Coastal Climate Change & Adaptation:

PART II – Evaluation/Exercises

Dan Lane, IOI-Canada,

Co-Director – C-Change (Canada)

Professor Emeritus,Telfer School of Management, University of Ottawa

Professeur associé, Université Sainte-Anne

Presentation to the 4th China- ASEAN Academy on Oceans Law & Governance, NISCSS Haikou, Hainan

PART II - Afternoon, November 13, 2018

*Coastal Climate Change & Adaptation - Outline

PART I - Afternoon

1. Introduction
2. Challenges for the 21st Century - Coastal Zones
3. Understanding Adaptation Needs - Profiling
4. Pillars of Sustainability - Reflecting Importance**

PART II

5. Assessing Vulnerabilities
6. Estimating Coastal Impacts
7. Adaptation Problem Solving and Strategy Options
8. Evaluating Decisions**
9. Climate Change Governance

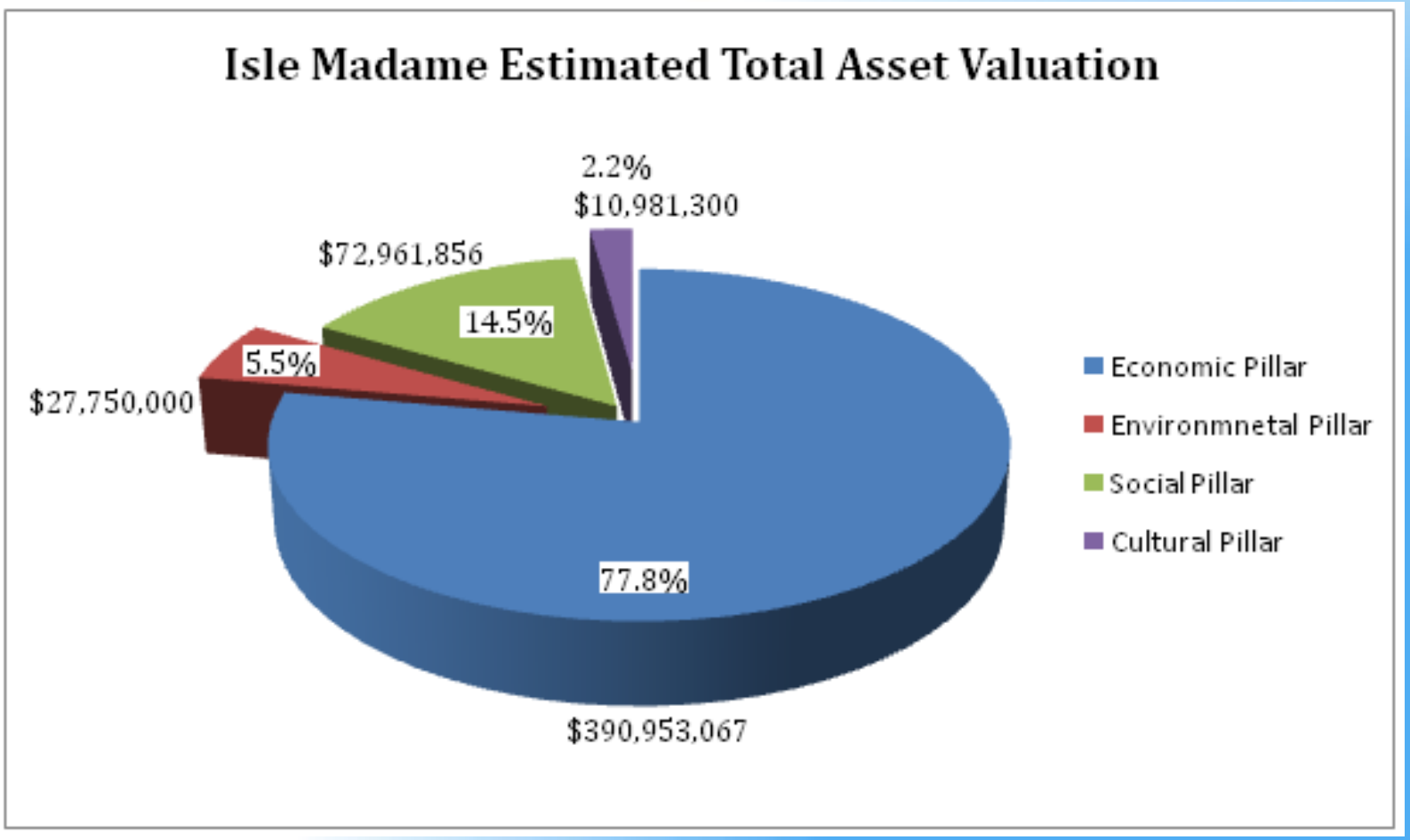
**Class Assignment

*5. Assessing Vulnerabilities

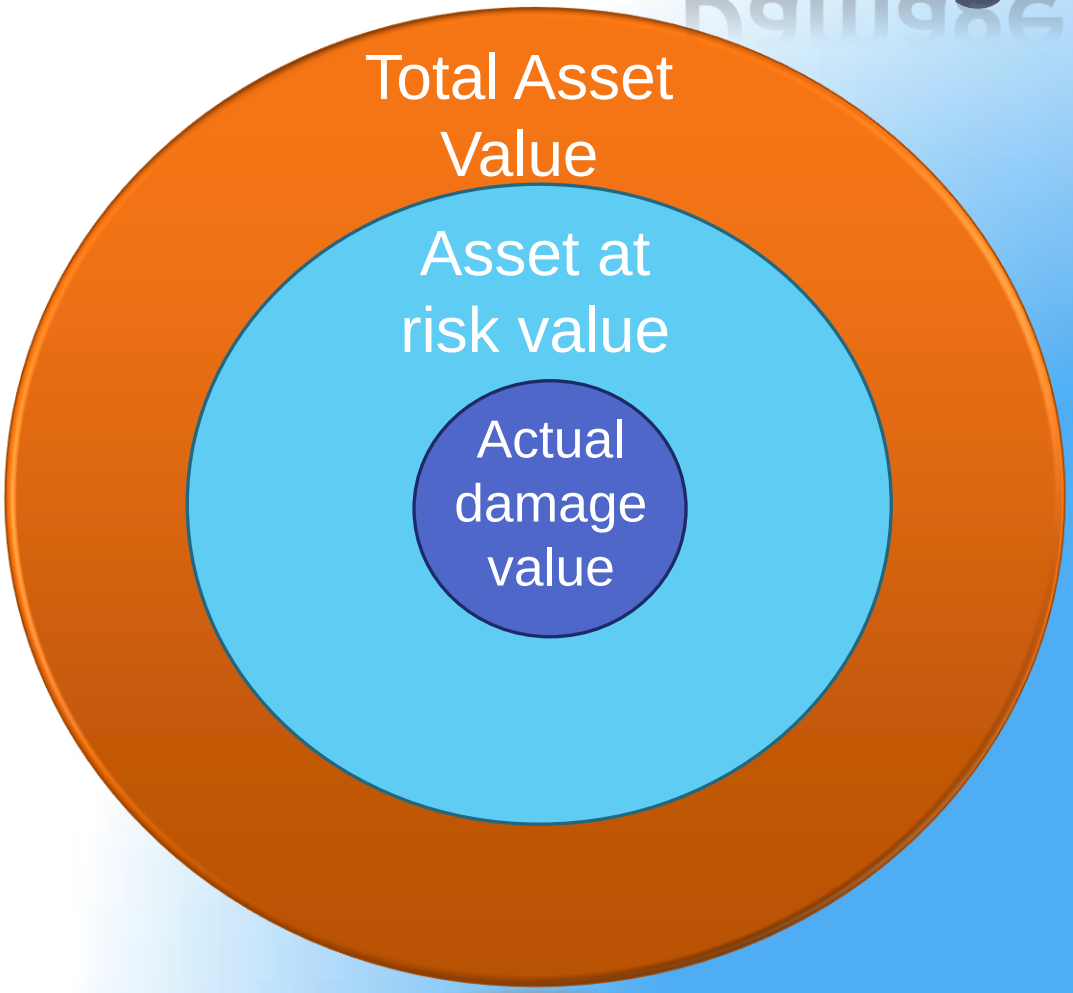
Source: Wikipedia

Name	Dates active	Sustain wind speeds	Pressure (hPa)	Areas affected	Damage (USD)	Deaths
Maria (Gardo)	July 3 – 12	195 km/h (120 mph)	915	Mariana Islands, Ryukyu Islands, Taiwan, E China	$490 m	2
Jongdari	July 23 – August 4	140 km/h (85 mph)	960	Japan, East China	>$1.46 b	0
Mangkhut (Ompong)	September 6 – 17	205 km/h (125 mph)	905	Marshall Islands, Mariana Islands, Taiwan, Philippines, Hong Kong, Macau, South China, Vietnam	>$2.52 b	>134
Kong-rey (Queenie)	September 28 – October 6	195 km/h (120 mph)	915	Caroline Islands, Mariana Islands, Japan, Taiwan, Korean Peninsula, Alaska	$155 m	3
Yutu (Rosita)	October 21 – November 3	215 km/h (130 mph)	905	Caroline Islands, Mariana Islands, Philippines, South China, Taiwan	$7.5 m	18

