, as being important enough to protect no matter where it is situated in the province, the PPS requires that separate rules be applied depending on its location. The result is that the same type of natural area will receive different treatment depending on whether it lies on specific parts of the Niagara Escarpment, in the Greenbelt, on the Oak Ridges Moraine, in the Lake Simcoe watershed, in southern Ontario or in northern Ontario. (p. 7).

Comment. What we appear to have here is a case of selective, spatial bias on the part of all the ministries, departments, boards, etc., Government of Ontario, that have seemingly been involved in an extensive amount of arbitrary and discriminatory decision-making based on location. While most of us are familiar with NIMBY, YIMBY, BANANA, and related declarations or exhortations about development actions here and there, those are typically "small potatoes" when compared with the apparent province-wide discriminatory practices arbitrarily employed by the Government of Ontario.

Moreover, a standard principle in planning is to avoid even a hint much less the appearance of discrimination when supporting or opposing planning or zoning amendment applications. Based on the excerpt from p.7, the Government of Ontario seems to be in a league of its own when it comes to arbitrarily using location as a driving policy variable in a manner that does not generally represent the conditions of "good planning".

On its face, this statement from the ECO suggests that the "development first-environment second approach" could be a rich source of GIS nuggets. However, when the statement is tracked back to *Ontario Planned?* <u>which discusses the origins of the "development first-environment second approach"</u> <u>during the1966-1975 time span</u>, it appears that this part of the ECO Primer could be in mother lode territory.

Working with MNR and MOE, MMAH has prepared a series of 17 technical papers that represent the Ontario government's approach to implementation of plan policies. They are intended to assist approval authorities, applicants, landowners, interested stakeholder groups and others in implementing policies and applying technical requirements found in the ORMCP [Oak Ridges Moraine Conservation Plan). The technical papers address:

 - *identification of key natural heritage features;*

- *significant wildlife habitat;*

- *supporting connectivity;*

- *landform conservation;*

- *identification and protection of vegetation protection zones for Areas of Natural and Scientific Interest;*

- *identification of significant portions of habitat for species at risk;*

- *identification and protection of significant woodlands;*

- *preparation of natural heritage evaluations;*

- *developing watershed plans;*

- *preparing water budgets;*

- *water conservation plans;*

- *hydrological evaluations for hydrologically sensitive features;*

- *sub-watersheds;*

- *wellhead protection;*

- *recreation plans;*

- *sewage and water system plans; and, stormwater management plans* (p.19).

Comment. The Oak Ridges Moraine is an extraordinary, one-of-a-kind Ontario resource. Consequently, in view of the development first-environment second decisions which have already impacted the Moraine, and the pressures which continue to be exerted for more of the same, in my opinion the 17 technical reports are at the low end of those that should be done regarding a feature of Ontario that will grow in importance with every passing year over the coming decades.

For the 17 reports that we do have, they would have been prepared by and/or supervised by professionals, including professional planners and engineers, and, possibly, GIS professionals. Given, therefore, that there is a spatial aspect to each and every one of the report topics, and that the technical reports are classifiable as professional productions, it follows that GIScience supported by GIS technology would have been integral to the preparation of all the reports.

It is my expectation that mining the current reports will yield an abundance of GIS nuggets, with many more to be found when the spatial contents of these reports are updated (using GIScience and GIS technology) as baselines, and as points of reference for future analysis, synthesis, and subsequent reports.

In the final part of the Primer, the ECO makes a number of recommendations. A selection of recommendations is presented for illustrative purposes, along with comments to demonstrate why I strongly recommend thoroughly mining this document for GIS nuggets.

The ECO recommends that the Ministries of Municipal Affairs and Housing and Natural Resources develop performance indicators for natural heritage protection under the Provincial Policy Statement and provide their findings to the public. (p. 47)

Comment. Designing and developing performance indicators with a spatial basis is of critical importance to the advancement of GIScience methodology, and to the use of GIScience and GIS technology. I expect that mining materials associated with this ECO recommendation could yield a number of M2 and M3 GIS nuggets for organizations and individuals with an interest in performance indicators, as well as in success indicators, disruptive indicators, and distribution indicators used in policy formation and evaluation (Smith and Wellar 1992)[6].

The ECO recommends that the Ministries of Municipal Affairs and Housing, Natural Resources, and Environment and Energy begin planning and implementing the promised systems for monitoring and evaluating the Oak Ridges Moraine Conservation Plan. (p. 47)

Comment. Materials from most if not all of the 17 technical reports are likely incorporated in the *"promised systems for monitoring and evaluating"*, **which points to an excellent source to mine for M1, M2, and M3 GIS nuggets.**

The ECO recommends that MMAH undertake public consultation on the government's population growth modeling and projections in order to provide a transparent context for land use planning decisions. (p. 47)

Comment. The spatial aspect of the Oak Ridges Moraine Conservation Plan means, by definition, that spatial data, GIScience, and GIS technology are part of the *"population growth modeling and projections"* **design activity, which points to a high potential for GIS nuggets when the recommendation is acted upon.**

The ECO recommends that MMAH work with the Ministry of Public Infrastructure Renewal (now the Ministry of Infrastructure) to increase the GGH Plan's intensification and density targets above existing business-as-usual development targets. (p. 48)

Comment. Both density and intensification concepts are based on spatial considerations, so any action on this recommendation points to GIS nuggets.

