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New Brunswick Climate Change Communication Needs Assessment: Expanding the Tantramar Map Viewer

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1. Introduction

Rising sea levels, due to thermal expansion of the ocean, and higher frequency and intensity of coastal and inland storms threaten coastal communities worldwide. The implementation of pro-active, planned adaptation to reduce community vulnerability is strongly dependent upon people's perception of the threat posed to their communities at the local scale. Unfortunately, the scarcity of research into effective risk communication limits our understanding of how climate change evidence can most effectively raise risk awareness and inspire community adaptation.

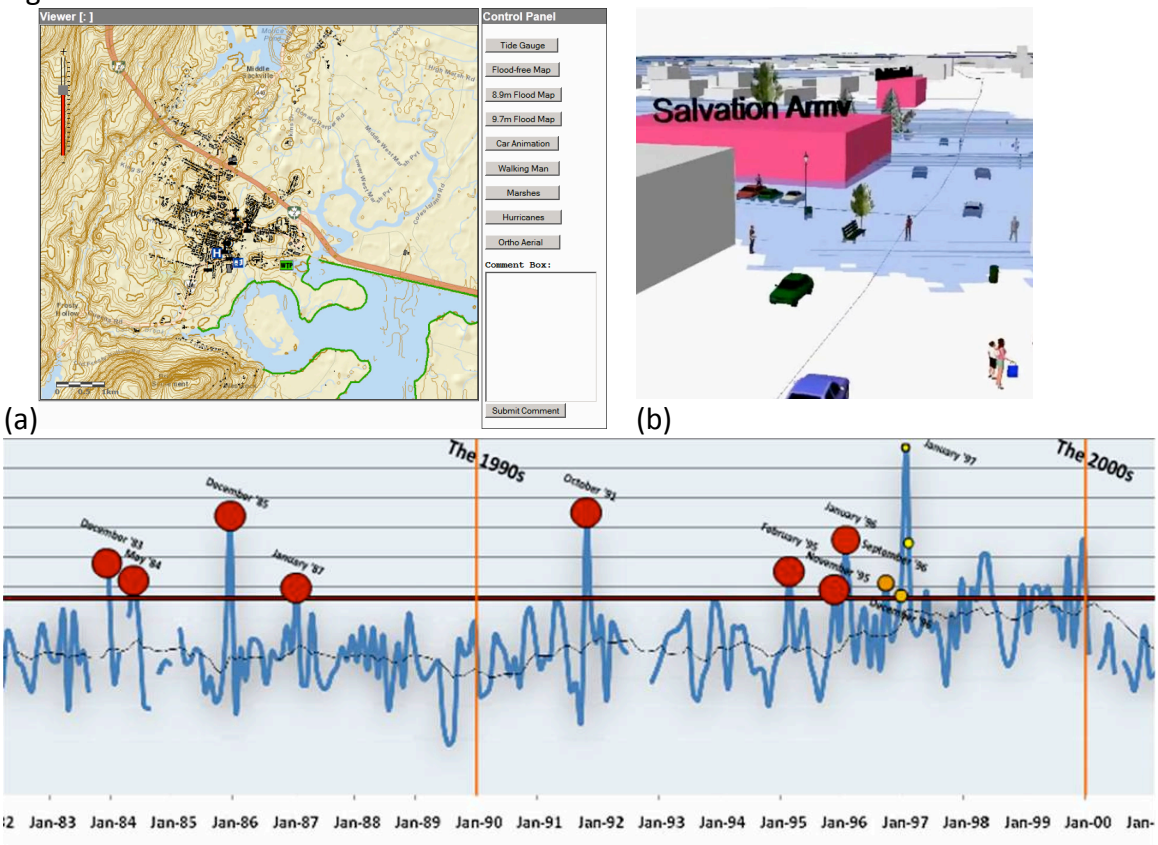
With a focus on a case study situated in the Tantramar area of South-East New Brunswick, an area subject to very large tidal forces from the Bay of Fundy, researchers from Mount Allison University (Sackville, NB) set out to assess public awareness about the link between climate change and elevated risk of regional dyke failure, measure how different multi-media visualizations influence public risk perception, and provide general recommendations for the development of flood risk communication strategies in coastal zones.

To do this, flood scenarios using GIS software were created to help members of the public visualize the extent of a number of flood scenarios (Lieske, Wade and Roness, *in review*[1]). The visualization tool was named the Tantramar Map Viewer. Then, through a series of focus groups, members of the public were brought together to discuss the threat of flooding in the Tantramar Region, and to conceptualize possible solutions to flood risk. The Tantramar Map Viewer was used during some of the sessions to present "geospatially-augmented" communication materials .

Design considerations for the Tantramar Map Viewer primarily centered around making the various communication materials accessible from buttons gathered together on one single interface (Figure 1a). This included a number of different web GIS maps of flood zones (8.9m and 9.7m flood scenarios), an animated "walking man" video (Figure 1b), and an animated 70-year tide gauge record for the city of Saint John to illustrate the concept of sea level rise (Figure 1c).

[1] Lieske, D.J., Wade, T and Roness, L.A. "Climate change awareness and strategies for communicating the risk of coastal flooding: a Canadian Maritime Case Example" in *Ocean and Coastal Management*, *in review.*

Figure 1.



(a) (b)

(c)

While geovisually-enhanced communication strategies involving 3D flood animations and web-based GIS maps, were no more effective at raising risk awareness than a non-enhanced communication package, qualitative responses suggested that the geovisualizations had greater emotional impact ("shock"), and contributed disproportionately to an expressed desire to become politically and socially active around the issue.