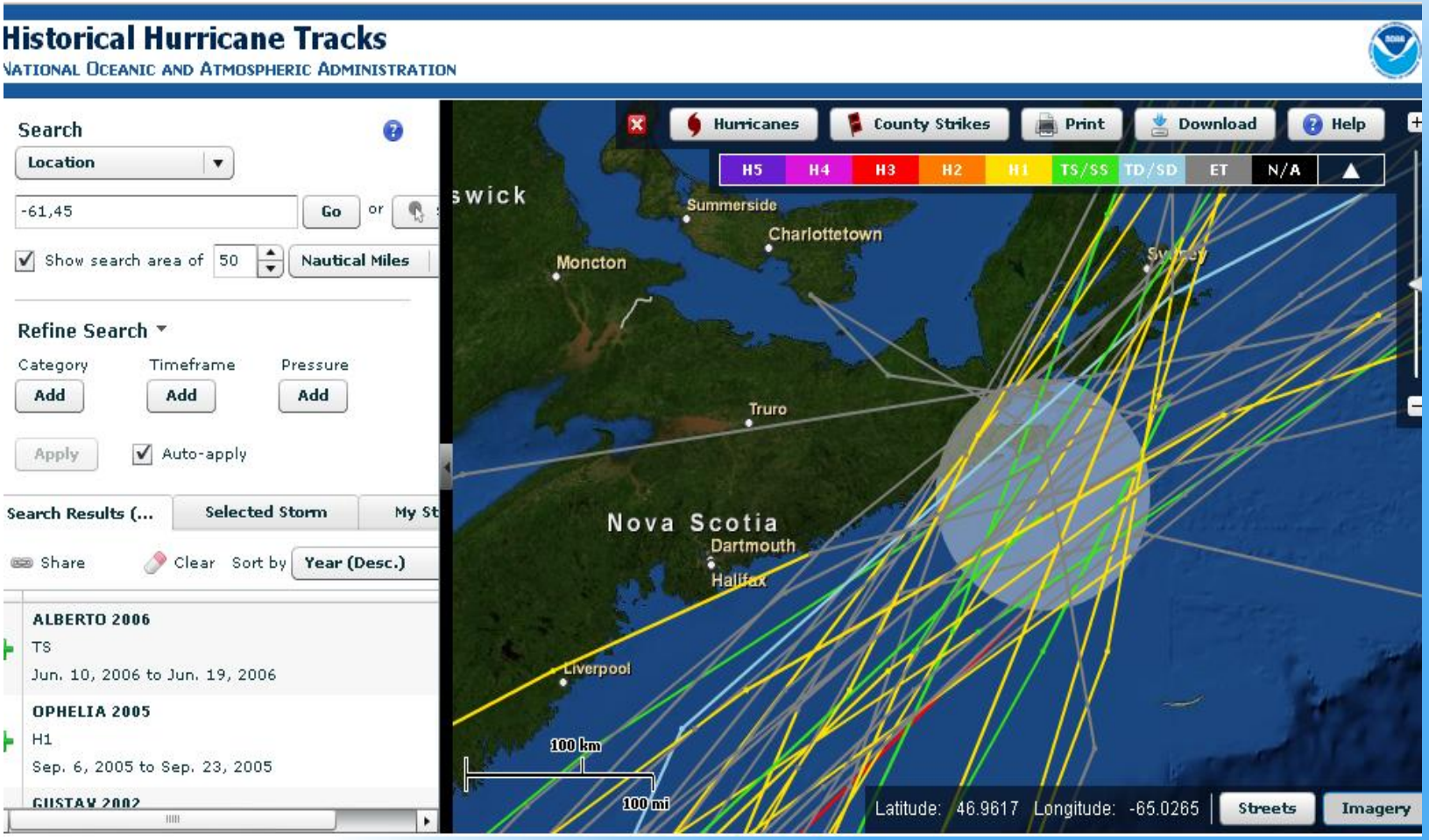
* Isle Madame Asset (Pakdel 2011)



*Asset - At-Risk Assessment-Damage Model



*Isle Madame Storms Review



2. Assessing Vulnerability Premium Crab plant - Jan 2, 2010 “No Name” storm

Source:
www.coastalchange.ca
Gallery

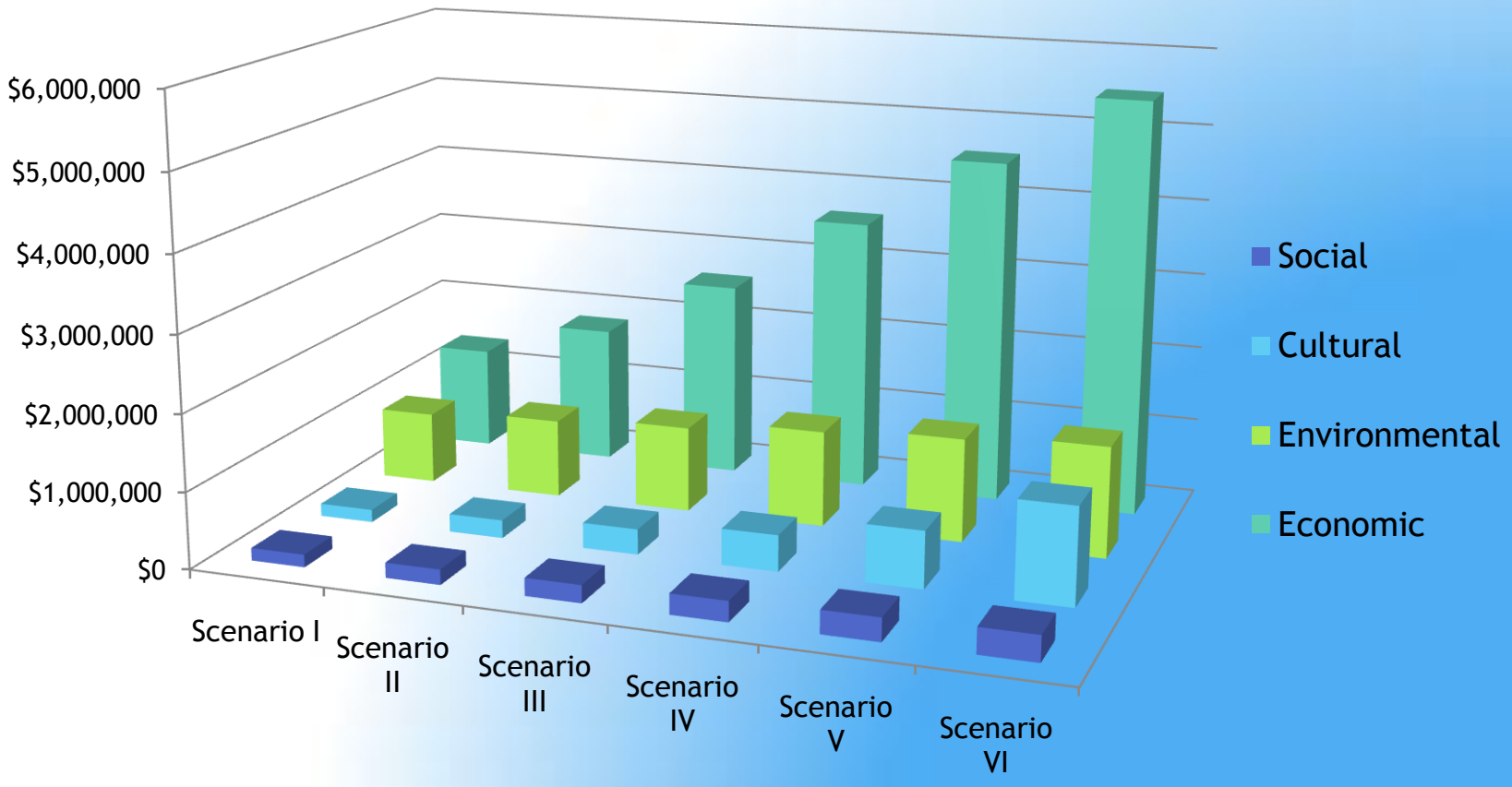
Hoi An flooding - Typhoon Damrey

- Vietnam's death toll from Typhoon Damrey rises to 61, with heavy damage to more than 80,000 homes and roads. Hoi An is one of the cities seriously affected, but authorities say the coming Asia Pacific Economic Cooperation (APEC) summit of the region's leaders will not be disrupted.
- Video: https://www.scmp.com/video/asia/2118740/vietnam s-historic-hoi-flooded-typhoon-death-toll-rises (South China Morning Post, Nov 2017)

