Technical Report on Local Climate Change Visioning for Delta:

Findings and Recommendations

Report prepared for the Corporation of Delta

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The Collaborative for Advanced Landscape Planning at UBC

Authors: Kristi Tatebe, MSc.P; Dr. Alison Shaw; Dr. Stephen Sheppard

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EXECUTIVE SUMMARY

It is widely accepted that the world must act urgently to mitigate greenhouse gas emissions if there is any hope to remain below the two degree global temperature increase that is expected to lead to catastrophic climate change. Climate change science has been largely global and expert-driven, which has been insufficient to motivate local responses. The Local Climate Change Visioning project has developed compelling 3D visualization techniques and participatory processes to explore visions of the future under climate change. Its first case study was for the Corporation of Delta, a local municipality facing serious potential consequences from sea level rise if quick, decisive action is not taken.

There were two main components of this research. Phase 1 constructed frameworks and methods for downscaling climate change impact information and visualizing alternative climate futures at the local scale. Phase 2 tested the influence of these visualizations on the awareness, emotional responses, and motivation for behaviour change of the local community participants.

In general, the Local Climate Change Visioning process resulted in an increased awareness of climate change as an issue, and of local adaptation and mitigation actions that could be taken to address it. The visualizations resulted in an increased concern and heightened sense of urgency, as well as an increased desire to take action to address climate change. A workshop with Delta staff identified top priorities for climate change planning in the municipality, and verified that the imagery would be useful in communicating impacts to the public and increasing awareness and the sense of urgency.

These results suggest that a visioning approach may help to overcome common social and perceptual barriers to climate action (particularly a lack of knowledge of local collective actions that can be taken to address the problem), and be useful to a variety of planning processes. The report makes recommendations for these applications, as well as for policy change to promote climate action; it discusses the relationship between adaptation and mitigation responses, & presents a preliminary decision-support matrix for evaluating response options. Areas for future research are also recommended, that would fill existing data gaps and assist the Corporation to remain a leader on climate action and adaptation in B.C.
1. INTRODUCTION

Both local and global in its causes and impacts, climate change poses an unresolved challenge for scientists, politicians, entrepreneurs, and citizens. Climate change research has been largely global in focus, aims at enhanced scientific understanding, and is driven by experts, all of which have been insufficient to trigger serious climate change action in regional and local contexts.

The Local Climate Change Visioning Project (LCCVP) is one new approach that may assist local decision-making. It uses compelling 3D visualization techniques and participatory processes to explore visions of the future under climate change for communities such as the Corporation of Delta.

This technical report outlines the potential climate change impacts faced by Delta, in relation to relevant current policies. It presents the rationale behind a visioning approach to advance community engagement and planning for adaptation to and mitigation of climate change impacts in the community of South Delta, including the implications of inaction. It describes the methods used in the Local Climate Change Visioning Process and the key findings. The discussion section of the report discusses the utility of the approach to planning processes, and outlines barriers to climate change action that such processes may help to overcome. In this context, the report also discusses the Corporation of Delta’s Flood Management Strategy, as well as the importance of interactions between adaptation and mitigation initiatives, and makes recommendations regarding policy programs and possible adaptation/mitigation approaches. Finally, it outlines ongoing and potential future research areas to assist Delta’s decision-making process on climate change.

2. DELTA CONTEXT

The Corporation of Delta is bounded on three sides by water, and largely comprised of the floodplain of the Fraser River (Figure 1). Much of Delta lies between zero and two meters above mean sea-level, and thus requires protection by over 60 km of dikes.
Originally dominated by seasonally flooded wetlands, Delta has had several historical flood events since settlement by non-natives. The earliest recorded was in 1894, however at this time the area was sparsely populated and so little damage to people or property was caused. In 1948 however, damages were reported (in 1948 dollars) at $20 million (Environment Canada, 2009). If this same flood were to occur today, damages would be an estimated $1.8 billion in the Fraser Valley (Corporation of Delta, 2009). Delta’s vulnerability to storm surge has also recently been demonstrated during numerous storm events in the past, particularly in 2006, where, according to local officials, sea levels rose almost 1m and waves were up to 5.5m above mean sea-level (pers. comm. 2006) (Figure 2).

Delta was home to approximately 96,000 individuals in 2006, and is composed of three distinct urban communities, each with unique demographic profiles, located in the central, southern, and north-eastern regions of the municipality. Almost half of Delta is farmland, much of it included in the Provincial Agricultural Land Reserve, which is a provincial zone that recognizes agriculture as a priority.
use, encouraging farming and controlling non-agricultural uses (Agricultural Land Commission, 2009). The Tsawwassen First Nation has recently signed a Treaty with the Provincial and Federal governments, and the Musqueam First Nation also has a reserve in Delta. This report briefly discusses regional climate change issues, but focuses primarily on South Delta in the Roberts Bank/Westham Island/Tsawwassen area.

2.1 Local Climate Change Policy

The history of climate change policy in the Corporation of Delta begins in the mid-1990’s. This section outlines past and current climate change policies.

1996 - Delta signed on to the Federation of Canadian Municipalities’ Partners for Climate Protection (PCP)milestone system(Federation of Canadian Municipalities, 2009), to aid in setting greenhouse gas reduction targets to mitigate against future climate change. Steps include:

1) create a greenhouse gas inventory,

2) develop greenhouse gas reduction targets,

3) develop a local action plan,

4) implement this plan,

5) monitor progress towards these targets

Delta has so far completed step 1 at the community level and step 3 at the corporate level.

2005 - Official Community Plan Review - Issues related to the environment and sustainability were considered.

2007 – Nine-part climate change initiative developed. This was the first of its kind in BC & developed mainly in Engineering & Environmental Services departments, focusing primarily on corporate emissions (from municipal fleet, infrastructure, buildings), but also addressing some adaptation (in the context of climate change, this is understood as actions communities take to prepare for the impacts of climate change). In the case of Delta, this includes the flood management and infrastructure improvement plans). Management of natural areas, staff training and community education were also addressed in the report, although without a high level of specificity in terms of budget and work plan.

2008 – the Flood Management Strategy Work plan developed in response to recent flooding & growing awareness of flood risks. Its purpose is to identify next steps in long-term flood management planning. A guiding principle is to “Explicitly consider the potential impacts of climate change over 20, 50, and 100
year time frames in flood protection planning (Corporation of Delta, 2008b). It includes preparation of a flood risk – consequences study, and area flood protection plans. At time of writing, the results from these studies have not yet been released, and Area Flood Protection Plans are not yet available. Delta also placed a senior environmental officer in charge of climate change issues, and is planning on further development of both adaptation and mitigation policy.