2. Project Overview

2.1 Project Purpose

The current project is a complementary component and a follow up to this earlier study. The purpose was to bring together planners, GIS technicians and planning directors from the 12 planning districts in New Brunswick to discuss:

- The climate-change related risks facing their planning district;
- The challenges they encounter when communicating with the public about climate change;
- The types of software tools they would like to have to facilitate public communication, and;

- How web-based maps and other types of geovisualizations (e.g., animations) could help facilitate public communication.

Workshop participants were also asked to provide feedback on the Tantramar Map Viewer, a web-based risk communication tool developed by Dr. David Lieske and the Mount Allison University Geospatial Modelling Lab.

2.2 Research Questions

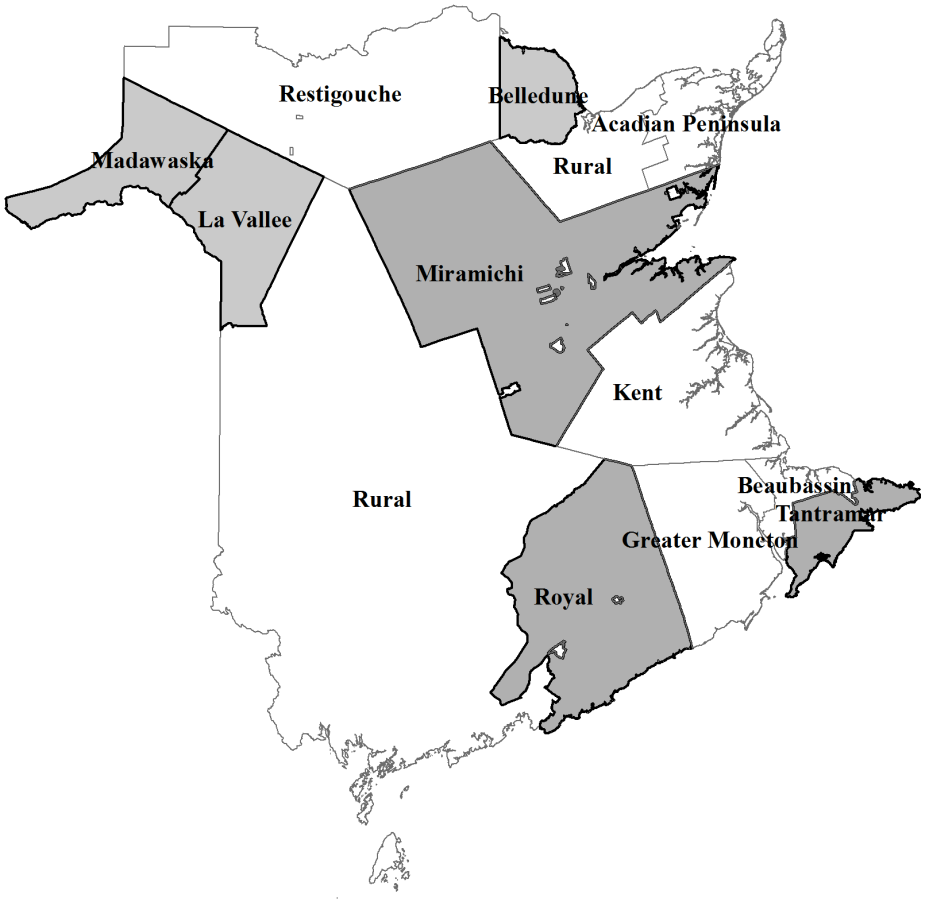
The research questions were:

1. What challenges do participants encounter when communicating with the public about climate change?
2. What are participant opinions about the web-based risk communication tool developed by Dr. David Lieske and the Mount Allison University Geospatial Modelling Lab (GML) and how can the tool be further refined?
3. What types of software tools would you like to have to facilitate public communication?
4. How can web-based maps and other types of geovisualizations (e.g., animations) help facilitate public communication?

2.3 Methodology

The methodology involved hosting a one-day workshop. In preparation, an invitation was sent to planners, GIS technicians, and planning directors at the 12 planning commissions in New Brunswick. Figure 2 illustrates the planning districts in New Brunswick.

Figure 2.



38 people were invited to the workshop. Ultimately, there were 10 attendees representing 6 of the 12 planning commissions (figure 2). We also had one independent land use planner in attendance. The planning commissions that were represented included:

1. Belledune District Planning Commission
2. La Vallee District Planning Commission
3. Madawaska Planning Commission
4. Miramichi Planning District Commission
5. Royal District Planning Commission
6. Tantramar Planning District Commission

The bulk of the workshop was held as a plenary because of the small group size. In addition, three workstations were set up so that participants could have the opportunity to use the Tantramar Visualization Tool. A short self-guided interactive activity was distributed to each participate to guide them through the key elements of the tool. A short written questionnaire was also distributed to participants; they were asked to complete the questionnaire as a way of providing feedback on the tool.

3. Discussion Results

The workshop began with Dr. David Lieske providing an overview of the Tantramar Visualization Tool. Thereafter, discussion revolved around the main research questions noted above in section 2.2. The results of the discussion are presented below.

3.1 Challenges Encountered When Communicating with the Public about Climate Change and Particularly Flood Risk

Numerous challenges were identified in terms of communicating with the public about climate change and flood risk. These challenges are grouped by theme and are presented below.

Issue Agreement

- It is **difficult to agree** on the issues and the level of risk.
- Achieving **solidarity around the issue of flood risk is difficult**.

Collaboration

- When flood risk is identified, **divisions are quickly created** based on whether one is or is not located within a perceived flood zone.
- As a result, there are **challenges around bringing people together** to cooperate.
- There is (potential) **resentment** towards people who knowingly build in flooded areas and who are then bailed out or receive government compensation for damage due to flooding.