*Hoi An, Vietnam Flood Map

*6. Estimating Coastal Impacts

Isle Madame
Total Estimated Damage Costs for Storm Scenarios I-VI

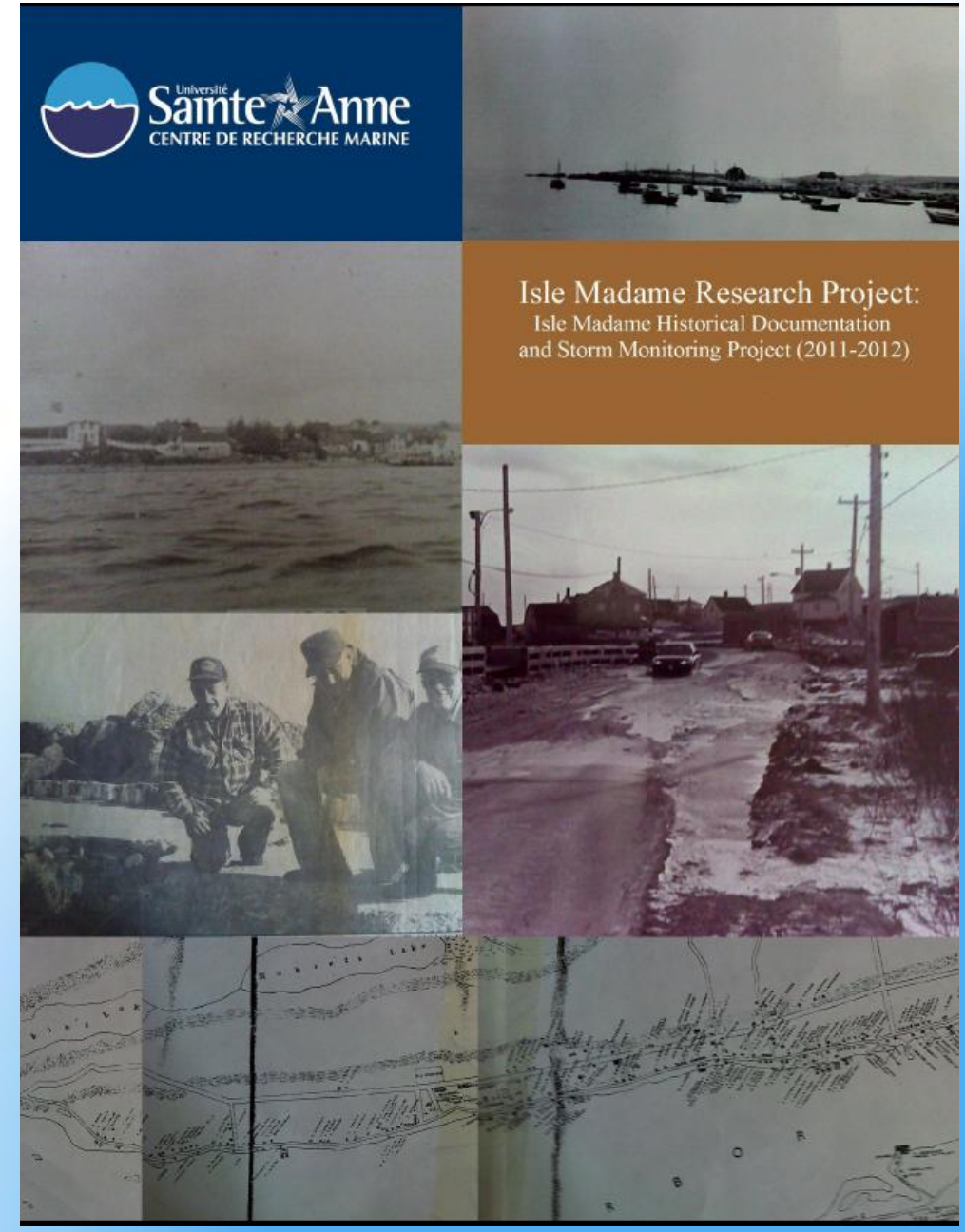


Université Sainte-Anne

Isle Madame Vulnerability Report

Report Prepared by:

Aleasha (Boudreau) David,
Recherchiste,
Centre de recherche marine
and
Michelle Thériault,
Coordinatrice,
Centre de recherche marine



*Discuss

1) What are the impacts of Typhoon Damprey on Hoi An?

1) How can the costs of the impacts be determined?

1) How can the impacts of future typhoons be avoided or lessened?

* Adaptation Strategy Options (Pilkey & Young 2009)

(Photo: suburbanbloke/Flickr)

1. Protect

Hard armouring (sea walls, groins)

Soft armouring (mangroves, wetlands)

- No changes to buildings or use
- Costly - Requires expert design, needs periodic maintenance and upgrading

2. Accommodate

Continued use of lands / structures, with some changes

- Low costs / Low regrets
- No costs / No regrets (mangroves)

3. Retreat

Accept flooding and damage will occur

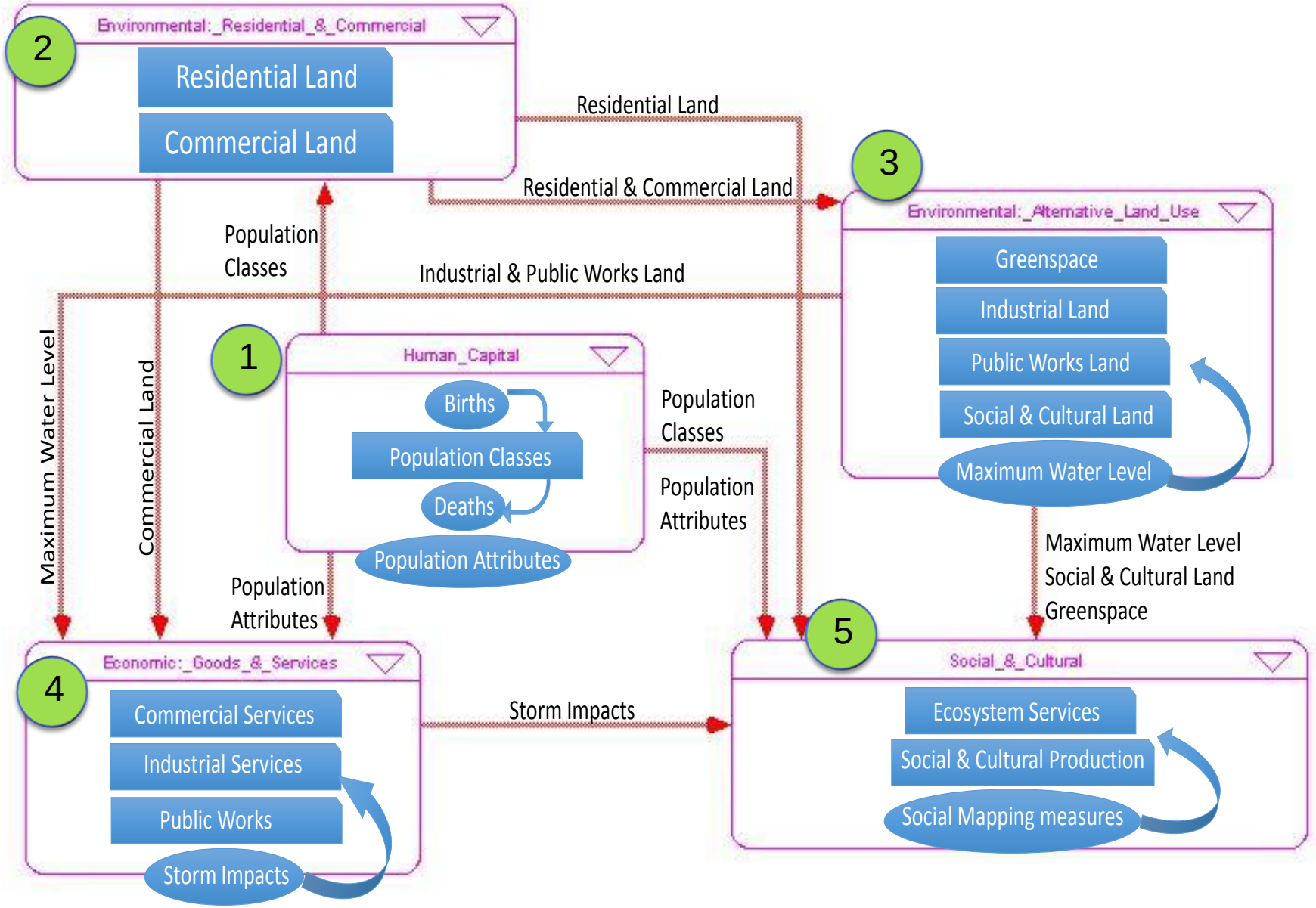
- Protect/accommodate not feasible
- Change uses, move structures