2008 – In line with Bill 44 establishing provincial GHG emission reduction targets of at least 33% from 2007 levels by 2020, and at least 80% by 2050, The Green Communities Act (Bill 27) amends the BC Local Government act, giving local governments the power to designate Development Permit Areas for GHG reduction, as well as requiring all local governments to set GHG reduction targets in their Official Community Plans or Regional Growth Strategies, as well as enact policies to ensure action is taken to meet these targets, by May 2010.

In addition to these policies, Natural Resources Canada also chose Delta’s Roberts Bank shoreline as the focus of a detailed study of sea-level rise impacts (Hill, 2006). This report was updated again with new estimates of sea level rise for the BC Coast in 2008 (Hill et al, 2008). Also, in 2009 the Pembina Institute produced a report outlining policy opportunities and hindrances to reducing energy and emissions from new buildings in the Corporation of Delta.

3. The Local Climate Change Visioning Project: Why Visualize?

In light of the climate change and policy context in Delta, what benefits does a visualization process bring? Perhaps the greatest potential value lies in the ability to make complex science and data easily understandable to local decision-makers, planners, and the public, in order to enable these groups to increase their understanding of the issue and its impacts, to make visible alternative futures that Delta can strive for, and to make appropriate decisions today that will influence the breadth and depth of action taken in the future. Additional benefits lie in the participatory nature of the process. While not designed specifically to focus on overcoming particular barriers, the process was intended to increase awareness, inform policy, and potentially motivate action on climate change. Among other things, it provided staff and councilors with useful information on public attitudes toward climate change action locally (see below). One outcome of this process was an increased understanding by participants of the impacts faced in Delta, and the consequences of inaction with regards to climate change adaptation and mitigation locally. This information is critical to planners and decision makers as they face increasing challenges & hard decisions into the coming decades. The following sections outline some of the possible consequences of inaction on climate change for Delta, as a key reason why an informed and in-depth dialogue is needed urgently within the community, leading to new and comprehensive policy and
planning strategy on both adaptation and mitigation. The methods and results of a new prototype process developed to meet this need (Sheppard, 2008), and first pioneered in Delta through a partnership with UBC and many other agencies and stakeholders, are described next. The research, initiated in 2005 and ongoing, has been supported by funding and other contributions from the GEOIDE Network Centre of Excellence, Natural Resources Canada, Environment Canada, BC Ministry of Environment, Integrated Land Management Bureau, Metro Vancouver, the Corporation of Delta, the City of Vancouver, ESRI, the David Suzuki Foundation, and UBC.

3.1 THE CONSEQUENCES OF INACTION

It is imperative that local governments and decision makers in Delta understand just what is at stake, and the possible consequences of inaction of failing to act decisively to address climate change. Scientists tell us that the world must start substantially reducing its currently rising carbon emissions within the next 10 or so years if there is to be any hope of staying within the 2 degree average global warming that is considered to be the threshold of dangerous climate change (Hare, 2006; Grassl et.al, 2003). This will require deep cuts in GHG emissions from all communities in countries like Canada with high carbon footprints, in line with BC’s mandated GHG reduction targets. At the same time, sea level rise is accelerating and other local impacts of climate change will become more severe for relatively vulnerable communities such as Delta.

The following section outlines some possible impacts faced by Delta if no adaptive or mitigative options are pursued, drawn from one of the scenarios developed in the Local Climate Change Visioning project that is based on IPCC’s A2 global scenario of a high-carbon world (4 degree warming by 2100) without effective local or global action on climate change, and on best available regional/local information (see below). It should be stressed that the following impacts represent only one possible future for Delta. This is a “World 1” scenario (defined below), assuming continuation of current trends in a high carbon world, corresponding to the global A2 GHG emissions scenario (Nakicenovic et. al., 2000). It is not meant to be a prediction of probable future states, although if current trends continue, the local impacts may be similar or worse than this scenario. In this possible future, the following situations could arise. A large portion of Delta’s ALR is subsiding and rests somewhere between 0-2m above mean sea level (Figure 3).
Figure 3. Elevations in Delta. Blue colour indicates elevations below 2 meters above mean sea-level

Figure 4. Robert’s Bank presently (photograph at left), and in 2100 (graphic at right) with the current dike, normal high tide, sustained storm surge and dike breach in a high-carbon world.

The risk of sea level rise (SLR) is problematic for a district that is dependent on an extensive dike system. The pair of images in Figure 4 shows the projected sea level rise along Roberts Bank, taking local subsidence, climate change, and other factors into account (Hill, 2006). Conservative SLR projections under this scenario (made in 2006) estimated a mean local rise of 0.58m by 2100. When combined with the high tide (2m) and storm surge (0.9m), the 3.48m water level would lap up against the top of the 3.5m dike. Without the typical 0.75m freeboard or clearance, over-topping could occur on a windy day even with minimal wave activity, and longer-term flooding behind the dike could occur with a dike breach. It should be mentioned that this and all other visualizations of sea level rise presented are conservative, and more recent studies (Bornhold, 2008) project even higher levels, with an extreme high estimate of 1.2metres of SLR in the Fraser River Delta by 2100.
Figure 5. Brunswick Point at left with mean sea level, and at right with normal high tide and storm surge flooding. Westham Island is just visible in the top right corner of the image. Note that it is submerged with current normal high tide and storm surge.

Normal high tide is held at bay on Westham Island by the 2.9m dike on the landward side of the island, the lowest of the island’s dikes (DeltaMap, 2009). However the addition of storm surge (0.9m) without sea level rise would crest the dike (Figure 5), causing saltwater damage to fertile lands and crops. Without protective measures under a world 1 scenario such as this, the George C. Reifel Migratory Bird Sanctuary, and surrounding wetlands (within the nationally recognized flyway for migratory birds such as snow geese) would be regularly inundated with saltwater throughout the century. This regular inundation could change species composition and ecosystem dynamics. Bird populations could dwindle as crucial winter habitat is reduced. With high tide, a storm surge, and 0.58 m sea level rise, by 2100 Westham Island would be submerged.

Sea level rise would impact a large portion of the ALR in terms of salination. Occasional breaching, lack of maintenance of the dike, reduced summer precipitation, and salt water intrusion as a result of a creeping salt wedge up the Fraser may increase the salt content of the soil by 2020, making crop production non-viable in some areas. Under this scenario by 2050, large areas of the ALR along the coastline could be abandoned for conventional farming due to subsidence, saltwater intrusion, and limited protection from the dike.
Sea level rise causes coastal squeeze or shoreline ecosystems and changes the composition of species that thrive in the intertidal zone. As shown above, marshland areas outside the dyke could shrink and dominant species composition could shift with higher water elevations. High marsh plants (Alkali Bulrush - *Scirpus maritimus*) become reduced as low marsh, mudflat plants (Bullrush - *S. americanus*) become dominant. This has implications for ecosystem dynamics: changes to habitat and predator-prey relationships shift as species change, halving overall biodiversity in the region (Hill, 2006). Such changes to the habitat and plant community would cause a cascade of effects throughout the ecosystem.