Data Challenges

- **Not everybody is comfortable with pure data**. It can be difficult to understand and can be laden with jargon.
- Some of the **data that is available is quite old**. Doubt can be raised when people look at flood maps based on old data, or if their experience is different than the map suggests. In other words, old data does not instil confidence.
- **Data is not static**. It is always a work in progress.
- **LiDAR is expensive**. As a result, LiDAR-based data is not always accessible.
- It is **difficult to predict where the water will go**. The truest line is where the flooding has actually been. Therefore, one should develop a buffer around the true line and develop plans from there. At the same time, **people are looking for definitive answers**.
- There is a lot of information on coastal areas but there is **not as much information for inland areas**. However, inland areas are also at risk, not only from coastal flooding but from back area and higher elevations where water and sediment cannot escape. Consider other sources of flooding like fresh water flooding, inland flooding, upland flooding, etc.
- There is **no definitive conclusion about where and how the water will travel**. However, this is a question that is continually raised.

Level of Knowledge Challenges

- In some cases, there is a **lack of knowledge of flooding issues** and flood risk.
- **People forget and forget quickly**. People do not accurately remember what has happened in the past.
- Some **people do not want to deal with flood risk**. The problem is not seen as immediate and there are more pressing issues that have to be attended to on a daily basis.
- **People appear to want to know the link between climate (e.g., rainfall) and downstream consequences**. This can be difficult to ascertain.

Public Participation/Involvement Challenges

- **Attendance at information sessions can be low.**
- **When money is at stake, people tend to come** to meetings. Similarly, attendance at public events is generally attended well if there is a concern about development.
- At the same time, there is also a **danger that people will also interpret cost estimates or data speculations as being definitive** and perfect rather than the estimates they actually are.
- It can be **challenging to attract people who are supportive** of planning or a flood mitigation initiative to information sessions.
- Some people want to help or get involved but they **do not have the time**. Others do not support flood mitigation projects at all. People from the latter group seem to be the ones that appear to have the most time on their hands and often are the ones that raise the most opposition.
- People who are **naysayers seem to attend public information sessions and form blocs of resistance**. It is difficult to talk to people who do not want to listen and believe the data.
- **Misinformation is a significant barrier**. Some people will even spread misinformation deliberately and will sabotage a process or communication attempt.
- **People want to do what they want**. They feel that they can and should be able to do what they want on their own land.
- **Passion can ignite**. Flood risk has implications for property owners, especially coastal owners, and this can raise a lot of emotion.
- There is often **not enough time allotted for meetings**, community planning sessions, etc.
- People can be **reluctant to admit when they do not know** what planning is about. This can manifest in many ways, including in negativity and frustration.
- **Some people will not move** even if relocation were a viable option. Some people are just very attached to their land and their homes.

Education and Communication Challenges

- **Education is a long process** and should be undertaken long term.
- **Communication is part of the education process** and should also be taken with a long-term perspective in mind.
- A **significant number of meetings are needed** in order to overcome biases and blocks in thinking.

- It can be **challenging to change mindsets**, particularly rural mindsets. People in rural areas, in particular, sometimes do not appear to want to be involved in what they see as 'urban or town planning'.
- A **significant amount of public consultation is often required**.
- Many people are **aware of flood risk/issues but do not like the implications**. This seems to be especially true of people who own property on a coast.
- The **media can help or hinder** a communication effort.
- It is sometimes **difficult not to generalize**.
- There is a **hesitancy to communicate** about flood risk. There is a lack of clarity around how to communicate and how to minimize fear, panic, and upset.

Governmental/Bureaucratic Challenges

- **Governments tend to be very compartmentalized in the way they operate**. This can also hinder efforts to communicate about flood risk and can also hinder cohesive action plans and lead to conflicting information and advice.
- The **Government of New Brunswick Department of the Environment does not record waterways at less than a 1/10,000 scale** so landscape features that actually exist may not be represented.
- **Politicians think in short terms** but addressing flood risk and communication requires a long-term strategy.
- Municipal **governmental decisions are not always based on fact alone**. There are other motives like political, social, and economic concerns that guide decision-making. These can conflict with the scientific data and can cause confusion.

Authority Challenges

- One challenge is in **having the authority to use tools and data**. In some instances, planning commissions and other planning professionals have information and the tools to collect information but cannot use them because of concerns over liability.

3.2 Obstacles Facing Planning Districts

Several obstacles that planning districts identified include:

- There is an overall **lack of trust** of planners.
- **The updating of zoning bylaws is hampered** by the absence of data.
- At the same time, collecting data that would allow this is discouraged out of concern for the **risk associated with non 'experts' producing measurements** that might be incorrect (inviting legal backlash).
- It is **challenging to build one's own data**.
- **More information is needed** and that data needs to be standardized and kept up to date. More specifically, more information is needed that combines impacts and 'downstream' consequences.

- **Accessing sites to assess flood risk can be problematic** as doing so in practice requires property owners' permission, which may or may not be granted.
- **Working in rural areas can be challenging**. People expect visits from planners to be negative, and assume that there is an agenda to restrict land use.
- **Community divisions can really harm planning efforts**.
- There is also a need to **integrate potential domino effects**, such as a a sewage lagoon getting knocked out as part of a chain of events.