4. Do Nothing

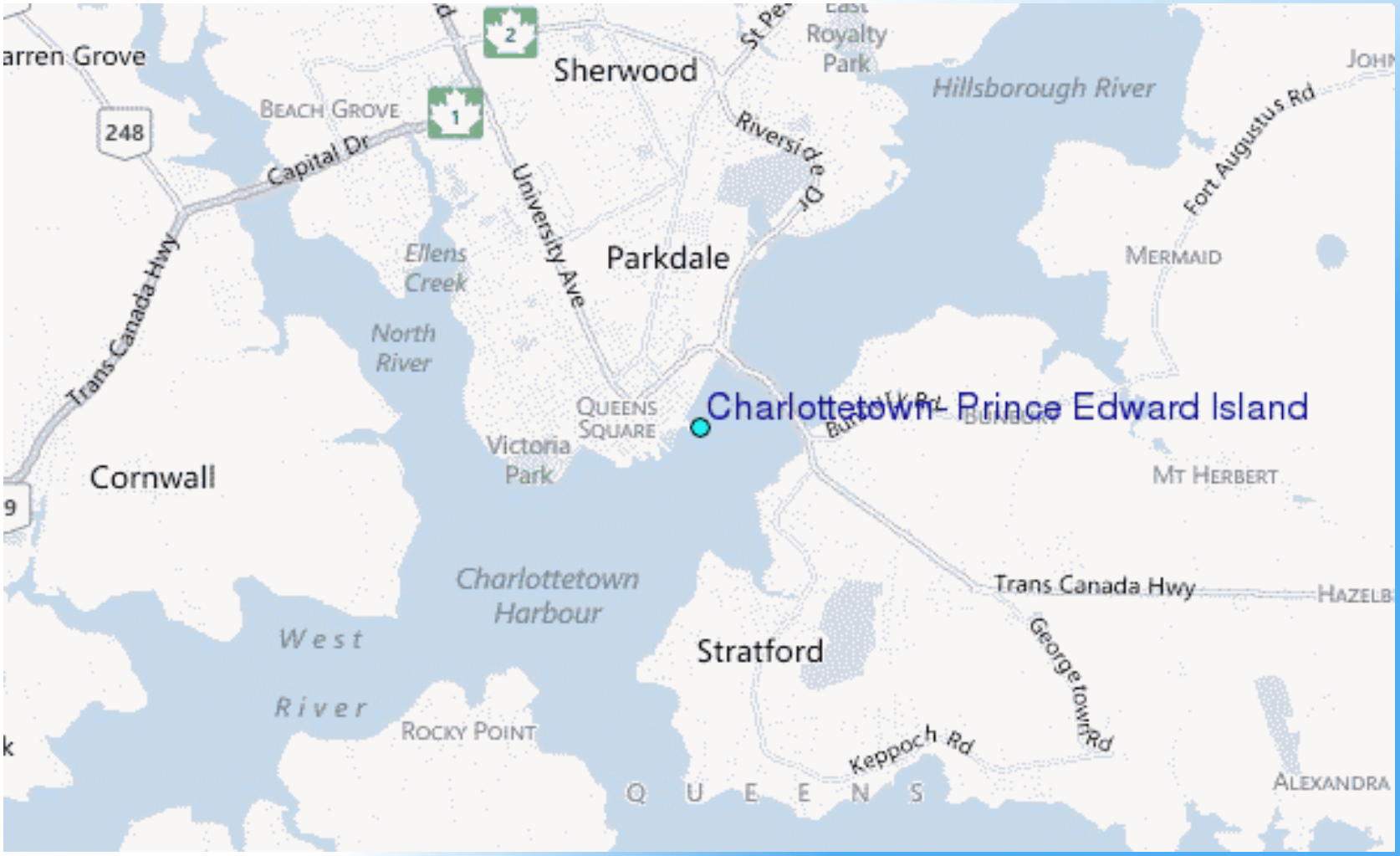
Strategic Systems Simulation

- Development of specific adaptation strategies
  - Protect, Accommodate, Retreat, Status Quo (Do Nothing)
- Application of Static and/or System Dynamics model
- Pillars of Sustainability/Community Preference
  - Environmental, Economic, Social & Cultural
- Adaptation strategy evaluation indicators
  - Vulnerability, Resilience, Adaptive Capacity

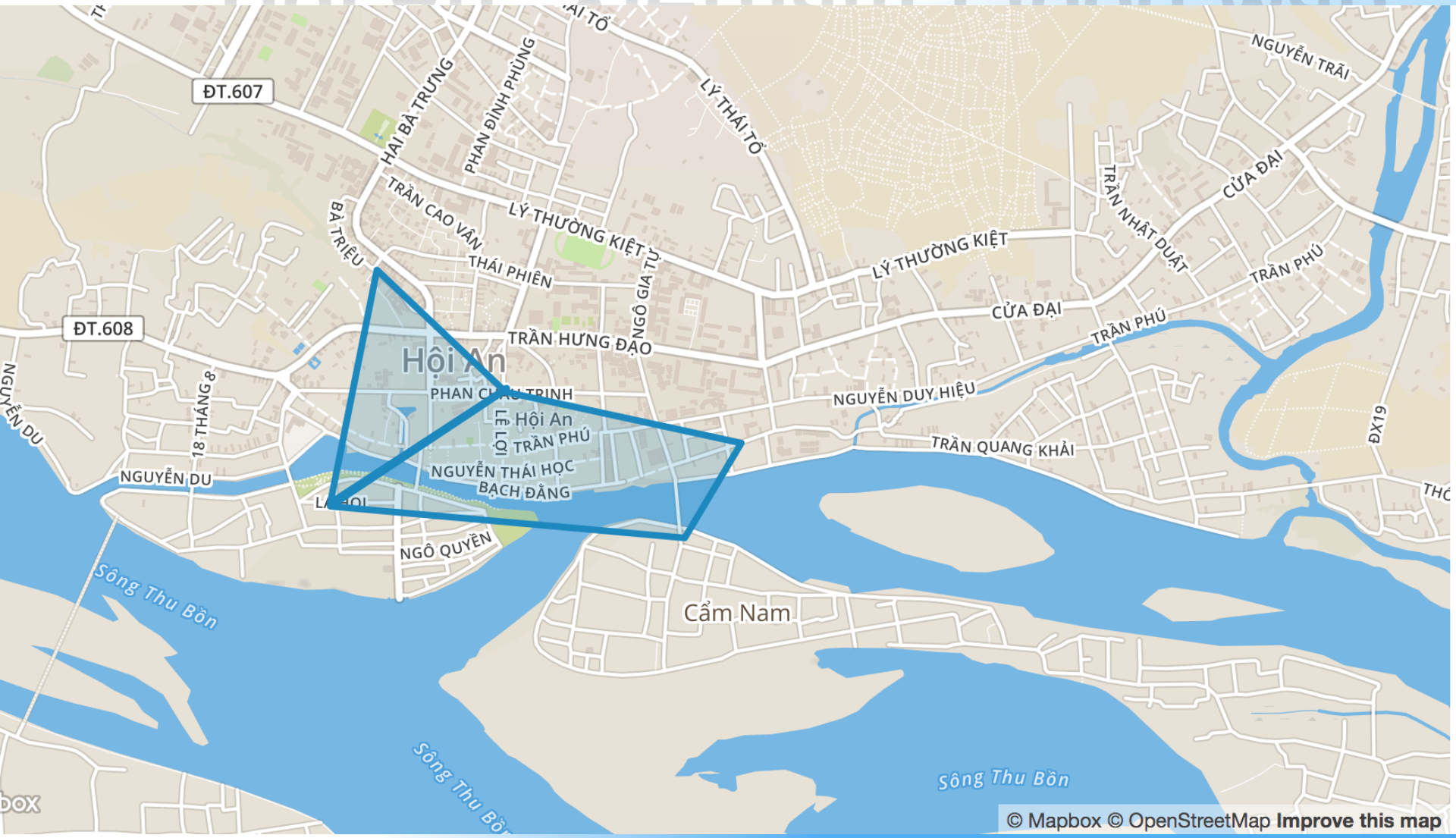
*7. Adaptation Problem Solving and Strategy Options