If we project current global growth trends and assume the rest of the world makes no major effort to respond to climate change, the Greater Vancouver area would become a relatively even more desirable place to be. Displaced people from other nations and communities vulnerable to climate change impacts will begin to look to Canada and south-western BC in particular, placing new growth pressures on local communities.

In this hypothetical high-carbon world, large-scale projects such as the Delta Port Third Berth Project and the South Fraser Perimeter Road could expand truck freight and transportation routes, driving up Delta’s already high per capita greenhouse gas emissions. Similar to today, a large proportion of residents (85%) could continue to commute to jobs that are available only outside of Delta, preferring the convenience of single occupancy vehicles. Vehicle kilometers traveled could double by 2020 and triple by 2050 for Delta as a whole (based on projections by Carmichael, 2007 using the GB QUEST tool), increasing congestion and in turn leading to the construction of further infrastructure such as roads and bridges to serve the growing suburbs. These expanded road networks would encroach on habitat areas, drive carbon emissions higher, and increase the associated risks of poor air quality (such as respiratory
ailments and hospital visits). By 2050, environmental refugees seeking asylum in southwestern BC could contribute to a tripled population. If limited geography and room to grow in the region, all developable land in the region would be utilized to accommodate a rapidly expanding population; thereafter, residential development could encroach onto Delta’s agricultural land and habitat areas. If the ALR was overturned (consistent with development patterns across most of urbanizing Canada and the USA), Delta’s land use could shift from predominantly agriculture practices to a residential suburb, with single-family housing and road infrastructure being built on agricultural lands to house the increasing population (Figure 7).

![Development in Delta at present (top), and in 2020 (bottom), as development encroaches onto the ALR (as per current exclusions of land from the ALR). Development could spread across remaining agricultural lands by 2100 if existing agricultural land policies are altered to accommodate growth.](image)

If development continues in the floodplain in the World 1 Scenario, more properties would be at risk, and therefore the total value of assets at risk increases. A San Francisco study (Miller, 2003) argues that a 0.3°C increase in temperature makes the 100-year storm surge flood event a 10-year event. With increased occurrence of river and coastal flooding, the damages incurred by 2100 could increase from

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current levels by a factor of 14, with intra-urban flooding costs increasing by a factor of 20. In areas such as Delta the costs of insurance are projected to increase by 50% (Association of British Insurers, 2005). The cumulative effects of flooding and subsidence could create situations where rebuilding would be costly and insurance costs prohibitive.

![Figure 8. Boundary Bay community at present (left), and in 2100 with sea level rise and storm surge flooding.](image)

Real estate along the Boundary Bay coastline would remain desirable until mid-century; the west coast aesthetic and the view naturally draw people to the shores. Beach Grove beachfront could expand and redevelop. This scenario assumes opposition to raising seawalls due to access and view losses. The sea wall would remain 2.9m in height, with some residents accepting the risk of occasional storm breaches and subsequent flooding. However, sea levels could rise 0.17m or more by 2050 and with the increased frequency of storm events moving in from the southeast, some people living in homes along the coastline may not feel comfortable with the increased risk of flooding. It is expected that by 2050 the number of intense weather events would increase approximately 25% and 60% by 2100 in the northern hemisphere. By 2050, more owners would become sensitized to the risks and could be forced to pay very high insurance payments or to abandon their properties altogether late into the century. Those that could afford to might move to higher land in Tsawwassen, which could become a gated community in the highlands. Later in the century, Tsawwassen could become the safe-haven for the more affluent against a backdrop of low-income residential growth across the high-risk floodplains.

It is important to consider the local impacts of both local and global climate change, including socio-economic impacts. While contemplating such impacts and futures as described above may be uncomfortable for many, the good news is that much can be done to both adapt to the likely impacts of
climate change, as well as mitigate against the severity of future climate change by reducing greenhouse gas emissions as part of a world-wide effort, with local co-benefits of more sustainable lifestyles for community residents. Decision makers have the power and opportunity to be leaders in innovative solutions, and if they can build public support and find the will to act decisively and quickly, may help avert some of the more catastrophic effects into the next century. It is hoped that the Local Climate Change Visioning process can assist decision-makers with this task.

3.2 METHODS

There were two main components of this research. Phase 1 constructed frameworks and methods for downscaling climate change impact information and visualizing alternative climate futures at the local scale. Phase 2 tested the influence of these visualizations on the awareness, emotional responses, and motivation for behaviour change of the local community participants.

3.2.1 PHASE 1 - PARTICIPATORY SCENARIO METHODOLOGY

The participatory multi-scale scenario approach employed in this study is structured into three main steps (Fig. 9): synthesizing global scenarios of climate change (Step 1); downscaling global climate change scenarios using participatory approaches (Step 2); and visualizing local climate change scenarios (Step 3). The steps and results are illustrated in Figure 9.

![Diagram](image)

*Figure 9: Participatory, multi-scale approach*
The scenario and visualization methodology is described in detail elsewhere (Shaw et al., 2009). It draws on available socioeconomic modeling, GIS mapping and spatial analysis, local expertise and climate change scientists in working groups, to develop and integrate alternative land-use and climate change scenarios, through a participatory process, in order to inform local decision-making and planning.

3.2.2 Phase 2 - Imagery Impact Methodology

‘Visioning packages’, which include local storylines and visualized scenarios generated in Phase I, were used in Phase II of this project to test their effects on community perceptions of climate change and the need/urgency for response. The focus here was on whether and how mapped and visualized scenarios increased awareness, affected emotional response, and motivated behavioral change or support for local policy-making.

In order to test the effects of the visioning process and the resulting visioning packages, four public testing sessions were held in the community of Delta. In two of the sessions, groups of 15+ individuals were exposed to a climate change presentation that included numerous highly localized 3D images of climate change futures. In the other two sessions, similar sized groups were exposed to a comparable presentation using more traditional media for climate change information, in the form of maps, graphs, and diagrams only. In each session, a questionnaire was given to each participant prior to the presentation to assess their level of knowledge on climate change, and the identical questions with some new additions were provided in a second questionnaire after the presentation. This structure allowed us to elicit two types of responses:

1) Individual responses to determine whether the presentation had an influence on individual awareness, affect (feelings and emotions), and intended behaviour change;

2) Collective responses to determine whether the groups (and individuals) exposed to 3-D imagery had a greater (or lesser) response than those exposed to similar information without 3-D imagery.