The ECO recommends that MNR significantly speed up the process of wetland identification and evaluation and ensure that Provincially Significant Wetlands are incorporated into municipal official plans. (p. 48)

Comment. Methodologically-based action on this recommendation would involve retrospectively tracking research that goes back 30 or 40 or more years, as illustrated in the Doomsday Map publications. (Wellar 1990, 2014). And, for obvious reasons, the response to the recommendation would of necessity be GIS-

based and GIScience-driven. Again, we appear to be in mother lode territory with regard to mining for GIS nuggets.

The ECO recommends that MMAH amend the Provincial Policy Statement to prohibit new infrastructure such as highways in Provincially Significant Wetlands unless there are no reasonable alternatives and it has been demonstrated that there will be no negative impacts on their ecological functions. (p. 48)

Comment. The stipulation, *"it has been demonstrated that there will be no negative impacts on their ecological functions"* **is preceded by a body of impact assessment literature with a history of more than 40 years. How MMAH (Ministry of Municipal Affairs and Housing) incorporates GIScience and GIS technology in demonstrating impacts would undoubtedly be a body of demonstration material worth deep, intensive mining for M1, M2, and M3 types of GIS nuggets.**

The ECO recommends that MNR, in association with Conservation Ontario, review and update floodplain maps in Ontario in order to adapt them to impacts from climate change. (p. 49)

Comment. Issues involving geospatial data, GIS technology, and GIScience methods, techniques, and operations are central to the review and update of floodplain maps, the design and implementation of the situation review and map update processes, as well as the field work aspect. This recommendation by the ECO has the potential to become a mother lode of M1, M2, and M3 GIS nuggets for years to come.

The preceding exhibits from reports by the ECO are suggested to be more than sufficient to establish the value of mining the source reports and other ECO productions for GIS nuggets.

Further, in all the ECO reports there are links to additional, relevant materials, which substantially increases and enriches the ECO body of oversight agency literature as a source of GIS nuggets.

6. Conclusion

The following statements in the exhibits, or the comments on the ECO report statements, are among the many which establish the importance and validity of mining ECO materials for GIS nuggets.

Comment. Four of the six concerns identified by the ECO –

- **siting of aggregate operations near urbanized areas and sensitive natural areas;**

- **a low rate of rehabilitation of pits and quarries;**

- **inadequate long-term planning; and**

- **the geographic scope of the *ARA*** –

have explicit geographic implications, and the two other concerns

- **a lack of capacity at MNR to fulfil its obligations; and**
- **a lack of compliance with approvals by aggregate producers and enforcement of approvals by the province;**

could be directly related to limitations/failures by MNR in the use made of GIS technology and GIScience. (From exhibit 3)

Rather than viewing an ecological feature, such as a provincially significant wetland, as being important enough to protect no matter where it is situated in the province, the PPS requires that separate rules be applied depending on its location. The result is that the same type of natural area will receive different treatment depending on whether it lies on specific parts of the Niagara Escarpment, in the Greenbelt, on the Oak Ridges Moraine, in the Lake Simcoe watershed, in southern Ontario or in northern Ontario. (Exhibit 4)

The ECO recommends that the Ministries of Municipal Affairs and Housing and Natural Resources develop performance indicators for natural heritage protection under the Provincial Policy Statement and provide their findings to the public. (Exhibit 4)

The ECO recommends that the Ministries of Municipal Affairs and Housing, Natural Resources, and Environment and Energy begin planning and implementing the promised systems for monitoring and evaluating the Oak Ridges Moraine Conservation Plan. (Exhibit 4)

Comment. Both density and intensification concepts are based on spatial considerations, so any action by provincial government ministries, agencies, boards, etc., on this recommendation points to GIS nuggets. (Exhibit 4)

Based on a detailed examination of productions by the Environment Commissioner of Ontario, it is my recommendation that all productions of the ECO warrant being mined for GIS nuggets.

7. Endnotes

1. As stated in posted reports beginning in late 2014, the decision was made to separate the colloquium and the conference rather than hold them both during a three-day event in February 2015. The current plan is to assess the value, impacts, and messages of the colloquium and, if appropriate, to proceed with a conference in 2016 in conjunction with the Esri Federal GIS User Conference in Washington DC.

2. My comment is limited to "thinking Canadians" since my reports for the colloquium discuss Canada's (federal) Commissioner of Environment and Sustainable Development, and the Ontario Commissioner of Environment. However, as a general principle, I

encourage thinking citizens everywhere to have high regard for the productions of their oversight agencies.

3. Not all of the current provinces were in existence at the time that the BNA Act was passed in 1867, so not all of them have had 150 years to sort out functional, structural, institutional, financial, and other relationships with the municipal level of government. However, all provinces have had at least 60 years to sort out such relationships, which seems to be an abundance of time to sort things out, and especially because federated and centralized governance systems had been around for hundreds of years previously.

4. Governments make policy, program, and plan decisions that are purported to be in the public interest, but no such claim is associated with "political decisions", which are decisions made to primarily if not exclusively serve the interests of the political party currently forming a government.