3.3 Education Strategies to Overcome Barriers

Participants made several suggestions that could be used to educate the public about flood risk and overcome barriers and resistance. They include:

- Having a **constant presence**.
- Holding public meetings and **meetings with key groups**, stakeholders, 'players'.
- **Finding champions** to work on your behalf.
- Having **food at events** as a draw.
- Having **interactive programs** and other opportunities for greater participation.
- Having **processes that are bottom-up**, not just top-down.
- **Listening to feedback**.
- **Listening to people's lived experiences**. They should be taken into account.
- Being sensitive to the fact that **people do not always want what their neighbour wants**.
- Being **sensitive as well to divisions within communities**, such as people who are regarded as 'out-of-towners' and those who feel they are locals.

3.4 Audience for the Tantramar Visualization Tool

The Tantramar Visualization Tool was initially developed as a research tool. However, there was discussion around the possibility of gearing the tool to wider audiences, including:

- The general public;
- For workshops and focus groups;
- Grassroots organizations;
- Nongovernmental organizations;
- Municipal governments;
- Industry;
- Entrepreneurs, and;
- Developers.

It was also felt that the tool could also be enhanced for a broader range of users as well, such as:

- Planners;
- GIS technicians;
- Professionals, such as lawyers, property assessors, surveyors, and realtors;
- Teachers and others in the education field;
- Emergency response professionals, such as firefighters, police, and the Red Cross, and;
- Land owners, vendors, and purchasers.

3.5 Strengths of the Tantramar Visualization Tool

Participants identified a number of strengths of the Tantramar Visualization Tool. They noted that:

- It is an **easy-to-use interface**.
- It is **highly interactive**.
- It allows for **point and click interaction**.
- It is **fast**.
- The tool has **broad application**.
- It is a very **powerful communication tool**.
- It is **web-based and no special technology is required** to operate it.
- This tool can be **helpful for planning the maximum depth on footings** and relating to the maximum high water mark. For example, this could help people when they construct homes to so they can avoid flooding in basements.
- The tool **conveys technical information** that is often difficult for the public to be interested in or to understand **in a digestible and engaging way**.
- It has the potential to be a **portal or common resource** that specializes in flood modeling.
- It is a **visual tool** that reflects or conveys risk.

3.6 Areas for Enhancement of the Tantramar Visualization Tool

Participants were also asked to comment on the limitations of the Tantramar Visualization Tool and how it could be enhanced.

Accessibility

- The tool should be **understandable and accessible** to the average person.
- New or additional **information should be easy to add** so that the tool can continue to be built upon.
- The tool should be **available in both English and French**.

Navigation

- **Symbols and a legend would be helpful** and could be used to explain where key landmarks, like schools, hospitals, police and fire stations, etc., are located as well as other key sites like septic fields or well water. In particular, school symbols do not appear on the 8.9m flood scenario map but should.
- Likewise, **symbols should transfer into the flood scenario maps** (such as those used to indicate a hospital or a school). These symbols should be visible at a lower scale as well.
- There is a need for a **fixed scale across visualization layers**. In other words, the scale re-set function should be eliminated so that if one is at a 1:10,000 scale on one screen, for example, the 1:10,000 scale remains if one switches to another screen. That way, one's location and scale in one map will maintain consistent in another layer. Otherwise, one has to readjust and reorient oneself with every screen change.
- The tool could be **constructed as a portal** so that one part of it can be accessed and used by laypeople and another part of it could be more technical and more useful for professionals.
- It would be helpful if there were the **ability to zoom in and out.**
- It is not clear **how to activate or deactivate the grab hand**.
- **Additional navigation buttons could be present**, such as a select button, measure button, information button, and PDF printout button.

Reliability

- The tool is not subject to a liability test. In other words, there is **no way to verify the data** used to support the tool.
- The tool **does not gauge the quality of people's knowledge**.

Interactivity

- **Sophisticated queries are not possible** at this time.
- The tool could be **more interactive using hydrodynamic modeling**.
- It would be helpful if the tool had **emergency response information** like the location of possible escape routes, how people can get to the hospital if the highways or roads are cut off, what are the emergency plans, etc.
- It would also be helpful if the **public could add their own information** recognizing that there may be challenges to doing this, such as disk space, how to verify information provided by the public, and so forth.
- Having the **ability to generate one's own flood model** based on user-defined criteria would be a benefit.

Types of Data/Information Presented

- **Metadata should be presented** in the tool.
- Information about what the **assumptions are behind the data** should also be presented in the tool.
- It would be helpful to use the tool to **demonstrate where possible escape routes are**, how people can get to the hospital if the highways or roads are cut off, what the emergency plans are, and so forth.

- The tool should be updated to **include the new Sackville Town Hall**.
- **Historical data should be presented as well**. For example, a timeline could be included that will enable viewers to compare scenarios in different years or periods.
- **There should be a financial component to the software**. People tend to attend events more or pay more attention when financial issues are at stake. If the software could incorporate, for example, an estimate of damage costs, it may garner more attention. Other cost issues that could be considered are: the financial repercussions of not doing anything, the cost of clean up, financial costs to a municipality, the cost to the economy, and so on.
- The tool should **show different grades of risk** rather than present information as being in or out of a flood zone.
- Because inland areas are also at risk from flooding, not only from coastal flooding but also from back areas and higher elevations where water and sediment cannot escape. Therefore, one should **consider other sources of flooding** like fresh water flooding, inland flooding, upland flooding, rain, snow, and storm surge, etc.
- **Information should not be articulated in a cut and dry way**. It is important to keep open to solutions and to identify the vulnerable and less vulnerable areas.
- The tool should **illustrate the high water mark, property lines, and flood depth**.
- The tool could **better address speculations about how far the water could extend** since there is no definitive conclusion about where and how it will travel.
- The tool should **contain a disclaimer** that it is for modeling purposes only and to clarify what the data is intended for.
- The tool should indicate **action plans for each different scenario** it presents.
- The **presentation of gauge data**, e.g., tide gauge and river gauge, could be improved. Having gauge data could allow linkages between rainfall and river loading to be established.
- **Basic information should accompany the 3-D animations** (e.g., the 'walking man') is presented. In other words, some basic information about the scenario being presented, such as the flood scenario, would be helpful.