It should be noted that these questionnaires relied on self-reporting, but the results were somewhat validated by qualitative analysis of comments.
Other similar sessions using visualizations were conducted with Delta staff (later in this report), and regional practitioners (reported elsewhere).

3.3 KEY FINDINGS

A number of striking themes emerged from this testing. The findings presented below are based on the Delta public sessions and have been selected for their relevance to local decision-making and policy in Delta. First, significant findings are presented from the public group that was exposed to the presentation using visualizations (n=48). Following this, the key similarities and differences between these results and those of the non-visualization public group are summarized. Finally, the results from a workshop held with Delta staff are presented.

3.3.1 PUBLIC VISUALIZATION GROUP FINDINGS

The respondents in the visualization group were 36% male and 64% female. 48% of respondents were over age 60, with 20% between 50 and 60, 18% between 40 and 50, 9% between 30 and 40, and 5% between 20 and 30. The vast majority (87%) had completed some post-secondary education, with 23% holding graduate degrees. Respondents most often reported their income to be in the $20,000-$40,000 range (33%), with 26% in the >$80,000 range. Respondents most often reported that they were retired (33%). 95% of respondents lived in Delta, and of these, 52% were from Tsawwassen, 38% from Ladner, and the remaining 10% from other areas in Delta.

FINDING #1: INCREASED AWARENESS AND RELEVANCE OF CLIMATE CHANGE INFO IN THE COMMUNITY

The most statistically-significant findings concerned increases in respondent’s awareness about climate change. Overall, in the visualization sample, respondents’ awareness about the local impacts of global climate change and the types of response strategies required to reduce greenhouse gases increased in a statistically significant way after the treatment. 49% of respondents indicated that they had a good idea or a very good idea about GHG reductions preceding the treatment, compared to 81% after the treatment (Figure 10).
Similarly, in pre-testing, 32% of respondents indicated that they were either quite or very knowledgeable about the effects of climate change on their local area, compared with 81% following the visualization treatment—also a statistically-significant result (Figure 11).

**Figure 11: Pre and post understanding of local climate change impacts**
One respondent elaborated on this localizing influence, "I was somewhat aware of global warming impacts on Maldives and polar ice caps - this presentation placed my own community in that context." There was an increased awareness about climate change and its relevance at the local scale. One respondent noted, "I learned how climate change could affect my community in a very graphic way. Numbers may not stay with me but visuals will." Increasing awareness is a powerful way to begin building a climate change constituency in the community.

Through the presentation, alternative response strategies were made clearer through the scenario depictions. One respondent noted; "It helped me to see differentiation between containing impact by adaptation vs. mitigation". The scenarios and the localizing influence of the visualizations also contributed to a statistically-significant increase in the number of respondents who said they understood what their family needs to do to adapt to the risks of climate change, thus helping develop awareness and capacity among the public. 83% of respondents indicated in the pre-test that they either agreed or strongly agreed that they understood how they and their families could adapt to climate change, while following the visualization treatment, 98% of participants responded similarly (figure 12).

![I understand how my family and I can adapt to climate change](image)

Figure 12. Pre and post understanding of family responses to climate change risks

It should be noted that the participants generally considered themselves to be reasonably knowledgeable about climate change and GHG reductions before seeing the presentation.
**Finding #2: Increased Concern about the Impacts of Climate Change**

Respondent’s level of concern about the effects of climate change in the local community increased in a manner just outside of a statistically significant result ($P_{0.05}=0.07$) (Figure 13).

![Figure 13](image)

*Figure 13. Increasing levels of concern about the local impacts of climate change.*

Again, levels of concern were already very high among participants, perhaps due to flooding of neighbourhoods in 2006. There was a small but not statistically significant change in the community assessment of when climate change will start having serious impacts on people in their community. Respondents generally felt that impacts would occur either 20 years from now (39% of respondents before, 36% after), or are occurring already (39% of respondents before, 48% after).

When asked how climate change made them feel, negative emotions such as sadness, concern, anger or frustration were the most common responses. Viewing the visualization presentation appears to have increased some of these feelings, and reduced others (table 1 below).
Table 1: Responses to the question “How does climate change make you feel” in the visualization group, pre-and post-treatment.

<table>
<thead>
<tr>
<th>Positive Feelings</th>
<th># of Pre-test responses</th>
<th># of post-test responses</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivated</td>
<td>1</td>
<td>2</td>
<td>33%</td>
</tr>
<tr>
<td>An urgency to act</td>
<td>2</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>Hopeful for change</td>
<td>1</td>
<td>3</td>
<td>50%</td>
</tr>
<tr>
<td>Optimism</td>
<td>1</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Excitement to improve situation</td>
<td>1</td>
<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>Compassion</td>
<td>1</td>
<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>The need to make changes to lifestyle</td>
<td>0</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>Need for cooperation</td>
<td>0</td>
<td>1</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negative Feelings</th>
<th># of Pre-test responses</th>
<th># of post-test responses</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td>3</td>
<td>4</td>
<td>14%</td>
</tr>
<tr>
<td>Rage</td>
<td>1</td>
<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>Frustration</td>
<td>3</td>
<td>4</td>
<td>14%</td>
</tr>
<tr>
<td>Anxiety / Worry</td>
<td>2</td>
<td>1</td>
<td>-33%</td>
</tr>
<tr>
<td>Fear</td>
<td>1</td>
<td>2</td>
<td>33%</td>
</tr>
<tr>
<td>Concern re: response</td>
<td>5</td>
<td>6</td>
<td>9%</td>
</tr>
<tr>
<td>Hopelessness</td>
<td>2</td>
<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>Helplessness</td>
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<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>Loss</td>
<td>1</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Depression</td>
<td>1</td>
<td>0</td>
<td>-100%</td>
</tr>
<tr>
<td>Guilt</td>
<td>1</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Shame</td>
<td>0</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>Sadness</td>
<td>5</td>
<td>3</td>
<td>-25%</td>
</tr>
<tr>
<td>Skepticism</td>
<td>0</td>
<td>1</td>
<td>100%</td>
</tr>
</tbody>
</table>

**FINDING #3: INCREASE IN EMPOWERMENT TO ACT ON CLIMATE CHANGE**

When asked which scenarios applied to Delta, 60% of respondents felt that Delta was currently in a World 2 situation (primarily adaptation activity), while 70% felt Delta should be striving for World 4 (high mitigation and adaptation, with a radical shift in societal values allowing large reductions in carbon emissions). As well, there was a statistically significant increase in the number of respondents who said that they believed that their actions can reduce climate change impacts, from 45% to 68% saying “yes” unequivocally (Figure 14).
This was accompanied by a desire to take personal action. Qualitative responses were classified into eight key action areas during content analysis: 1) transportation energy reductions, 2) education, 3) household energy reductions, 4) buy local and organic, 5) waste reduction, 6) alternative energy, 7) development and planning, and 8) other responses.