2
Environmental:_Residential_&_Commercial
Residential Land
Commercial Land
Residential Land
Residential & Commercial Land
3
Environmental:_Alternative_Land_Use
Greenspace
Industrial Land
Public Works Land
Social & Cultural Land
Maximum Water Level
Population
Classes
Industrial & Public Works Land
Maximum Water Level
Commercial Land
1
Human_Capital
Births
Population Classes
Deaths
Population Attributes
Population
Classes
Population
Attributes
Maximum Water Level
Social & Cultural Land
Greenspace
Population
Attributes
5
Social_&_Cultural
Ecosystem Services
Social & Cultural Production
Social Mapping measures
4
Economic:_Goods_&_Services
Commercial Services
Industrial Services
Public Works
Storm Impacts
Storm Impacts

*City of Charlottetown



*Hoi An, Vietnam Flood Map



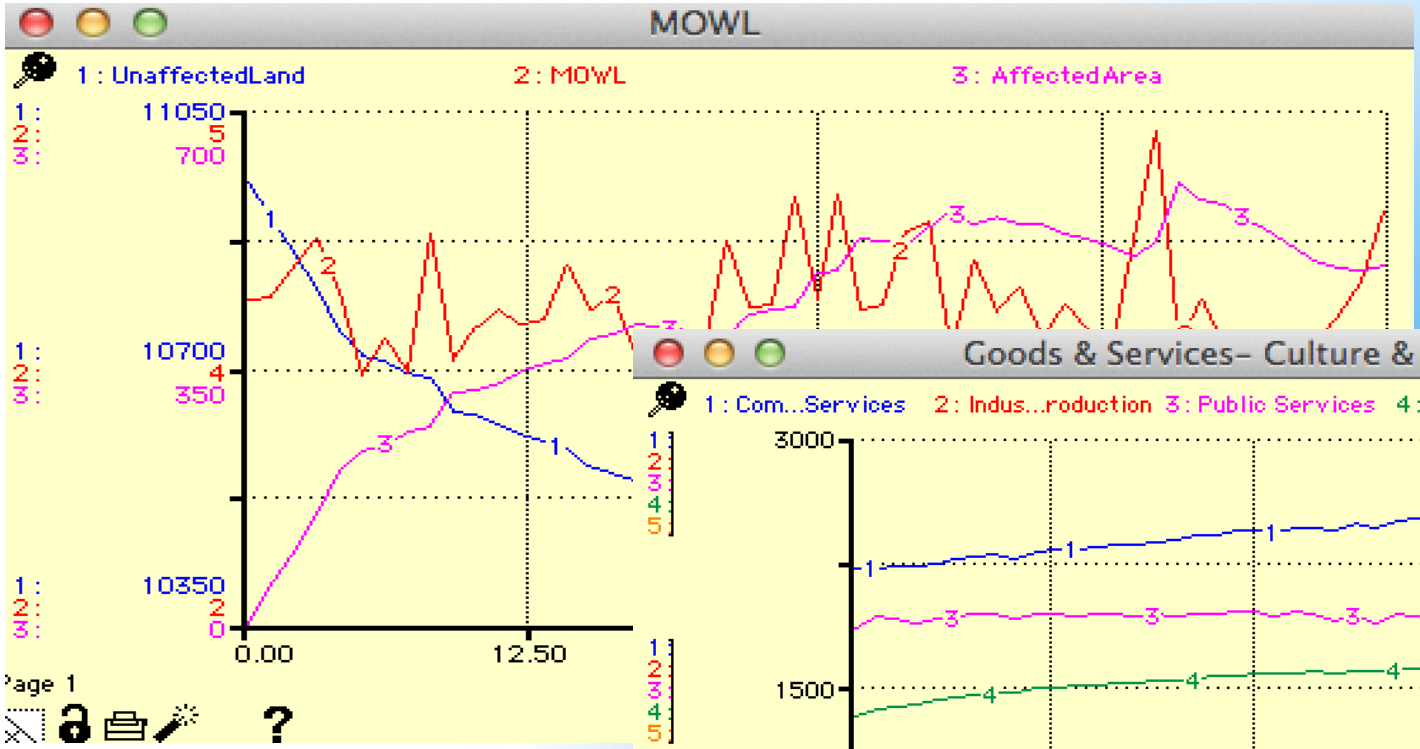
* Attributed Land Value Assets

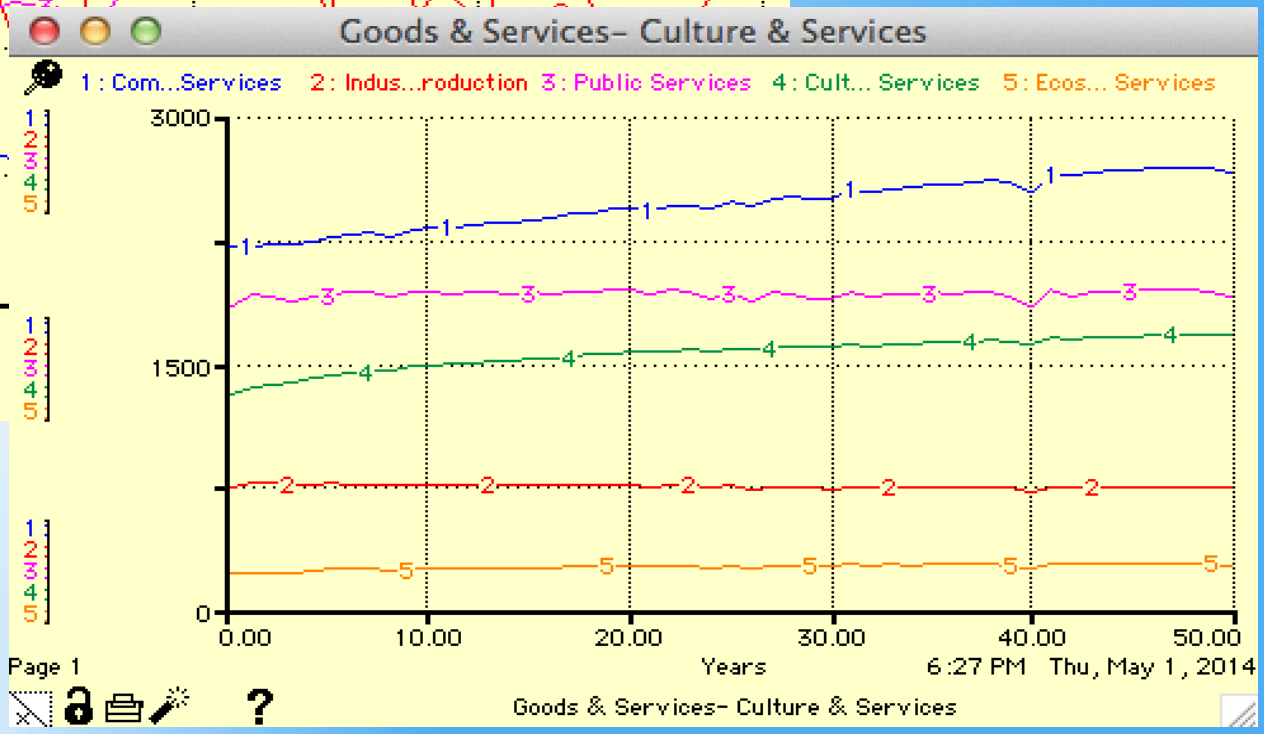
Land Use	Space (acres) (2012)	Land Value ($M/acre)	Description/Source
Residential	3,225	$2.855	Housing - average discounted selling value/acre for January 2016 Multiple Listing Service (MLS) Ottawa listings for detached bungalows prorated to 2012 Charlottetown average aggregate valuation; Royal LePage (2016)
Commercial	2,680	$3.484	Commercial property - average discounted selling value (to 2012) for January 2016 Multiple Listing Service (MLS) Ottawa listings for Business and Retail properties prorated to 2012 Charlottetown average aggregate valuation ; Royal LePage (2016)
Industrial	1,239	$4.149	Industrial property - average discounted selling value (to 2012) for January 2016 Multiple Listing Service (MLS) Ottawa listings for Industrial and Office properties prorated to 2012 Charlottetown average aggregate valuation ; Royal LePage (2016)
Green space	472	$1.500	Estimated value of city park lands, sport fields, trails, open recreation space (Charlottetown 2007)
Public works	2,011	$3.000	Estimated value of infrastructure for water, electrical power, and sewage/water treatment, roadways, bridges, maintenance (Charlottetown 2007, 2010)
Cultural & Social	1,326	$2.000	Estimated value of lands for schools, hospitals, community centres, libraries, arenas (Charlottetown 2007)