Those interested in learning more about recent political decisions by the Government of Ontario may wish to examine the files on the decision to terminate *The Northlander* which was operated by the Ontario Northland Railway (Wellar 2013), and the long-running media account of the costs to taxpayers (more than a billion dollars) of the decisions to cancel construction of gas plants in Oakville and Mississauga.

5. I use the term "could be" advisedly, since MNR has long been fully apprised of the value of geographic information systems, courtesy of such events as the 1990 Geographic Information Systems Seminar which the agency co-sponsored (MNR 1990), and in which I participated as a speaker (Wellar 1990).

Based on the ECO materials, something went seriously awry between the presentations by MNR at the 1990 Seminar and other venues, and the subsequent, apparently failed application of geographic data, GIS, and GIScience over the next 25 years (and counting) to meet the Ministry's mandated duties regarding aggregates.

6. The URISA 1992 anniversary conference report by Smith and Wellar was commissioned to "examine the contribution of information systems, including financial information systems, geographic information systems, land information systems, management information systems, etc., to the formulation and realization of public policies".

Based on the substantive, long-term foundations underlying the anniversary paper written in 1992, and the identified shortfalls (geographic data and information, geographic information systems) in the reports of Environmental Commissioner of Ontario, the 1992 paper may provide instructive spatial, temporal, and political contexts in which to perceive and mine the technical reports produced by the Ministries of Municipal Affairs and Housing and Natural Resources some 20-plus years after the Smith-Wellar research set out a number of performance parameters.

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Acknowledgements

Mining Open Data in Search of GIS Nuggets

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ABSTRACT. Open data is the term given to the concept that certain data should be freely available for anyone to use, reuse and republish as they see fit, without restrictions from copyright, patents or other mechanisms of control. While the term has been around for some time, it has garnered more attention recently in part due to the release of the G8 Open Data Charter in 2013, which encourages governments around the world to make their data open by default. This paper recognises the value of open data, especially in the GIS context and suggests a number of ways in which geographic open data can be discovered and subsequently used for GIS and GI Science purposes. The paper will also show the benefits of mining and using open data including what web sites would be good to search in terms of finding open data.

KEYWORDS. Open Data, Open Government, Esri, GIS, AutoCarto, Government of Canada, Community Map of Canada.

1. Introduction and History of Open Data in Canada

The 1983 AutoCarto Conference paper that I helped produce was entitled "*On the Transfer of Remote Sensing Classifications into Polygon Geocoded Data Bases in Canada*". This paper was clearly related to spatial data, but it covered technical issues around data sharing such as data modelling and format standards for getting image classification results into a GIS data base. In 1983, when the application was developed and the paper written, both the input image data and the GIS data needed to be purchased. Within the federal government at that time, data was considered as a way of doing some cost recovery. In other words, if you wanted government data you needed to pay for it. For example, the cost of a single Landsat image in 1983 was many thousands of dollars. Vector format GIS data was available from many federal government departments, but it too cost (often a lot of) money to obtain and use.

Across the globe in 1980's there was a quite a bit of diversity in terms of cost models for government geographic data. For example, the United States government felt that the taxpayer had already paid for the collection and processing of geographic data so it was generally available for free or at least for a nominal charge from the US Geological Survey. On the other hand, the United Kingdom charged full cost recovery for spatial data from the Ordnance Survey. Canada, as usual was somewhere in between. Natural Resources Canada charged a fee for digital topographic data, but it was not full cost recovery. Within the walls of the Canadian federal government however, the "fee data or free data" debate raged on for many years at senior levels of the government. Finally in 1997 the policy was changed, NRCan began offering its electronic topographic maps free of charge. Over subsequent years, many other Canadian federal departments followed suit by providing their geographic data for free under an open data license.

In the early 1990's, Statistics Canada developed the "Data Liberation Initiative" to provide statistical data for the research community free of charge. Natural Resources Canada started the "GeoGratis" website that allows users to find and download selected NRCan spatial data free of charge. Also in the early 1990's the federal / provincial / territorial government coordination group called the Canadian Committee on Geomatics (CCOG) started the "GeoBase" program. This program collected base geographic layers from the provinces and territories and integrated them into consistent national layers. These national data layers were then made available on the GeoBase website for free and with unrestricted use. This program is still in operation although CCOG and NRCan are looking at how to reengineer the GeoBase funding model and how to improve the workflows so that this authoritative data is kept up-to-date more quickly.

In 2010, the Canadian federal government started the move to open data with the release of the government's Digital Economy Strategy and the Open Government Resolution. This culminated with the announcement in 2011 by the Treasury Board Secretariat regarding the availability of Canada's first federal open data portal. This site was subsequently rebranded in 2014 as the open government of Canada portal. This rebranding was to indicate that the site had more than just data, but contained a wide variety of government information that was available to the public free and unencumbered. Many of the data sets that are available on the open government portal are geographic in nature.

In 2013, the Group of Eight (G8), which is an international forum for the governments of the world's eight leading economies, became involved with the open data movement when they adopted the Open Data Charter at the G8 Summit in Northern Ireland. At that time, the G8 members agreed to implement a set of open data principles and best practices that would lay the foundation for a program for the release and reuse of government data, which is to be implemented before December 31, 2015.