The most commonly suggested actions included reducing energy use, particularly as it relates to transportation; driving less, walking or biking more, using public transit, and carpooling. Materials reduction via recycling was listed as a way to reduce overall carbon footprints, along with buying local. While not considered direct climate change actions, recycling, over the long term, reduces materials waste going to landfills and incinerators. In addition, recycling and buying locally has the potential to reduce the overall energy used (and carbon emitted) in the per capita primary production of goods and transportation over the long term. It is unclear whether these people fully understood this relationship between climate change and recycling, or were simply responding with actions generally considered to be “green.” Further study would be needed to answer this.
3.3.2 Visualization versus Non-Visualization Groups

The respondents in the non-visualization group were 30% male and 70% female. 35% of respondents were over age 60, with 20% between 50 and 60, 25% between 40 and 50, 14% between 30 and 40, and 4% between 20 and 30. The vast majority (87%) had completed some post-secondary education, with 26% holding graduate degrees. Respondents most often reported their income to be in the $40,000-$80,000 range (46%), with 24% in the $20,000-$40,000 range. Respondents most often reported that they were retired (32%). 90% of respondents lived in Delta, and of these, 52% were from Tsawwassen, 36% from Ladner, and the remaining 12% from other areas in Delta.

Analysis conducted comparing the demographics of the visualization and non-visualization samples revealed no statistically significant differences in the demographics of the two samples. As such, a comparison can be made between the outcomes in the two samples.

Finding #4: Imagery can help to build understanding and capacity

Participant observation of both the visualization and non-visualization groups during the presentation revealed the visualization group participants to be more engaged than their non-visualization counterparts. When asked whether or not the presentation had taught them anything new about climate change, 29% of the visualization group reported that they had learned a great deal, compared to only 8% of the non-visualization group (Figure 14), although a statistically significant difference was not found between the two groups.
Results indicated that following the visualization treatment, 81% of respondents felt quite or very knowledgeable about the effects of climate change on the local area, when compared to their non-visualization counterparts, of whom only 55% felt quite or very knowledgeable. This statistically-significant finding is especially important because one of the central goals of the project was to make a global and abstract concept, such as climate change, meaningful at the local level. For this reason, the content of the visualizations pertained mainly to familiar and iconic local spaces in Delta. 98% of respondents in the post-treatment visualization group also indicated an understanding of how their family can adapt to climate change after the presentation, compared to 76% of their non-visualization counterparts. This represents a key statistically-significant, important finding because, due to the domination of GHG reduction strategies in media and popular reporting on climate change, participants may not have been exposed to a wealth of information regarding adaptive strategies. The visualization package, given the importance of issues such as sea-level rise in Delta, provided new information about alternative adaptation strategies.
Two critical findings show that while not statistically-significant, participants who received the full visualization treatment were much more willing to support local measures to adapt to climate change and to mitigate the problem through GHG reduction. Among the visualization group, 89% of respondents stated their willingness to support local adaptation measures had increased a lot, whereas only 18% of non-visualization respondents said the same (Figure 15).

![Chart showing willingness to support local adaptation measures]

**Figure 15: Change in willingness to support local adaptation from visual and non-visual presentations**

Similarly, among the visualization group, 73% of respondents indicated that their willingness to support local measures to mitigate climate change had increased (after the presentation) either somewhat or a lot. This varied substantially from the 59% of respondents in the non-visualization group who responded similarly (Figure 16).
Figure 16. Change in willingness to support local mitigation from visual and non-visual presentations.

The suggestion is that visualizations can be more effective at building a constituency for climate change at the community scale.

**FINDING #5: VISUALIZATIONS INSPIRE THE NEED FOR ACTION**

Participants from the visualization group were statistically-significantly more likely to accept personal responsibility for acting. 74% of the visualization group participants indicated that they were more motivated to do something about climate change, whereas only 56% of the non-visualization sample said this (Figure 17).
What this illustrates is that respondents from the visualization group were affected in such a way as to increase their desire to respond to climate change on an individual level. It should be noted however that the presentation focused primarily on community scale responses. One of the shortfalls of the presentation and the project at large is that it was not able to address in detail individual actions in each of the four world scenarios. Yet it appears the understanding that individuals are accountable was either conveyed in the presentation or was already understood.

3.3.3 Delta Staff
A workshop was held with 14 Delta engineering and planning staff. Participants were exposed to the presentation and then split into four working groups. A facilitator in each of the four groups asked two questions: First, whether further policy changes addressing climate change are advisable in Delta and what the priority policy changes should be; second, have staff opinions on policy changes been affected
by the visioning process or visualizations? Responses were organized into 1) Delta staff’s top priorities for policy initiatives and 2) effects of the visualizations on Delta staff.

1) Delta Staff’s Top Priorities for Policy Initiatives

A) Land-use planning

a. A local community climate change plan is needed for Delta with indicators and regular monitoring.

b. Sustainable land use is required to support climate change action; including densification (multi-use buildings, different housing forms, etc.), planning for live-work relationships (community economic development, etc.), and more efficient use of land (e.g. community gardens) and infrastructure.

c. Better understanding is needed among staff of Delta’s current commitment to climate change and climate policies (e.g. energy efficiency in capital projects).

d. Development of community alternative energy systems is needed.

e. Better integration between different groups of Delta staff is needed to develop comprehensive policy.

B) Financial commitment

a. A commitment is required to achieving climate change targets and plans that factor in the triple bottom line, not just economic bottom line.

b. Need for a real capital plan to commit to policy changes related to climate change (extended 10 years).

C) Education

a. Improved public education and engagement with residents and developers (e.g. cost implications to changes in resident’s home) is needed, with direct assistance provided to residents.

b. Need for demonstration projects (e.g. green roofs, lighting and heating alternatives, community gardens, etc.).
2) Effects of the Visualizations on Delta Staff

There were three main findings about how the presentation and the visualizations influenced staff participants. First, it provided a comprehensive synthesis using imagery; second, it generally increased the staff’s interest in and concern for climate change effects in the community; and third, a number of participants stated they did not experience major effects from the visualizations because they were already informed, but that it would be valuable in the public context.

A number of participants stated that the visualizations helped to synthesize the issues, including varied types of impacts and response options. One participant noted: “my opinions have changed, not because the images showed me something I didn’t realize (i.e. it will flood), but more seeing what the effects of the decisions we make look like (i.e. land-use planning)... Seeing Delta warming was very real, not just global warming.” Another participant noted, “Visualization helps immensely. There is nothing like imagery to drive the point home. You look at the image to see how to change it.” Still another suggested that, “talking to the public about changes could incorporate visualizations into the rationale”. There was some concern over the land-use planning series that showed single-family housing expanding onto the agricultural land reserve (ALR), with one participant stating, “I just can’t imagine it happening. It would require policy changes, etc.” This suggests that visualizations may be an effective way to promote discussion and debate, though local input to selection of imagery is vital.