Imagery/Animations

- **The floodwater layer should be transparent** and laid over roads, terrain, and other landmarks so they are visible underneath the water.
- **Missing elements, such as blue skies, can cause users to lose perspective**.
- The **map is too precise** and the lines are too crisp. Viewers may also question the accuracy of the lines. The lines also convey a certain definitiveness but what we actually are conveying are 'best guesses'.
- The **animations can be too fast** at times.
- It would be helpful if the **contour lines were lighter** so that they are not too distracting.
- **Building footprints are hidden in the outer zoom** so one loses site of the streetscape.
- **Visualizations should be realistic** to some degree and should reflect a particular community. In other words, the community being represented in the visualization should be recognizable. Otherwise, visualizations can fail or not convey information properly.

- **3-D imagery might be more effective**. Three-dimensional imagery could provide more depth and perspective. At the same time, 3-D animations have the potential to confuse people, especially if the animations are moving too quickly.
- There are **no time lapses** in the visualization tool at this time.
- **Scale can be used to hide buildings** outside a viewable range.
- There should be some **indication of the level of flooding** that the walking man animation is set to.
- The GUI or **geographical user interface could be improved**.
- An **explanation of how much sea rise or precipitation would change water levels** would be helpful.
- The **imagery or map layers could be more polished or visually pleasing**.
- **Map layers could also be less crowded** to increase readability.
- **Photo archives could be added** to specific sites.

Audience

- Currently, the tool is designed as a research tool. Its relevance may expand it if its **purpose were expanded** so that it could be used to engage the public.

To summarize, the main challenges of the Tantramar Visualization Tool that were identified during the workshop are presented along with potential solutions in table 1 below.

Challenge	Potential Solution
Getting flood data in rural/inland areas where the province has not invested in LiDAR	• Have a map viewer that shows low-tech evidence of flooding. This could include: ○ Geo-tagging and dating photographs to provide evidence of flooding in different locations and over time. ○ Ground truthing during flood events using relatively low cost methods, like differential global positioning systems (DGPS), balloon mapping, and unmanned aerial vehicles (UAV). ○ Providing location specific links to other resources (such as video clips). ○ Allowing users to upload/digitize their own material to put on the map.
Having tools that can help convince decision makers that flooding is a problem and that adaptation action needs to occur. (These would be targeted for council meetings rather than public tools.)	• Have a map showing the infrastructure at risk (this could also show storm/sewer lines that are not in the flood zone). • Have a tool that can tabulate the economic cost of flooding under different scenarios.

Challenge	Potential Solution
Uncertainty about where streams/rivers are. This is a barrier when trying to plan development away from wet areas (e.g., a permit may be given based on where a stream appears on a map, rather than where it actually is).	• Have maps that show different hydro layers (NB-NBHN, NB-ETB, NB-DNR, DFO, FED, DEM derived, UNB-WAM) overlaid on DEM or aerial photos.
Discrepancy between local knowledge of flooding and a model-derived flood extent (the actual or modeled area (or extent) that would be flooded in a given event). Both have limitations. The bathtub hydro model gives an estimate of extent, and does not account for the accumulation of water due to surface imperviousness or rainfall plus coastal flooding. Local knowledge can be more specific, but there is the risk that it is not well informed (such as flood location was not seen at its highest point).	• Show both on the same map. • Depict more advanced modeling where sufficient data exists (such as storm surge coastal modeling or inland hydro models that account for storm infrastructure and surface type).

3.7 Potential Uses for the Tantramar Visualization Tool

Workshop participants were also asked what they foresaw the Tantramar Visualization Tool being used for. Some suggestions included:

- **'What if' scenarios**. The tool could be used to demonstrate different scenarios and potential courses of action. For example, it could demonstrate evacuation options if the main street of a town is flooded.
- **For emergency measures**. The tool could be used as a way to communicate evacuation options, information sharing among emergency responders, identifying potential road blocks, communicating different storm scenarios and their effects, costs, planning restrictions, and so forth.
- **As a meeting tool**. The tool could be used in meetings with municipal councils, agencies, community groups/stakeholders, etc. to discuss climate change impacts.
- **To communicate vulnerable areas**. Such communication could help disaster response preparedness and in developing flood risk land use regulations.
- **To support adaptation activities**. The tool could support priority adaptation projects such as culvert enlargements for at-risk portions of main roads.

- **To support planning activities**. The tool could be shown to working groups, such as the Climate Change Adaptation Working Group, to help plan and prepare communication tools for various activities. It could also be used to bolster requests for funding and demonstrate funding needs in a more concrete way.
- **To bolster support**. The tool could be used to foster enthusiasm and support among potential partners in climate change adaptation.
- **To support policy-making**. The tool could be integrated with zoning, municipal planning, infrastructure planning, GIS data, etc. to inform future land use policy development and disaster response/emergency planning.
- **To raise awareness and engage the public**. Municipalities, councils, planning commissions and other such agencies could use the tool for awareness building and for public engagement.
- **To respond to public inquiries**. For example, it could be used as an office tool so that when someone comes to ask questions about their property or when they come for a permit, the tool could be used to demonstrate flood risk or related issues.
- **To anticipate flood areas** so that future issues could be avoided or addressed in advance.