With most of the world's leading governments behind the open data movement, it's clear that open data is here to stay. Also a lot of the technical barriers have been reduced or eliminated. So what is the research methodology that can be used to scrutinize, find and use open data? In other words, how can one mine for GIS nuggets in open data?

2. Background and Context on Open Data

The Canadian federal government in their Open Data 101 has defined open data as structured data that is machine-readable, freely shared, and can be used and built on without restrictions. They summarize the most important points about open data as:

- **Availability and Access**: the data must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form.

- **Re-use and Redistribution**: the data must be provided under terms that permit re-use and redistribution including the intermixing with other datasets.

- **Universal Participation**: everyone must be able to use, re-use and redistribute. There should be no discrimination against fields of endeavour or against persons or groups. For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purposes (e.g. only in education), are not allowed.

The Open Data Handbook indicates that there are numerous benefits and advantages to open data. They indicate that it is already possible to point to a large number of areas where open data and especially open government data is creating value. Here are some of the examples from the Handbook with an indication of whether this particular advantage to open data is really an advantage for open geographic data. The analysis is as follows:

- Transparency and democratic control

  Examples of projects in Finland, Britain and Canada indicate how open data has helped show where the governments are spending money and where tax fraud has been found. These are important areas, but presumably spatial data could be used to determine what parts of a country are receiving more tax funding than others. Also it may be possible to determine where there is more potential for tax fraud so that efforts to control this could be focussed to particular regions.

- Government participation and self-empowerment

  Open government data has been helpful in providing applications for dog walking parks, public restroom locations, air quality ratings and finding good places to live. It is pretty clear that these examples require the use of geographic data.

- Innovation and new private products and services

  The Handbook indicates that several studies have estimated the economic value of open data at several tens of billions of Euros annually in the EU alone. New companies and their products are re-using open data for applications such as energy efficiency, financial planning, finding builders, determining government subsidies and translation. Several of these examples use geographic data. Esri Canada for example uses a considerable amount of open data in the creation of the Community Map of Canada. The Canadian data is also used for the creation of the World Topographic Map by Esri Inc.

- Improved efficiency and effectiveness of government services

  The Handbook indicates that open data has been successfully used for government education, training, and historical purposes. While it may be a stretch to use geographic open data in these examples, it is possible that government services could be improved using geographic data. A recent Canadian example is the application for finding a job within a certain commuting distance of one's home.

⬧ New knowledge from combined data sources and patterns in large data volumes

The Handbook indicates that health surveillance has been very successful. More recent examples include the use of demographic data, social media feeds and sensor networks. Most of these applications use open geographic data.

While open data clearly has its merits and supporters, there are a few researchers who are not as convinced. For example, Duncan Edwards in his post related to international development assistance entitled "The revolution will NOT be in Open Data" states that he feels uncomfortable with the framing of many open development projects with the assumption "openness + ICTs = development outcomes". Edwards indicates that just providing open data is not sufficient for uptake and use. Further work is required and in developing countries, this often does not occur without (often financial) assistance. He indicates that he is also concerned that risks and privacy were not being adequately considered.

It is clear that open data on its own is not really a disruptive technology or game changer. What makes open data useful and beneficial is what users do with the data. If a user uses open data in an application and people use the application for successful decision making then it is beneficial. Even if the user learns something from the data then it is beneficial. However just making the open data accessible is not sufficient to making it useful, but accessibility is simply a step in the methodology of making open data useful.

3. Open Data Initiatives and Implementations

In reality, open data would not be possible without the invention of the Internet. In fact, Sir Tim Berners-Lee who first invented the World Wide Web started the Open Data Institute (ODI) in 2013. Since its inception, the ODI has attracted members from government, universities and commercial companies. The ODI provides information about open data and provides training on open data. It has an open data certification program and has held its first annual summit meeting in November 2014. Certainly with the momentum that has been built, the ODI will likely be a thought leader in open data for some time to come.

As previously noted, open data is not a new concept and has been around for decades, but what is new is that it is being embraced by so many national governments across the world. Many countries including Canada, the US, the UK and New Zealand have open data portals for their federal government data. There are also many open data sites for provincial, state and municipal levels of government around the globe. Also many NGOs such as the UN and development agencies have open data sites in support of their clients. In addition, several commercial enterprises have open data sites including Esri, Google and Microsoft. The intent of this section is to highlight some of the research results from a review of selected open data material.

Reitano in his paper "The Benefits of Open Data" performed an analysis of the benefits of open data with a focus on Canada. He concluded:

- Many government organizations are currently seeking effective methods for publishing open data and are implementing strategic objectives for creating transparency and openness while attempting to support innovation and economic growth.

- Internal changes will build trust with communities, and governments will need to be as open as possible by publishing all their data.

- The data that provides the most benefit consists of national or international level data which includes statistical, population and geographical data. These are the types of data that have the most benefit and impact for research and innovation.

- Making open data available to external stakeholders will help direct the publication of open data and will lead to the development of applications servicing citizens in new and innovative ways.