3.3.4 Additional Comments on the Visioning Process

Participants in both the public and professional groups commented that the visioning process needed more information on costs and feasibility of response options, improved modeling of certain key variables such as economics and carbon emissions, and in some cases greater realism of the visualizations in representing impacts of climate change more accurately, e.g. More intense storms and waves. Other suggestions made were to try presenting this information to other communities in Delta, e.g. different resident groups in North Delta, who may have different levels of pre-existing concern.
4. **DISCUSSION: IMPLICATIONS FOR CLIMATE CHANGE PLANNING IN DELTA**

In general, the Local Climate Change Visioning process resulted in an increased awareness of climate change as a local issue, and of local adaptation and mitigation actions that could be taken to address it. The visioning process generally resulted in an increased concern and desire to take action to address climate change, as well as increased support for local mitigation and adaptation policies in principle. A workshop with Delta staff identified top priorities for further climate change planning in the municipality, and verified that the imagery would be useful in communicating impacts to the public and increasing awareness and sense of urgency.

The following sections draw on these results and also further follow-on research in 2008-2009 (funded by GEOIDE and BC Ministry of Environment). The goals of this ongoing research include liaison with Delta staff re: flood management policies; preliminary assessment of adaptation and mitigation strategies and planning approaches; policy recommendations on adaptation and mitigation options; and recommendations regarding Delta’s future research needs.

4.1 **ADDRESSING BARRIERS TO SOCIAL AND BEHAVIOUR CHANGE**

The literature suggests that a variety of barriers generally exist with regard to social and behaviour change in climate change planning. Institutional barriers also exist (Burch, 2008), but social and perceptual barriers are focused on in this section. These typically include the difficulty in communicating the urgency of climate change (Moser and Dilling, 2004); a perceived lack of money and time to make the necessary changes; a fatalistic belief that climate change is simply too large a problem to handle; a lack of public support for adaptive and mitigative government-led actions; and concern over how one’s behaviour would be perceived by others (Semenza et. al, 2008).

In Delta, however, the recent incidence and high profile of flooding in the Beach Grove and Boundary Bay communities, together with the release of Al Gore’s “An Inconvenient Truth” (which hit theatres months prior to the testing sessions), and other climate change studies conducted in Delta (Hill, 2006), seemed to evoke different feelings, at least among the people who showed up to public events, who already had high levels of concern and a desire for more action. Many participants stated that the local visioning presentation supplemented this information by focusing on specific and local impacts. The LCCVP itself and attendant publicity may also have had an influence on public awareness and council, as described by Mayor Lois Jackson, quoted in *Climate Wire* Magazine: “A picture says a
thousand words, as they say. We saw this and said, 'OK, we have to start planning'' (Friedman, 2008). In particular, it is hoped that the visualizations have helped some people over the barrier of not knowing what action should be taken, at a collective level.

The LCCVP was designed specifically to address these kinds of barriers. In the overall study sample, individual’s awareness and emotional engagement regarding climate change impacts and local response options increased after the presentation. Participants’ desire to take individual action also increased. Thus, individuals appeared to be influenced in all these dimensions during the presentation. It should be mentioned however, that the intent to change behaviour was self-reported and no systematic follow up on actual behaviour change or policy change lobbying has yet been possible. Further research is necessary to confirm this influence.

It is worth noting a key issue that may have influenced these results. It is suspected that despite efforts to attract a broad and diverse sample in Delta, a self-selection process occurred among citizens interested in climate change information. The choice of south Delta, as a case study area located in the Fraser River floodplain, is a vulnerable area in the Lower Mainland. The incidence of storm surge and river flooding events in the recent past has heightened the awareness to issues of climate change and increased vulnerability among the population. These events were likely a driver for people to seek out more information on climate change at the local level. It would be interesting to see if a similar response would be received from other floodplain Delta communities with different socio-economic characteristics, e.g. North Delta neighbourhoods.

4.2 IMPLICATIONS FOR PLANNING AND POLICY CHANGE

In terms of planning implications, the visioning process revealed high levels of concern and appears to make people more likely to support action on adaptation or mitigation, as outlined in section 3.3.2. This finding has significance to local planning processes, as an informed and supportive public enables and encourages decision-makers to act, addressing another common barrier to action (a perceived lack of public support). Similarly, the ability to build a constituency for change could help to address concerns around the perception of actions by others in the community. As a critical mass of community members taking action on climate change grows, such actions may become social norms, just as driving an SUV has become a social norm in the last few decades. The process could be very useful in identifying key enabling actions or policy changes to be undertaken by the Corporation, in supporting personal and community behaviour change.
The process is designed to test out a range of possible solutions to climate change, and could therefore help identify sensitive issues and explore popular or unpopular design/policy alternatives (e.g. raising sea-walls versus creating a berm on previously private property). Such work needs to be carefully thought through and defensibly carried out; this brings up the importance of visualization ethics (see Sheppard, 2005) and the importance of a participatory process to produce the visualizations used in public engagement. The goal should be to enhance public understanding and perhaps increase willingness to consider needed climate change responses for the greater public good, before these go to formal public review or implementation. For example, the raising of sea walls in Beach Grove has historically been opposed by local residents, but in the visioning sessions, discussion quickly turned to adaptation options with raised sea-walls, including building more decks in back-yards to retain the view of Boundary Bay.

This degree of influence also suggests that a visioning approach may be useful in:

- Enhancing community-based social marketing tools such as pledges or other personal commitments, prompts, incentives and disincentives (see McKenzie Mohr, 1999).

- Setting community carbon emission targets and adaptation priorities.

- Testing specific policy options for the OCP, Local Area Plans, achieving Bill 27 GHG reduction targets, or proposed bylaws.

It is suspected that coupled with existing planning processes or design charrettes, the participatory nature of the visioning process could help to build a sense of local ownership over climate actions and create a more supportive public, although this hypothesis has yet to be tested.

Delta is acknowledged as a leader in the adaptation field in BC, both within and outside the community. Still needed though, is a more holistic energy and climate action plan that links to traditional land-use planning processes and addresses mitigation at a community scale, without jeopardizing adaptation priorities. This would go beyond Delta’s Partners for Climate Protection GHG inventory work to date, and build on the Pembina report recommendations (on energy efficiency policies for buildings in Delta) (Bailie et. al., 2009), with: 1) spatial allocations of mitigation measures across the community, including both new or infill development and 2) an enabling retrofit policy and incentives to reduce emissions from the current built development. The sampled public suggested that they wish to see a transition in Delta to a low-carbon resilient condition like World 4. This desire is
consistent with BC policy and the upcoming Bill 27 OCP requirements for GHG reduction targets, policies and actions.