3.8 Types of Technology for Facilitating Public Communication

There was some discussion around the types of technology that could be used for facilitating public communication. Suggestions included:

- **SMART Board**. This is an interactive white board. Whatever is written on the board can be saved and downloaded. It is very user-friendly and interactive. It is a helpful way to get feedback and invite participants to mark up the map and add their ideas and experiences.
- **Prezi.com** is an online 'virtual canvas' tool that can be used to explore and share ideas.
- **Comparative pictures**. Basic imagery can be used to demonstrate 'before and after' scenarios.
- **ARC Hydro** is software that one can access for free with an ArcGIS software license. It could be used to demonstrate how water will disperse above and underground and better understand drainage of flooded areas.
- **Geo NB** is the Province of New Brunswick's gateway to geographic information and related value-added applications. It can be accessed at http://www.snb.ca/geonb1/e/index-E.asp.
- **TauDEM** (Terrain Analysis Using Digital Elevation Models) uses hydrodynamic modeling, which can be accessed free of charge. It would be useful to use this.

Software should be **easy-to-use** without too much thought. It should not be too elaborate and should be something that can be used without extensive training.

3.9 Cautions About Using Visualizations to Facilitate Public Communication and Other Challenges

Visualization tools such as the Tantramar Visualization Tool **should be used only as a flagging tool** and not be taken as firm evidence that a particular climactic event will occur with certainty.

People's **reactions to flood risk can be very emotional**. Therefore, caution should be taken in terms of how flood risk is visualized and communicated.

When using visualizations to communicate flood risk, there is a risk of **creating an 'us versus them' mentality** because a visualization tends to suggest definitive boundaries between those who will be on high ground, and those will not be.

3.10 Other Types of Visualizations

Discussion also revolved around the different alternative types of visualizations one could use to communicate flood risk to the public. Several suggestions were put forth:

- **LiDAR maps.**
- **Pictures of individual properties**. These can be a helpful way to start a conversation because as people look at the properties (especially their own), they tend to begin asking questions which segue into other issues.
- **Aerial photographs**, which provide a birds eye view of a larger area. **Orthophotos** are aerial photograph that are geometrically corrected so that the scale is uniform. They can be put together in different layers. If the photographs can be related to a familiar area, house, landscape, people begin to understand how an issue relates to them. The photos can be used to appeal to people's emotions.
- **Google StreetView** provides an opportunity to focus in on a certain streetscape. It was considered to be an important viewing technology to use when responding to specific requests from the public.
- **The web** can be an effective medium for reaching a broad audience and in making information widely available.
- **Social media** can also be used to communicate about flood risk. Consider using FaceBook and other types of social media.
- Technologically, **paper maps** are simple but they can be laid out on a table or hung on a wall and have no technological requirements. They can be useful for engaging people and for gathering information about specific properties. They can contain a range of references such as streets, land contours, major landmarks, flood risk lines, and actual flood lines.
- **Stickers** can be used with paper maps and can be colour coded to correspond with a legend.
- **Climate change 'peaks' over a historical period** could be used and could include tides, rain or snow falls, storm surges, flooding, ice jamming, high and low temperatures, etc.
- **3-D models** that show flood affected areas, particularly in residential or high use areas.

3.11 Challenges with Data Collection

Collecting data was regarded as a very significant problem and several challenges were identified regarding collecting data. These include the following:

- Collecting data **requires considerable human and financial resources** to collect. It is likely not realistic to think that there will be comprehensive data collected for every region of the province.
- There are **gaps in knowledge and data** that make it difficult to make one's case.
- Moreover, **not everyone wants data collected for their area or land**. People expect there to be negative consequences when data is collected, such as an increase in taxes.
- In some districts, collecting data is a challenge because **data collectors have to be formally trained and recognized as experts**. Therefore, lay planners (or others) are not able to collect data even when data collection tools are available. There is a concern that if data is not collected by a recognized expert, the municipal government or planning commission may be vulnerable to liability.

3.12 Additional Suggestions Regarding How Visualizations Could Be Used to Communicate Flood Risk

Additional ideas were put forth in terms of how visualizations could be used to communicate about flood risk. These ideas are grouped by theme.

Visualizations

Photographs should be collected of flooding events and organized into a photo archive. This is a fairly straightforward and economical way to preserve knowledge, particularly for areas where data is lacking.

Date stamp the photographs/imagery. By so doing the timeline of the images cannot be disputed.

A visualization tool has to be **people-friendly, place sensitive, and place relevant**. If the tool is too generic, its usefulness will decline.

Data Collection

Data collection should be ongoing so that one's information is as comprehensive as possible and as accurate as possible. Landscapes and features change and the data needs constant updating to reflect this.

Low altitude aerial photography would allow for gathering quick time specific imagery. This may enhance the data that is available and would not be as expensive as LIDAR. Nor would wait times for such data be as long as with LIDAR data.

An unmanned aerial vehicle (UAV) can be used to collect data. It is fairly inexpensive compared to other methods of data collection, has good accuracy (between 2cm and 30 cm accuracy), can be flown at most times of the year, can fly between 200 and 3,000 feet, and can cover a lot of ground in a short period of time (50 hectares in 10 minutes). As a result, it is therefore quite versatile.

Meteorological weather balloons could also be used to collect data. They are quite economical but there are drawbacks. For example, it is not possible to use them to get a digital elevation model (DEM).

Sources of Information

The **insurance industry has a lot of information**, not only about initial costs but about incremental damage as well. Therefore, information from the Insurance Board of Canada may be helpful.