- The worldwide movement of open data will create sharing practices across nations with new standards, best practices and guidelines that will make sharing of information easier than ever.

- Governments need to learn to share the data they use to inform themselves and the people they serve. In addition, governments need to understand that data is more valuable when it is aggregated with other data sources.

In the United States open data at the federal level is governed by the [Open Data Policy-Managing Information as an Asset](#) memorandum from the Executive Office of the President. In part the memorandum states:

- Specifically, the Memorandum requires agencies to collect or create information in a way that supports downstream information processing and dissemination activities.

- This includes using machine readable and open formats, data standards, and common core and extensible metadata for all new information creation and collection efforts.

- It also includes agencies ensuring information stewardship through the use of open licenses and review of information for privacy, confidentiality, security, or other restrictions to release.

- Additionally, it involves agencies building or modernizing information systems in a way that maximizes interoperability and information accessibility, maintains internal and external data asset inventories, enhances information safeguards, and clarifies information management

The memorandum goes on to indicate that US government open data will be consistent with the following principles:

- **Public** - agencies must adopt a presumption of openness to the extent permitted by law and subject to privacy, confidentiality, security, or other valid restrictions.

- **Accessible** - Open data are made available in convenient, modifiable, and open formats that can be retrieved, downloaded, indexed, and searched.

- **Described** - Open data is described so that data consumers have sufficient information to understand the strengths, weaknesses, analytical limitations, security requirements, and processing requirements.

- **Reusable** - Open data is made available under an open license that places no restrictions on data use.

- **Complete** - Open data should be published in primary forms (i.e., as collected at the source), with the finest possible level of granularity that is practicable and permitted by law and other requirements.

- **Timely** - Open data is to be made available as quickly as necessary to preserve the value of the data.

- **Managed Post Release** - A point of contact must be designated to assist with data use and to respond to complaints about adherence to these open data requirements.

The United Kingdom (UK) government has also embraced open data, but the national government is releasing public data primarily to help people understand how government works and how policies are made. UK Geographic data is controlled by the Ordnance Survey (OS) of the UK. Much of the open geographic data that is available from the OS is used as a map background. Very little of the UK open geographic data is available for analytics or for building applications, other than for map backgrounds.

The United Nations (UN) has also developed an open data site and it is populated with open data from the UN Statistics Division (UNSD). This data is suitable for analytics but there appears to be a very limited supply of basic geographic data on the UN Portal. Other sources of the base geographic data would need to be found in order to make the most benefit from the UN statistical data.

So clearly there are many governments and non-government organizations that have already geared up to provide open data and in particular open geographic data. Canada and the United States appear to be at the forefront of the open data movement and they both have open data champions at the most senior levels.

4. The impact of open data on the GIS and broader communities

Reitano in his paper "The Benefits of Open Data" examined the impacts and benefits of open data. He states "The analysis has demonstrated how open data can provide social, economic and environmental benefits to society. Several challenges surrounding the dissemination of open data are still preventing these benefits from being achieved." His analysis of the open data situation in 2013 let him to 5 recommendations which are:

1. The Government of Canada needs to launch the Directive on Open Government to help departments and agencies publish more datasets.

2. The Government of Canada should set a concrete goal to convert inert data available on their websites into a dynamic open format within the next year.

3. The Government of Canada needs to identify guidelines and standards for the publishing of open data.

4. The Government of Canada needs to collaborate with external stakeholders and all departments and agencies.

5. Changes within Government of Canada departments and agencies need to include a lean operational process for publishing open data.

These are all good recommendations and it appears that the Government of Canada is acting on providing open data in ways that are aligned with these recommendations. Our experience at Esri Canada with open geographic data has given us concern about the currency of the open data that is being provided. An additional recommendation could be that the Government of Canada should strive to keep the open data as current as possible. Refresh cycles every few years is just not sufficient for practical use of the open geographic data.

5. Implementation

A three step process is suggested to help users decide if open data is right for their application. The first step is to review the background, context and synopsis of open data, and especially the kind of open data that would be suitable for the user's application. The second step is to locate the specific open data that may be suitable for the user's application. The final step that the user should undertake is to examine and test the open data under controlled conditions to determine if that specific data set is right for them. While the open data topic covers many disciplines, this paper will focus specifically on geographic or location based open data.

Step one is to review the geographic data requirements of the application that is being considered for development. In particular, the geographic area, the required layer (feature), the required attributes and any possible topology requirements. Since one of the givens for open data is that you need to take what you get, there is very little flexibility in what data you receive. Thus the application needs to be more flexible in what type of data it can use. For example, if the application requires a road network then the developer needs to look at the resolution and accuracy requirements of the application and then determine if any open data fits within this requirement.

The next step is to search open data sites to determine if there is open data that is suitable for the application. For example the GIS application developer could search the Canadian federal government open data web site, the NRCan GeoGratis site, the CCOG GeoBase site or any others. The developer should then download the data and carefully review any documentation and data to ensure that the documentation is consistent with the data. Often there is little or no documentation for the data so the user must use their own judgement by examining the data for coverage, quality, consistency, accuracy (spatial and attribute), currency, precision, completeness and metadata quality.