* Annual Storm Levels, MOWL

Storm Severity	Description	Application^	IPCC Analogy*
I. Low (Base Case)	Modal MOWLs signal storms that result in minimal damage to property and infrastructure. This is the assumed storm definition for the Base Case scenario	$\alpha = 2.0$ and $\beta = 0.303$ Max MOWL < 4.0m	RCP 2.6 – GHG emissions peak 2010-2020 then decline substantially
II. Historical	Modal MOWLs consistent with the historical data values for 1911-2005 and signal storms that result in occasional appreciable damage to property and infrastructure.	$\alpha = 3.0$ and $\beta = 0.303$ Max MOWL < 4.5m	RCP 4.5 – GHG emissions peak by 2040 then decline
III. Medium	Modal MOWLs signal storms consistent with the increasing historical trend since the beginning of the 21st century and result in considerable damage to property and infrastructure.	$\alpha = 3.5$ and $\beta = 0.303$ Max MOWL <5.0m	RCP 6.0 – GHG emissions peak by 2080 then decline
IV. High	Modal MOWLs signal storms predicted with high certainty into the 21st century and result in significant damage to property and infrastructure.	$\alpha = 4.0$ and $\beta = 0.303$ Max MOWL < 5.5m	RCP 8.5 – GHG emissions continue to rise throughout 21st century

*System Dynamics View - STELLA Results





*Profile SD Results

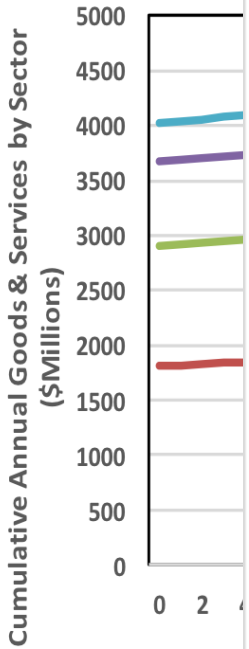
City of Charlottetown Annual Projected Land Value

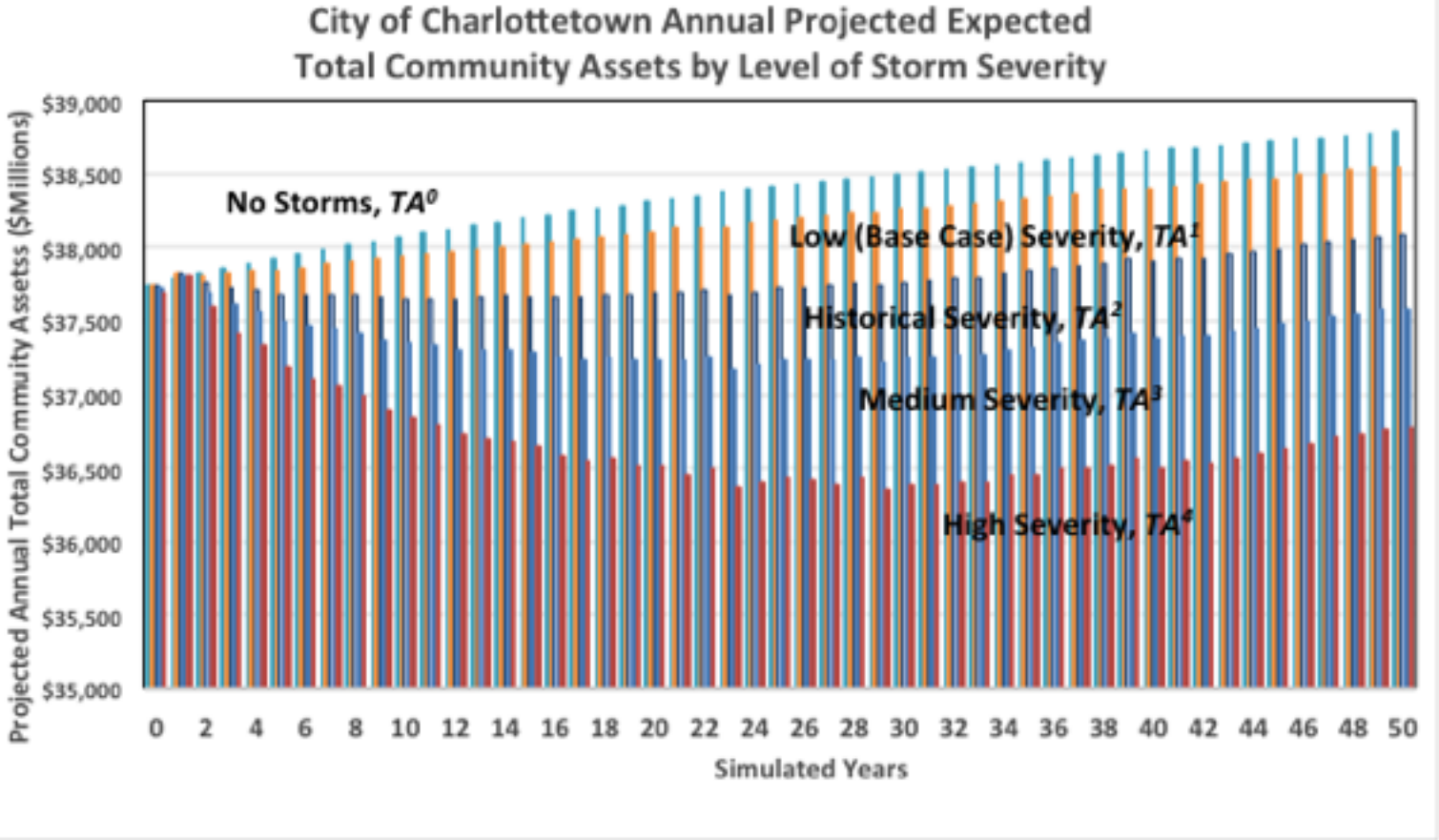
on

City of Charlottetown Annual Projected Goods & Services

Zero

City of Charlottetown Annual Projected Cultural & Social Value





*Controls

Adaptation Strategy, A_i	Description	Application: City of Charlottetown, P.E.I.
1) Protect	Physical coastlines reinforcement; 'hard' engineering - seawalls, breakwaters, gabions and groins; 'soft' engineering - grading coastal cliffs, planting or maintaining existing vegetation (Ollerhead, 2006)	-Construct 3.75m sea walls -Labor skills adjustment (professional skills enhancement) -Public service increase in cost of $100m investment over 5 yrs
2) Accommo-date	Construction of structures to reduce storm damage (e.g., elevated houses), improve land-use, zoning plans to restrict permission of coastal constructions; legislation and increasing natural resilience by rehabilitating coastal dunes and wetlands (Pilkey and Young, 2009)	-Labor skills adjustment for structures -Attributed land as Public Works -Public service increase in cost of $50m investment over 5 yrs
3) Retreat	Abandon areas closest to the coastline, place temporary or dispensable structures only in these areas; avoid direct impact from storms; land swapping, or management strategies such as rezoning, insurance denial, or tax policies (Shaw et al., 2002; Natural Resources Canada, 2010)	Adjustment to work skills Attributed increase in land to Greenspace Public service increase in cost $75m investment over 5 years
4) Status Quo (Do Nothing)	Toleration of all storm damages without attempting to mitigate storm impacts; arguably most commonly adopted strategy (McCulloch et al., 2002)	No adaptation strategy (Do nothing/Status Quo)

Simulation Scenarios

No.	Scenario Name	Controllable Variables - Adaptation Strategies for Charlottetown	Uncontrollable Variables - IPCC Analogy/Storm Severity for Charlottetown
R0	Base Case/ Benchmark	No adaptation strategy (Do nothing/Status Quo)	Low severity storms, IPCC, RCP 2.6: 2.0
R1	Worst Case	No adaptation strategy (Do nothing/Status Quo)	High severity storms, IPCC, RCP 8.5: 4.0
R2	Protect-Worst Case Storms	Protect with 3.75m seawalls Labor skills adjustment for sea walls construction (professional) $100m investment in 5yrs	High severity storms, IPCC, RCP 8.5: 4.0 and Strategy modification: IF MOWL<3.75m then 'No Impacts' ELSE 'Impacts'
R3	Accommodate - Worst Case Storms	Labor skills adjustment Attributed land as Public Works Public service increase cost $50m investment in 5 years	High severity storms, IPCC, RCP 8.5: 4.0 and Strategy modification: New MOWL = .75 Original MOWL
R4	Retreat - Worst Case Storms	Adjustment to work skills Public service increase cost Increase in Greenspace $75m investment in 5 years	High severity storms, IPCC, RCP 8.5: 4.0
R5	Accommodate - Historical Storms	Labor skills adjustment Attributed land as Public Works Public service increase	Historical severity storms, IPCC, RCP 4.5: 3.0 and Strategy modification: New MOWL = .75 Original MOWL