Communication with One's Audience

Visualizations should be personalized. Every local situation is slightly different. To increase public understanding of flood risk, one should appeal to where people's hearts are and to what they can relate to.

It is important to **inform one's audience about the data and assumptions** that underpin the visualizations.

It is also important to **communicate different scenarios**. By so doing, the audience will see the range of flood possibilities and perhaps gain a better understanding of the fact that the extent of anticipated flooding in an area is a 'best guess' scenario and not necessarily definitive.

Target the messages. Identify who one's audiences are and target the messaging to particular audiences. The tactics used with one audience may not be the same as the tactic used with another.

Public Outreach

Use different tactics to attract people to public information events, like through education, food, and interactive programs. The latter factor, interactive programs, gives people the chance to participate and build their capacity to participate.

Interaction can take many forms. For example, there could be opportunities for people to digitize their photos or to get people's feedback on what they want and/or to hear what they have lived/experienced in their area.

Public outreach materials should be diverse. By using a diversity of materials, one increases the likelihood of being able to reach and communicate with different target audiences.

One could consider a **public relations/communications expert/consultant** to help communicate about flood risk. The issue of flood risk can be highly emotional as people's homes, property, and even lives can be at risk.

A champion from the community can make a significant difference when communicating with the public. Champions can reach people in their 'living rooms'. Champions can also help open doors, particularly if experts are from outside the community.

Notion of Community

Work within communities. It is important to work within communities and with different entities within communities, like schools, hospitals, the municipal government and so forth. Only communicating with mapping and GIS experts may mean that vital segments of the community are not informed nor involved in flood risk communication.

Take a **more wholistic view of community** and flood risk should be regarded as a community problem. Rather than defining oneself according to whether one's home is on high ground or on the flood risk, the question should be how is the community going to be affected (differently) by the flood and how can it come together to ensure that people are safe and cared for in an emergency.

Supporting Information

Additional information or resources that could support the use of visualizations in communicating with the public could include: up to date data, and expert testimony or explanations.

3.13 The Issue of Adaptation/Relocation

The issue of adaptation and relocation arose and there was some discussion around they types of incentives or actions that might be particularly effective for adaptation/relocation in high-risk zones. Discussion points included:

- **Not everyone can afford to move**.
- **Not everyone wants to move**. Some land and homes pass from one generation to the next and people do not want to give up their land and homes, which they see as part of their heritage.
- In some cases, **landowners and the province exchanged land**. **Landowners exchanged their properties** in a flood risk area for another property (Crown land).
- Planning restrictions should be **phased in over a long period of time**.

- **Planning commissions can take a variety of preventative actions**. They can voluntarily stamp "this property may be subject to flooding" for development requests, red-flag at-risk properties and make recommendations for development around streams, rivers, etc.
- **Maps should contain disclaimers**.
- **Maps should also be layered**. They can amalgamate different data sets, present seasonal rivers, streams, small wetlands, and smaller pieces of data, etc.
- **Larger buffers are needed** in order to be safe. Likewise, larger tracts of wetland areas should be protected.

3.14 Ethical Issues

A number of ethical concerns about the visualizations and communication about flood risk in general. Issues that arose were:

- **How is the data being used?** For example, realtors and developers could use the information to determine where housing should be built or where houses will sell better. This could impact where houses are built.
- The **value placed on homes may be affected**. For example, homebuyers could use the information to justify lower offers on houses.
- Declaring an area a flood zone may cause people who already live in the area to have **difficulty selling their house**. As a result, their property could be devalued.
- **To whom does the obligation to disclose fall?** Do planners and planning commissions, as an example, have a legal obligation to disclose information about flood risk?
- There is a **tendency for the public to interpret maps as truth and evidence**, rather than as information or speculation. Therefore maps present an illusion of precision.