Once a data set or a combination of data sets has been selected for the development of the application, the developer should then make a go or no go decision if the data is suitable for the application. If so, then the data needs to be converted or modified for suitable use within the application. The application needs to be developed and a series of tests run on the application to ensure that it supports the desired features and functions. The developer should also note any data concerns to the user such as data currency or completeness (i.e. that the data was collected in 2012 or that the data only covers the City of Toronto). Once the application is thoroughly tested and complete then the developer can move the application to the appropriate area for his users to make use of the application.

While this is a suggested methodology for using geographic data in the development of an application, the application developer should be very careful to ensure that the open data that is used in the application is suitable. The developer should therefore be more diligent and careful about making the decision to release the application than they might be if commercial or authoritative data was being used.

6. Conclusions

There is an old saying that "you get what you pay for". So by analogy, if you pay nothing for something then the something must be worthless. However, this paper has determined that open data does not fit the old saying and that there is valuable open data. There are nuggets of open GIS data that are worth obtaining and using in your GIS. Many of the issues or barriers that have been blocking or reducing the use of open data have been or are in the process of being broken down. Government policy is eliminating barriers to access by making open data accessible by default. Technical issues related to formats and standards are being reduced through the use of commonly accepted industry standards. Legal and liability issues are no longer an impediment with the use of common open data licenses and limited liability clauses.

However, data quality issues still exist in open data as the data is essentially being used for purposes for which it was not collected. Data currency will always be an issue as GIS data is really a reflection of the real world, which as we know is in a state of constant change. Data completeness is being addressed by the various levels of government, but users should be careful that the open data that they are using covers all their geographic areas of interest. Data accuracy and precision will always be an issue that users should take into account before using the open data.

Notwithstanding the current issues about using open data, there is a gold mine of open geographic data that can be mined and used for various applications. However, open data users need to be vigilant and cautions in their approach to using the open data to make sure that it remains suitable for their application and provides reasonable results.

So open data use is still in its infancy and there are still lots of lessons to learn and lots of mistakes to be made. However, based on this research it appears that most countries, particularly countries in North America are on the right track for releasing

open data. The key is to keep moving forward and to look for GIS Nuggets in the global supply of open data.

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Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research

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ABSTRACT. The development of geographic information systems (GIS) in its many academic and practical reincarnations resulted from a selective application of the relevant literature and prevalent ideas at that time. This selectivity has resulted in a widely accepted and practical, but notably incomplete set of tools for geographic analysis. Most non-scientific applications of this toolkit rely heavily on the more basic techniques – those most commonly associated with the early development of GIS. These techniques emphasize the classification of map components and comparative analysis of those map components. Some argued at that time that this approach was largely unscientific and by extension, lacked rigor. This paper argues that, while the application of the scientific method has an increasing role in GIS research, a deeper understanding of the process of the land classification literature, especially as it pertains to land assessment and management may yet contribute substantially to the development of GIS as a geographic toolkit for both scientific research and practical application.

KEYWORDS. Land Classification, Parametric Maps

1. Introduction

There seems little doubt that today's modern geographic information systems (GIS) did not evolve in an intellectual vacuum; rather their development was the culmination of generations of geographic thought. As with all intellectual pursuits, the direction of ideas often hinges upon the selective use of published information, the current trends in systematic thinking, the point of view of the researcher, and the intended audience for the application of the selected ideas. Despite the advanced nature of GIS as a toolkit it still does not yet exist as a complete digital embodiment of the discipline of geography. Given that geography itself is still incomplete, especially regarding processes, I will restrict my comments to limitations of GIS based on missed conceptual constructs already in the literature – both refereed and non-refereed.

In the early development of GIS much of the focus was on technical hurdles needed to link entity and attribute data, to determine effective and efficient methods of storing and retrieving large amounts of spatial data, and even to decide on the data models to be used for geographic representation. The Canada Geographic Information System typifies such efforts in a production setting and further illustrates the focus on traditional map analysis techniques for its analytics. A vector-based system, its analysis functions

revolved around data archive, categorical selection, measurement, and map overlay functions – this likely because of the typical activities of the company with which Roger Tomlinson worked prior to his early work on the GIS. The original functional requirements outlined by Tomlinson (1962) were for the analysis of continent-scale databases and included reporting the results of analysis in statistical and map form and the incorporation of mapped data from different sources and scales in a seamless database. He recommended the separation of the descriptor data from the image data, thus separating it from digital cartography yet it still remained largely focused on the analysis of cartographic data in forms and methods not dissimilar from basic map reading. Even the most sophisticated GIS software that extends beyond the basic map ready and analysis techniques fails to effectively replicate either the geography which it is meant to mimic or the methodological approaches of the geographer who compiles and analyzes geographic data and models.

The academic sector has contributed substantially to both the technical and theoretical foundations of the discipline. Some of the first innovations in computer aided mapping, for example SYMAP and SYMVU originated in the Harvard Laboratory for Computer Graphics (Chrisman 1998), as well as some of the original algorithmic innovations, raster data models, and significant analytical functions forthcoming from a range of universities. Early on the GIS experiments in universities focus predominantly on the technical aspects of data flows and were driven by a traditional cartographic paradigm in their design. Among the major advances came about from the work of Joseph K. Berry and his PhD. student C. Dana Tomlin (1980) as they developed a layer-base raster system combined with an analytical language called Map Algebra that became the basis of much of the raster-based GIS analysis encoded in professional GIS today.