*8. Evaluating Decisions

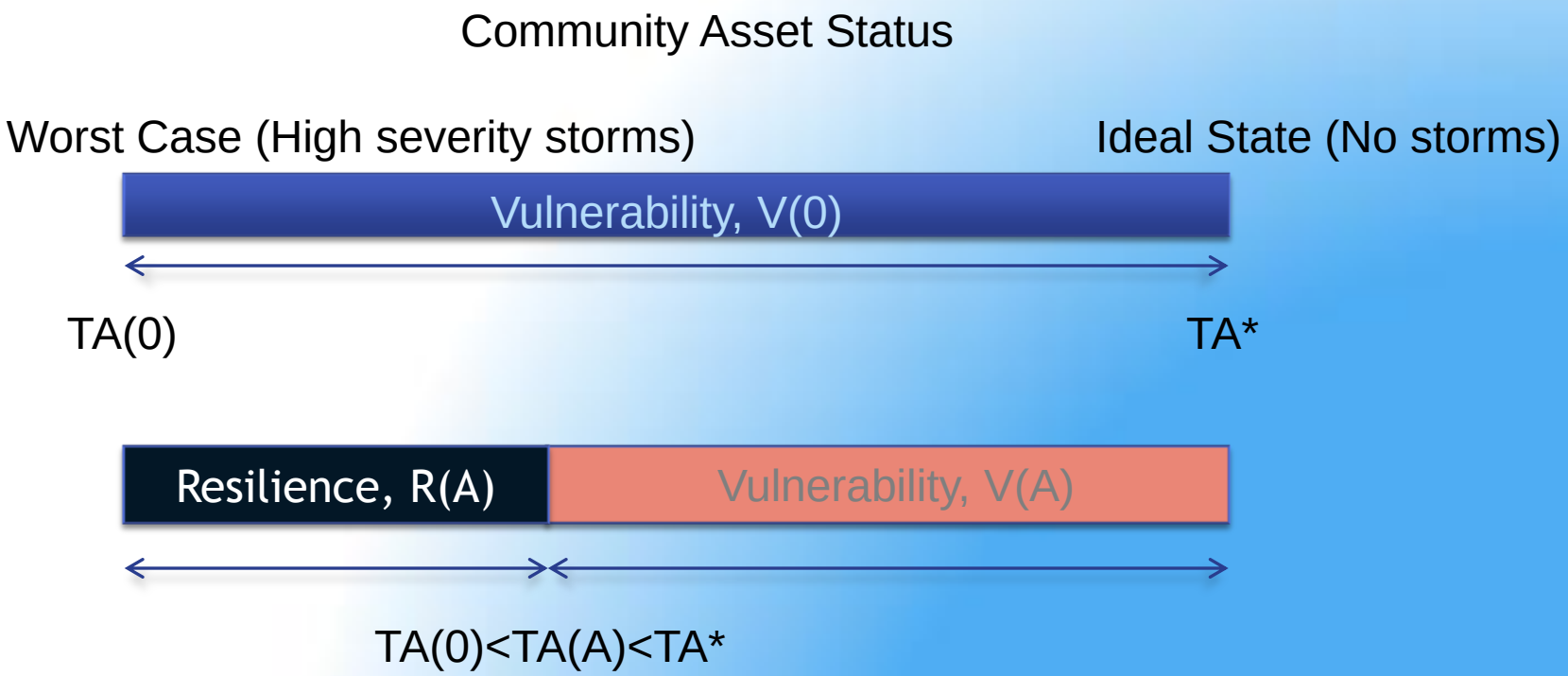
Evaluation of Strategy Alternatives

* Methods:
  * Static analysis – AHP application, multiple participants (SEPS paper – *Camare & Lane 2015*)
  * Dynamic analysis – SD model over strategic planning period (50 years) – *Lane et al 2017, 2018*

* Indicators:
  * Vulnerability – expected storm damage estimates by sustainability pillar
  * Resilience – function of adaptation strategy as reduction of 'no action' vulnerability
  * Adaptive Capacity – resilience (reduced vulnerability) as a proportion of total vulnerability

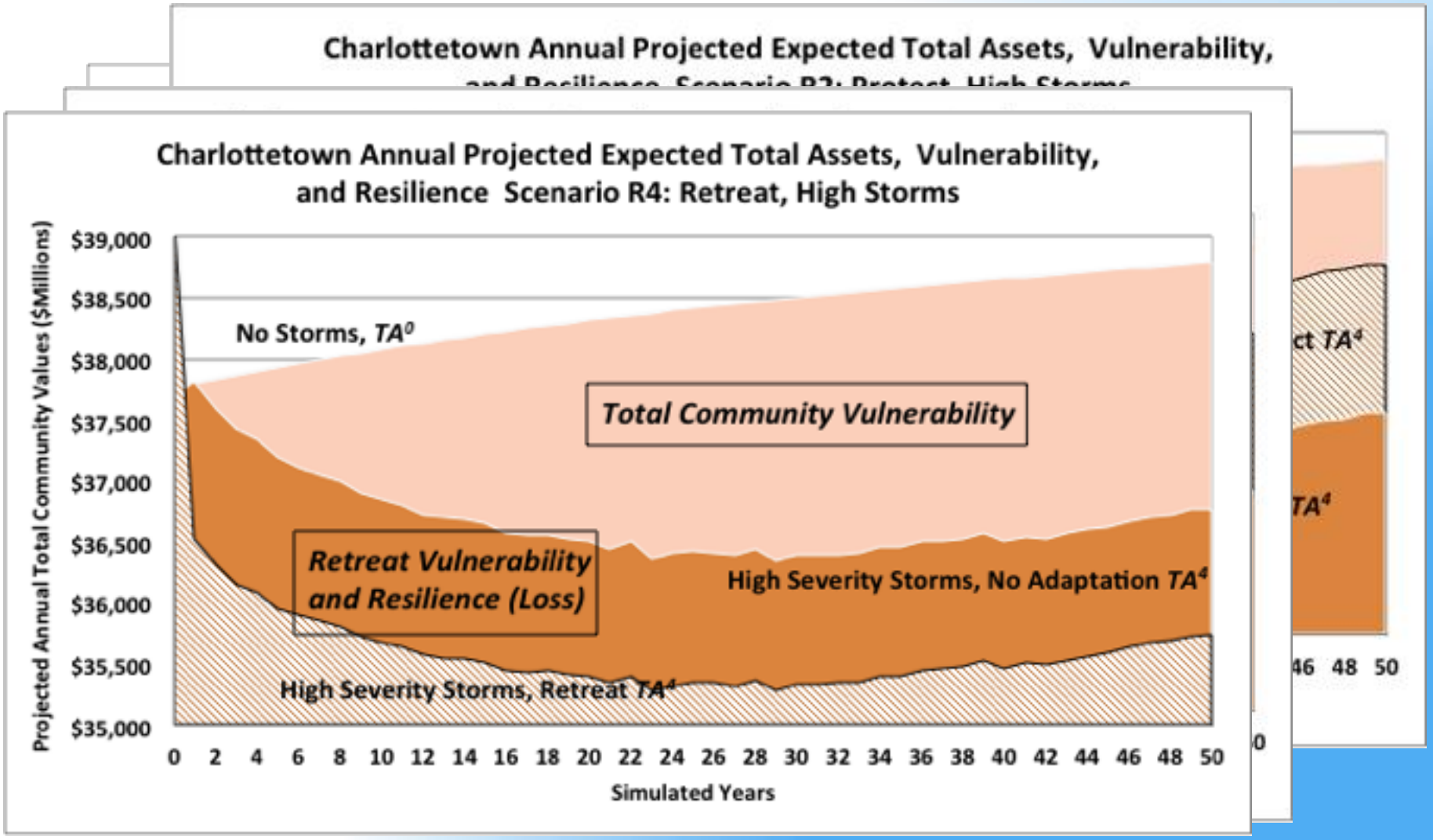
*Vulnerability Gap with Strategy

Lane et al 2018



Adaptive Capacity: AC(A) = RA(A)/V(0)