4.3 APPLICATION TO FLOOD MANAGEMENT STRATEGY

The Corporation of Delta’s Flood Management Strategy work plan (Corporation of Delta, 2008b) outlined 9 guiding principles to meet Delta’s current and future flood protection challenges. A visioning process could be of assistance in the implementation of a number of these principles, as follows:

Principle 2: Analyze the specific risks and consequences related to the flood design levels in each community and, if appropriate, make adjustments for a more conservative return-period based on the findings of such an analysis.

Once the flood risk/consequence study is completed, if it is deemed necessary to invest more than is currently planned in flood prevention strategies, then a visioning process could help to communicate the relative levels of risk and other pros and cons to the public, and build understanding and support for these investments. The effects of climate change in terms of sea level rise, Fraser River flood risk, and precipitation intensity should also be integrated explicitly into the flood risk-consequence analysis, and this critical work has been proposed for pending funding.

This task presents an opportunity to meet the expressed desire of the Delta public in providing more detailed quantifications of cost, feasibility, etc. for various scenarios or design variations in responding to flood threats (e.g. alternative flood construction levels, coastal protection structures, building foundation designs, etc.).

Principle 5: Explicitly consider the potential impacts of climate change over 20, 50, and 100-year time frames in flood protection planning.

The LCCVP used the same time horizons in its framework and visualizations. Thus, the outputs (both visualizations and data) are very applicable to the flood management strategy’s flood protection planning. Updated studies (such as recent higher sea level rise estimates by Bornhold, 2008) should be incorporated into previous work and used to inform future planning decisions.

Principle 8: Seek provincial and federal support for an incremental upgrading program.
The compelling nature of local data and visual graphics could be used to the Corporation’s advantage in securing resources. The visuals could help to communicate the significant degree of risk (perhaps taken from the outputs of the flood risk/consequence studies?) as part of funding proposals and may significantly strengthen the Corporation’s bid.

**Principle 9:** *Educate the public about flood risks and adequately plan for emergencies.*

As presented by this report, visioning processes are effective in increasing awareness and knowledge of the risk of flooding from sea level rise, and the consequences of adaptation. There are many possibilities for a visioning approach to be incorporated into existing emergency preparedness or other outreach programs as a communications and capacity-building tool. Possibilities exist for interactive flood risk mapping and other forms of outreach and visual communication to convey the risks and options more clearly. In addition, scenarios can be used to explain and explore the trade-offs and linkages between flood management activities and other land use or climate change mitigation plans (e.g. retrofitting neighbourhoods to meet Delta’s GHG reduction targets).

In addition to supporting many of the guiding principles in the work plan, the local, downscaled data may be useful in the preparation of Area Flood Protection Plans for local neighbourhoods in Delta. The visioning approach could be adapted to any public process associated with these plans, and other planning processes such as area plan reviews and the development of new bylaws (at the very least, as a communications tool at public workshops, but ideally as part of an integral, longer-term engagement strategy with a core working group of stakeholders and staff exploring different adaptation and mitigation scenarios). When used in this way, the possibility for a constituency supportive of change exists, that might in turn make it easier for Mayor and Council to pass new bylaws and policies developed by staff in an efficient manner, in a form acceptable to an informed community.

### 4.4 Adaptation & Mitigation Interactions

Any adaptation action taken will have varying degrees of associated emissions impacts. If not coordinated at the outset, there are indications that adaptation strategies could have adverse side effects (Adger et al., 2005), such as the emissions caused by initiating and maintaining dikes, flood pumping, air conditioning, etc. A holistic process is required to address this interaction, perhaps as part of ongoing community-scale planning processes such as OCP or Area Plan reviews. Neighbourhood scale mitigation/retrofit strategies may provide opportunities for cost-sharing or implementation of
adaptation strategies, or vice-versa. One possible approach would be to use a decision-support framework such as that presented in Table 2 to systematically evaluate and prioritize adaptation/mitigation options.

In this framework, public support could be evaluated using a participatory process and visualizations. The Carbon Cost / Benefit can be seen as contributions to meeting Delta’s GHG reduction targets. Future modifications to this matrix could include classification of carbon costs as embodied (one-time), or ongoing, and a column on public acceptability (based on research results from the LCCVP). The examples addressed to date do not focus on ecological or other kinds of responses. This table in its current form is incomplete and for discussion purposes only – more research, including cross-case comparisons using credible sources is needed to provide a more accurate decision-support tool.
<table>
<thead>
<tr>
<th><strong>Response</strong> (A = Adaptation, M = Mitigation, (G) = general resilience to various impacts)</th>
<th><strong>Ease of implementation</strong></th>
<th><strong>Carbon Cost/Benefit</strong></th>
<th><strong>Planning Horizon</strong></th>
<th><strong>Total Score</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost to CoD</strong></td>
<td>Public Support (** = high)</td>
<td>(− = negative carbon impact, + = positive carbon impact)</td>
<td>(S = short, M = medium, L = long)</td>
<td>(sum of all scores)</td>
</tr>
<tr>
<td><strong>Engineering/Design Solutions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raise and strengthen sea and internal dykes A</td>
<td>$$$</td>
<td>-3 ***</td>
<td>3 -</td>
<td>-3 S</td>
</tr>
<tr>
<td>Strengthen &amp; upgrade pumping stations A</td>
<td>$$$</td>
<td>-3 ***</td>
<td>3 -</td>
<td>-3 S</td>
</tr>
<tr>
<td>Build seawall A</td>
<td>$$$</td>
<td>-3 **</td>
<td>2 -</td>
<td>-3 S</td>
</tr>
<tr>
<td>Biomass plantations for energy production M/G</td>
<td>$</td>
<td>-2 **</td>
<td>2 neutral</td>
<td>0 M</td>
</tr>
<tr>
<td>Fill to raise construction areas &amp; roads to FCL A</td>
<td>$</td>
<td>-2 **</td>
<td>2 -</td>
<td>-3 M</td>
</tr>
<tr>
<td>Raise new houses in flooded areas on stilts A</td>
<td>$</td>
<td>-1 *</td>
<td>1 neutral</td>
<td>0 M</td>
</tr>
<tr>
<td>Offshore wave barrier A</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Coastal berm A</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Required Research</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study soil salinity A</td>
<td>$</td>
<td>-1 **</td>
<td>2 neutral</td>
<td>0 M</td>
</tr>
<tr>
<td><strong>Policy/Program Changes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retreat from vulnerable areas A</td>
<td>$</td>
<td>-2 *</td>
<td>1 neutral</td>
<td>0 L</td>
</tr>
<tr>
<td>Encourage/develop residential agriculture programs M/A/G</td>
<td>$</td>
<td>-1 *</td>
<td>1 +</td>
<td>3 M</td>
</tr>
<tr>
<td>Economic Development to increase local employment options and reduce commuting M/G</td>
<td>$</td>
<td>-1 ***</td>
<td>3 +</td>
<td>3 S</td>
</tr>
<tr>
<td>Mandate flood construction level at redevelopment/new development A</td>
<td>$</td>
<td>-1 **</td>
<td>2 neutral</td>
<td>0 S</td>
</tr>
<tr>
<td>Direct development to compact communities in low-risk areas M/A/G</td>
<td>$</td>
<td>-1 **</td>
<td>2 +</td>
<td>3 M</td>
</tr>
<tr>
<td>Support low-carbon retrofits of existing communities A/M/G</td>
<td>$</td>
<td>-1 ***</td>
<td>3 +</td>
<td>3 S</td>
</tr>
</tbody>
</table>