Even with the Map Algebra language and innovations I vector analysis through the years, GIS is still in its infancy, particularly regarding the ability of the software to replicate real geographic conditions and relationships. Despite these technical and analytical limitations, the modern geographic information system toolkit is replete with techniques whose theoretical underpinnings have long been established in the published geographic literature and professional documentation. Among its most important strengths is GIS' ability to allow users to explore portions of the earth in ways that are far beyond our former capabilities if for no other reason than simple but copious operations can be performed in a small fraction of the time they could by hand. Importantly these same limitations frequently require the geographer to be more explicit in problem definition and to provide a much more thorough explanation of the geography that is to be represented by the software. Additionally few technical innovations in geography have sparked as heated a discussion as the advent of digital geographic information systems (GIS) thus enlivening the discipline through argument and discourse.

2. The Problem of Land Classification

Given that the initial GIS software, in particular the vector-based incarnations, focused heavily on traditional map use and map reading skills well known for analog maps, it is

no surprise that a determination of categorical classes was paramount among the activities with which GIS analysts concerned themselves. Most of the efforts to incorporate cartographic principles regarding classification revolved around the use of statistical techniques for class level determination in statistical surfaces. Unfortunately little effort was expended with regard to nominal classification, especially with regard to polygonal entities. This was in line with efforts found in the cartographic literature as well.

The topic of polygonal classification however was common in the formative literature of American geography dating back into the early 1920's. The first major research article dealing with what was then called land classification (Sauer 1921) focused on the practicality of classifying land to answer two questions – what use is the current land being used and what is its potential. You will notice a strong correlation between this paradigm and that under which the Canada GIS was developed.

This line of reasoning found its way into the large-scale applied geography related to land management and planning including work on the Tennessee Valley Authority (Geography Section TVA, 1935, Draper 1938, Lilienthal 1944), and early mapping efforts of the US Department of Agriculture (Colby 1941). Concurrently the published literature began efforts to link field techniques and field data collection techniques and land classification itself (Jones and Finch 1925, Hudson 1935a, 1935b; Whittlesley 1927). One major outcome of that work was the development of a series of schemes to incorporate land use and soil capability data in a single map – perhaps precursors to the GIS map overlay process itself (Finch 1933, Berry 1962). The advantage of this process is that it allowed the analyst to compare the two sets of correlated data at a glance.

On the surface, the classification of land might appear to be a simple one but the sheer number of potential factors that can be mapped is staggering. Soils criteria collected by soil surveys for example contain enormous varieties of facts, each of which could be mapped individually. Crop types in agricultural land use polygons, their conditions, fertilizer applications, varieties, and many more characteristics again demonstrates the possibilities.

3. Classification versus Quantitative Geography

The use of the classified map as a major tool of the geographers' craft for describing spatial distributions persisted for some time and is still relatively common today. In fact one school of thought during the late 1960's believed that there was serious question that research not focusing on the use of maps was geographic research at all. The question, however, was not that the classified map was central to the work, but rather that its purpose was mostly descriptive rather than analytical. This debate was in tandem with a larger methodological debate that started in the 1950's.

Schaefer's (1953) article on exceptionalism in geography made a strong case for a movement away from the "descriptive" nature of geography itself, suggesting that

instead geography should focus on the advancement and testing of spatial hypotheses and the development of geographic laws. This work exemplified an alternative methodological approach to geography, often thought of as the quantitative revolution and was unwavering in its view that the purely chorological nature of the regional tradition, typified by Hartshorne's (1939) view of geography was outdated and at odds with other scientific disciplines. It further stated that the chorological approach placed geography in a juvenile role among other sciences because of its lack of rigor.

Hartshorne's methodological approach emphasized aerial differentiation and regional geography concerned with describing, cataloguing, and delineating unique places. This approach was, to some degree, encoded in the classification of maps as a result of the chorological approach. Schaefer argued that geography should be conceived of as a science concerned with laws governing the spatial distribution of features on the earth. The argument between Hartshorne and Schaefer continued on but the quantitative revolution took root in the 1950s and became well established in the 1960's with made mostly possible by the work of geographers like P. Haggett, R.J. Chorley, W. Bunge, and David Harvey.

Unfortunately the quantitative revolution was unable to engage with social and political issues, resulting in a counter-revolution focusing on social theory. Supporters of the quantitative revolution argued that the more scientific methodology removed geography from the "immature" science and turned it into a mature science. Detractors argued that the quantitative revolution required normative models of human behavior, that it focused more on models than on the impacts on the people being modeled, that it was unable to identify the mechanisms of human behavior.