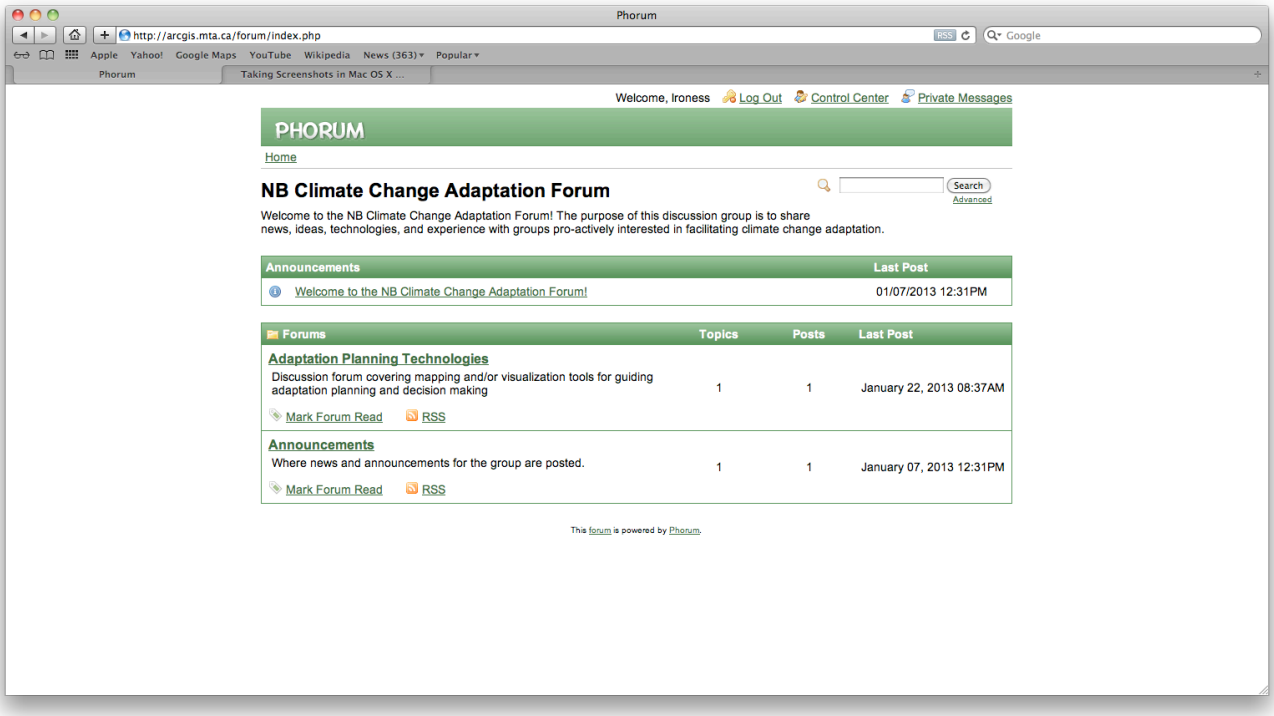
4. NB Climate Change Adaptation Forum

An unexpected outcome of the Tantramar Visualization Tool Workshop was an expression of interest from the participants to establish an online forum so that information exchange and collegial networking could continue after this workshop ended. As a result, the researchers developed the NB Climate Change Adaptation Forum.

The purpose of the online forum is to create a space where the workshop participants can continue the dialogue on flood risk, lessons learned, and mitigation efforts. Its purpose is to enable registrants to share information and exchange ideas, post informative web links and discuss current events and so forth.

The forum home page can be found at http://arcgis.mta.ca/forum/index.php (see Figure 3 below).

Figure 3.



5. Next Steps and Conclusions

The results of the Tantramar Visualization Tool Workshop confirm the literature[2] on the use of visualizations to communicate flood risk. Workshop participants felt that visualizations in general, and the Tantramar Map Viewer, in particular could be effective tools to communicate about flood risk. However, it was also noted that visualizations should not be used on their own and should be grounded within the local context.

A number of questions arose during the workshop around future collaboration. They include:

1. Are there options for sharing resources among planning commissions and flood risk/mitigation specialists?
2. How will information on flood risk and the Tantramar Visualization Project be available for small villages?
3. Is there a Sackville flood plan and how does it incorporate information/data/results from the Tantramar Visualization Project and Tool?
4. Are planners, GIS technicians and other planning professionals (and planning commissions) liable for the data collected?

[2] See the report entitled *Tantramar Dyke Risk Project: The Use of Visualizations to Inspire Action* (2012) by Lori Ann Roness and David J. Lieske. This report was sponsored by the Atlantic Climate Adaptation Solutions Association.

5. Is there an obligation to inform landowners about the results of data collection or flood risk?
6. How does one deal with members of the public who are adamant in the position, despite information and data to the contrary? In other words, how does one deal with naysayers?
7. How should this information be related to the public when no solutions are on hand?

It was noted that there are significant gaps in data. Most immediately, data is needed about local vulnerable areas but also about perceived risk, public concerns about safety, vulnerability factors, and so forth. Areas for data improvement include:

- Improved access to coastal LiDAR maps.
- Improved integration of property mapping and key (potentially vulnerable) infrastructure (such as, retaining walls, culverts undersize, sewage lagoon, cumulative impacts, etc.) in order to facilitate evacuation and safety measures and to better understand where the affected areas are and the extent of damage. There is concern that impacts will be more extensive than projected.
- Having more dynamic data.
- Having data that is uniform and which reflects what actually exists.
- Updating current data that is often out of date, especially data for high-risk areas.
- Ensuring that the entire province has equal access to updated information.
- Having provincial wide standards for data quality.

It was also felt that using a combination of data is best so that the information one has on hand is as accurate as possible. It was suggested that one could overlap the more scientific types of maps with maps based on individual experiences to get a fuller picture.

Workshop participants felt that having information from people and the community is really important and should not be discounted. People's experiences can fill in the gaps in the scientific data. Moreover, people are often more familiar with the landscape as it is currently and can therefore correct or update the data. Data maps are only updated every several years if not more infrequently and landscapes may not be the same from year to year. For example, a riverbed may have dried up or have been diverted in reality but a data map may not reflect that change.

There are areas that are chronically vulnerable to flooding. Planning for future flooding was regarded as being absolutely necessary. Therefore, a long-term (30 year) approach to planning should be adopted with both short and long term solutions. For example, in the short term, the dykes could be built up and in the long term, communities could explore longer-term options like relocation. In fact, it was considered to be a liability not to plan.

Notwithstanding the value of visualizations to communicate flood risk, the use of visualizations was regarded as being but one aspect of a communication strategy. Multiple strategies should be used to communicate with the public. The use of visualizations should be coupled with other communication and education activities that include, as examples, public presentations, engaging summer students to share information, posting an online toolkit, using social media to share information, and engaging

the public in multiple ways to 'reimagine our space'. Education about flood risk should be formal and informal and take many forms, using both conventional and more innovative approaches.

Moreover, communication about flood risk should be two-way. It should be as much about presenting data as it is about collecting information from the community. Therefore, it is important to be cooperative and collaborative in seeking information and in identifying solutions so that the most number of people will feel satisfied that their concerns are being heard and acted upon. Finally, people that are trusted and reliable sources of information should implement an overall communications strategy.

Participants also commented that there seems to be hesitancy on the part of public officials to embark on a communication strategy and therefore decisions to do so are often delayed. However, delays in acting will cause more problems in the long run.

Appendix A – List of Attendees and Contact List

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