Table 2: Possible Decision Support Framework for evaluation of adaptation and mitigation options
5. **SUMMARY OF RECOMMENDATIONS FOR DELTA**

A number of recommendations for Delta arise from the findings described above:

1) Strengthen existing planning and outreach methods by incorporating proven visioning and visualization tools more systematically:
   
   a) Identify current resources for visioning in Delta, and undertake a training / capacity-building program to strengthen these resources in-house (e.g. planning & environment staff, GIS staff, communications staff, regular consultants, etc.)
   
   b) Consider the use of a visioning approach embedded in current and future planning processes, that incorporates multiple aspects of climate change, compelling visual tools, and a participatory process (e.g. working group), including but not limited to:
      
      a. Area Flood Protection Plans and adaptation initiatives such as seawall construction and dike improvements
      
      b. Area Plan review processes (e.g., Tsawwassen)
      
      c. Any future Agriculture Strategy
      
      d. Future Official Community Plan reviews and GHG target setting /achievement for Bill 27
   
   c) Consider the use of visualization tools/material in emergency preparedness planning and public communications programs
   
   d) Use current and forthcoming visualization materials to strengthen funding proposals for both adaptation and mitigation initiatives

2) Develop integrated and implementable plans and policies on climate change:
   
   a) Develop a more comprehensive Climate Change and Energy Action Plan for Delta (going beyond PCP steps 2-4), as the next step in Delta’s Climate Strategy. This would build on work begun by the Pembina Institute to identify and examine specific additional policy and regulatory barriers to local climate action more broadly (going beyond the focus on energy and emissions in the Pembina report).
Test ways of overcoming these barriers (through education, design alternatives, and community dialogue) assisted by participatory visioning techniques, incorporating the key actions identified as priorities by the study participants (on P. 22).

b) Take action to address these barriers through policy change. Some areas to consider include:

i. Maintain strong policies to protect and support the viability of local agriculture in an attempt to reduce the increasing dependence on non-local food sources and the GHG emissions associated with this dependence.

ii. Consider development of a program to encourage and catalyze urban agriculture at the parcel and block scale, to reduce the pressure on agricultural lands and in anticipation of declining productivity from agricultural soils due to salination

iii. Develop a strategy whereby the new powers granted by Bill 27 to dedicate Development Permit Areas for climate action can be used to mitigate against increasing GHG emissions, for both new development and retrofit of existing neighbourhoods. Use upcoming planning processes (e.g. the Tsawwassen Area Plan) as prototypes. Include consideration of new energy options, including use of waste heat and residue from farming for local energy systems, eco-industrial networks, etc.

c) Use a decision-support tool such as the matrix presented in Table 2 to assist in decision-making with respect to adaptation and mitigation actions.

5.1 Recommendations for Ongoing/Future Research

Given the history of collaboration between various researchers and scientific agencies with the Corporation in recent years, it would be valuable to continue these mutually beneficial partnerships and deepen research in certain key areas of data deficiency critical to Delta, as described below. Some of this work could occur within ongoing funded GEOIDE work and Regional Adaptation Collaborative (Natural Resources Canada) studies as follows:
A. **Fill Data Gaps**

Initiate studies with input from appropriate experts to fill key data gaps in future planning, e.g., soil salinity modeling with sea level rise; renewable energy potential modeling for farm/industry/residential areas; ecosystem adaptation planning; local urban food production and intensive cultivation feasibility; costs and feasibility of neighbourhood retrofits, building on recent charrettes and workshops (e.g. Sustainability by Design).

B. **Visualize Flood Risk in Delta**

Build on ongoing GEOIDE Phase IV work, dike breach studies conducted by previous consultants, and recently updated studies on sea level rise in the Delta region (Hill et. al, 2008) to provide more detailed and updated flood risk visuals from the LCCV project.

C. **Test Decision-Support Framework on a Case-Study Application to Planning**

Revise proposed decision-support framework for integrating mitigation and adaptation and apply to a planning process to determine its utility.

D. **Model Projected Carbon Emissions Based on Land Use & Increased Employment in Tsawwassen**

Modeling projected carbon emissions based on land uses identified in current plans and LCCVP scenarios, building on current GHG inventories and methods developed in other Lower Mainland communities by Cavens et al. This could firm up the carbon emissions estimated in the LCCVP project scenarios and provide a finer-resolution method of testing land use/neighborhood options and Bill 27 GHG target attainment in the OCP. Use population data & carbon modeling projections to estimate the number of local jobs needed to reduce out-commuting and mitigate carbon emissions. Spatialize this number in Delta under varying development scenarios (compact, current policy etc.) to 2D maps; apply this to the 3D build-out model of Delta, to update/refine the World 4 low-carbon scenarios preferred by participants.

E. **Extend Visioning Presentation to Other Parts of Delta**

Extend the visioning presentation to other Delta communities (e.g. North Delta), to provide Council and staff with more comprehensive information on opinions and priorities about climate change in other neighbourhoods, in relation to results obtained in South Delta. For example, are
concern levels for climate change lower elsewhere, or have recent economic conditions affected public priorities?

Further mining of the public’s and professional’s LCCV response results already obtained is also possible, to address questions and needs of Council, staff, and stakeholders arising from this report.
6. REFERENCES


Sheppard, S.R.J., and A. Shaw. (2007). Future visioning of local climate change scenarios:


Van de Kerkhof M. (2006). A dialogue approach to enhance learning for sustainability - a Dutch experiment with two participatory methods in the field of climate change. Integrated Assessment 6(4) 7-34

Note: Questionnaires and raw Frequency Tables available upon request.