One component of the chorological approach revolved around the regionalism and systematics inherent in the creation of cartographic products, particularly those emphasizing absolute boundaries of defining discrete areal differentiation (Hartshorne 1962). By extension one might assume then that Schaefer's view was that the descriptive or communication paradigm of cartography was at least one component of Hartshorne's outdated approach. By the 1960's Töbler's Analytical Paradigm (Peterson 2002) suggested that, with the advent of computers, the geographer was no longer limited to the single cartographic product and instead could take advantage of the raw, un-compiled cartographic data to produce purpose-specific maps as was suggested by Küchler (1956). According to Peterson the distinction between maps for presentation and maps for analysis was an artificial one thus according the Analytical Paradigm perhaps a different name – that of a Holistic Paradigm. This distinction will soon become critical to the argument of this paper.

Despite substantial disagreements between the various schools of thought with regard to the relative validity of the chorological versus the quantitative approach to geography, the quantitative movement in geography experienced a resurgence in 1990's largely because the fulfillment of the Analytical Paradigm in the form of the rapid increase in quality and availability of sophisticated GIS software, remote sensing satellites and accompanying software, and GPS. Interestingly enough the advent of satellite remote

sensing in the 1970's actually produced a somewhat retrospective approach to the discipline in that much of its original strength was in the classification of land units much as was prominent in the hay day of aerial photographic interpretation. What sprung from it, however was a more robust set of techniques for producing multiple land maps and also the analysis of classification error in raster-based systems. This suggests that a retrospective approach regarding the role of land classification might then have enhanced the geospatial toolkit and still advances a quantitative yet solidly chorological approach.

4. Retrospective View

"There is pleasure in recognizing old things from a new point of view. Also, there are problems for which the new point of view offers a distinct advantage" (Feynman 1948). These are the guiding principles behind the thesis of this article in that it examines the fundamental premise that a more focused examination of map classification might yield some useful concepts to enhance GIS. As Sauer (1921) pointed out almost a century ago, the classification of land is a complex issue. This complexity is increasing exponentially with today's modern instrumentation – ranging from in situ instruments such as probes, traps, transects, and other field-related hardware to the increasingly refined spectral, spatial, temporal, and radiometric resolutions of today's remote sensor systems.

Beyond measurement systems there is the increased understanding of how complex land components, land uses, and factor interactions can be conceived of as representing the areal differentiation of which Hartshorne and his contemporaries spoke. While at once seemingly relatively unscientific especially a hundred years ago, today areal differentiations make up a potential myriad of classifications which themselves for not answers but rather working hypotheses under which GIS practitioners attempt to generate information for decision-making. This is the crux of the relationship between GIS development and the traditional regional and systematic nature of geography, especially where modeling is concerned.

5. Land Classification Informing GIS Development

DeMers (2014) suggested a research agenda that focuses not just on land classification as an end in itself, but rather on the many interrelated facets of the subject as a systematic geography. Among the facets that are likely to be of use to the GIS practitioner are factor or selection and attribute combinations as part of the process of GIS analysis. It is well established by practitioners of GIS that the selection of factors to be used to classify a single map has a profound – even determining impact on any analysis performed by its use. Much GIS research however still assumes that the maps chosen for analysis are somehow accurate by their mere existence in the database or because their use tends to generate reasonable results from analysis. There is a need to critically examine the validity of such map layers based on the nature of the analysis, the scale of the layers employed, and the importance of each layer to the overall model.

One of the major topics of research from the National Center for Geographic Information and Analysis was that of error propagation in GIS when multiple layers at multiple scales were manipulated in many ways by the software. The general consensus was that such a comprehensive analysis of GIS error, at least as an end-to-end analysis was impractical. Perhaps if one were to begin such examinations by first determining how a single nominal layer might affect the outcome of an analysis via a sensitivity analysis. Moreover, with the advent of new tools for scenario generation (e.g. geodesign) available in modern GIS, simply changing the categories might yield some interesting if not critical explanations for model outcomes.

This latter also suggests the idea of complex factor combinations to arrive at a single land classification. As our knowledge of geography becomes more complete, we might be able to suggest not just what factors might result in a correct classification of land, but also how they might be combined. A quick example is the well-known model describing soil-forming factors of climate, organisms, relief, parent material and time. While we are aware of these factors it might be an interesting experiment to develop soil classifications based on some measure of these factors by using the GIS itself to combine the layers of soil forming factors in multiple ways. This presents a true marriage of the land classification approach with the generation of scientific hypotheses … in this case hypotheses that might inform the soil scientist as well as the GIS analyst.

And while such complex models of land classification are generated, one must return to the NCGIA's research agenda regarding error. While the remote sensing literature has spent a substantial amount of time and effort examining error in the world of image pixels, there has been little research to develop concomitant methods of analyzing boundary accuracy (Klimaszewski-Patterson, A. 2009). Similar research regarding allocation agreement has already been suggested by Pontius (2011). Such methods would provide us some comfort regarding the individual accuracy of the land area maps in our GIS database and it could also lead to insights regarding the degree to which that accuracy affects the models we produce.

6. Conclusion

This paper has examined the general literature of land classification found both in refereed articles and applied reports. It demonstrates that, while there is much to be said for the quantitative movement in geography starting in the 1950, it should not be considered to the neglect of a strong and continuing interest in land classification, particularly where land planning applications are involved. It is clear that the two schools of though can not only coexist but that they are able to inform each other and thus improve the development of clean, useful land data layers and generate an enormous number of potential land planning scenarios (hypotheses) that can be applied to real world problems.

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