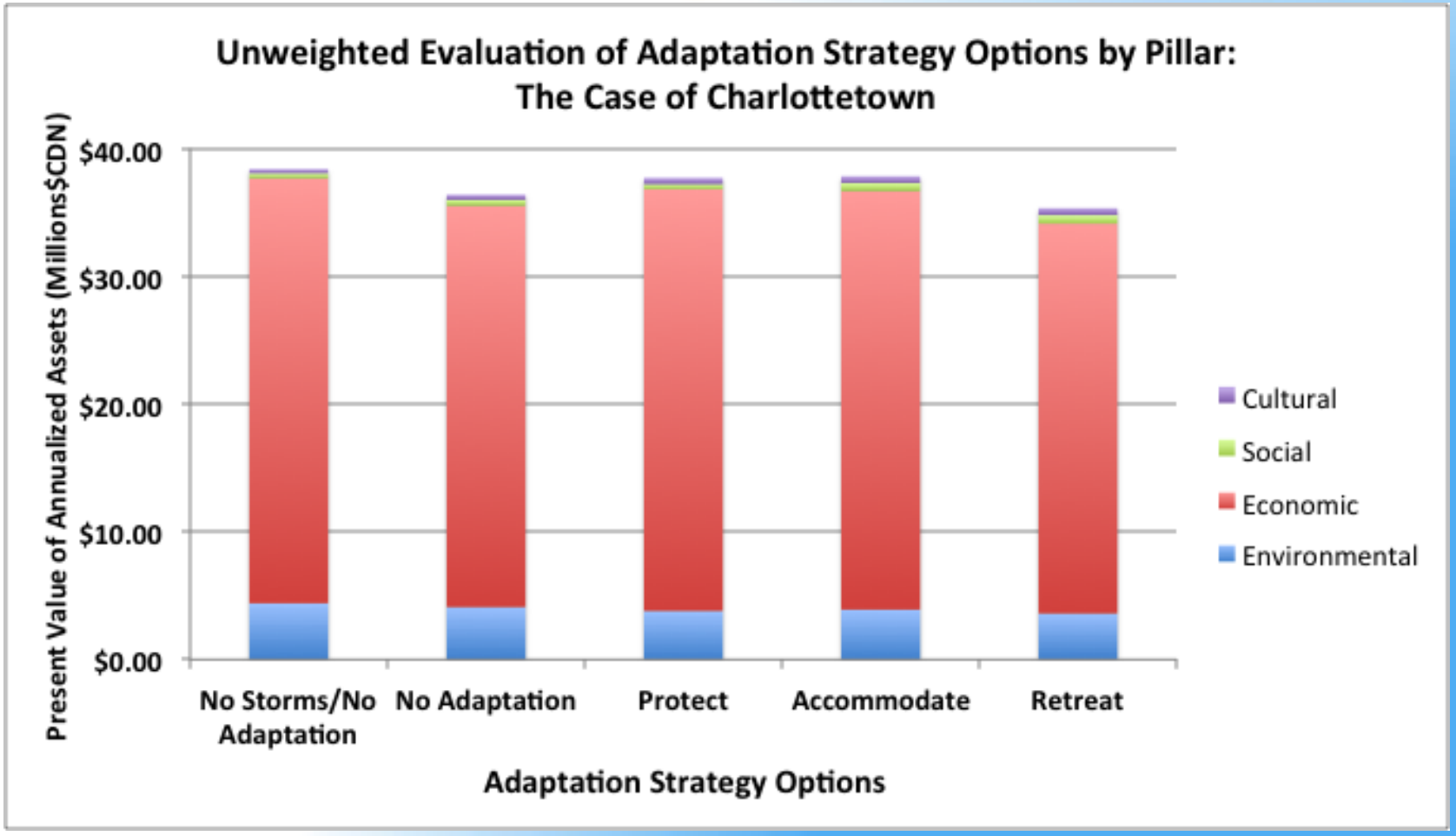
* Storm Simulation Results:Vulnerability & Resilience



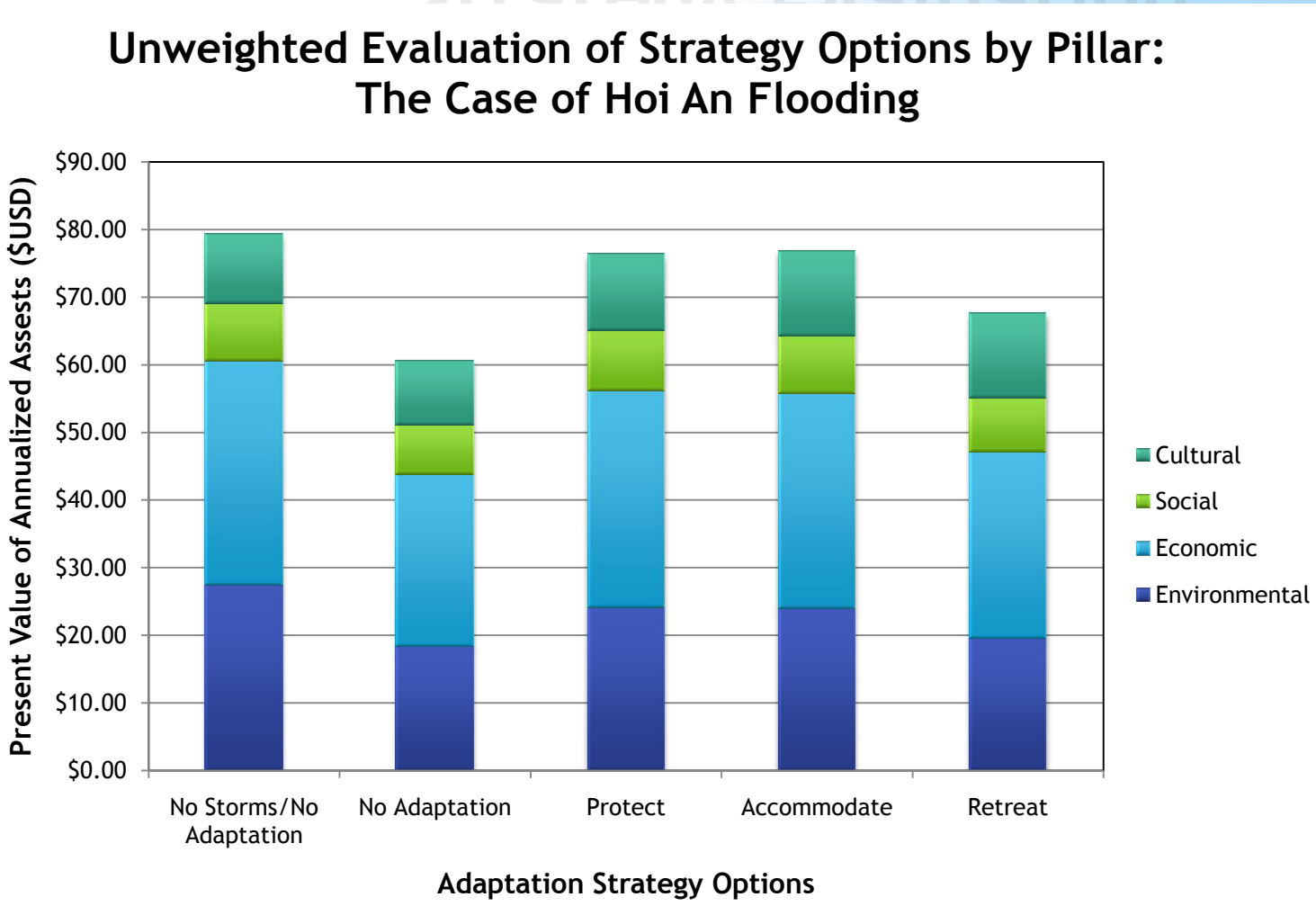
Evaluating Weighted Assets by Profile Priorities

- Different communities/nations have different priorities re the Pillars of Sustainability
- Requires weighting the asset results corresponding to each adaptation scenario
- Consider analysis of the Charlottetown problem weighted by the participants of the China-ASEAN Academy
- Note similarities and differences among weights and preferred adaptation strategy options

* No Weights- Annualized Strategy Evaluation



* No Weights- Annualized Strategy Evaluation



*Participants' Exercise - Decision Evaluation

Annualized Strategy Evaluation - table form with weights

National Group	Sustainability Pillar Normalized Weights: Environmental	Economic	Social	Cultural	Total	Sustainability Pillar Idealized Weights: Environmental	Economic	Social	Cultural
China-ASEAN	0.28378	0.29357	0.22073	0.20191	1.0	0.96665	1.00000	0.75188	0.68777
Brunei	0.28378	0.29357	0.22073	0.20191	1.0	0.96665	1.00000	0.75188	0.68777
Indonesia	0.33694	0.24815	0.18384	0.23107	1.0	1.00000	0.73647	0.54560	0.68580
Malaysia	0.33502	0.30030	0.20727	0.15740	1.0	1.00000	0.89637	0.61869	0.46983
Singapore	0.27872	0.37927	0.20733	0.13468	1.0	0.73489	1.00000	0.54665	0.35509
The Philippines	0.29468	0.29088	0.19630	0.21814	1.0	1.00000	0.98711	0.66615	0.74027
Cambodia	0.27624	0.32720	0.19416	0.20240	1.0	0.84425	1.00000	0.59339	0.61857
Laos	0.21579	0.46498	0.21032	0.10890	1.0	0.46409	1.00000	0.45231	0.23421
Myanmar	0.23058	0.36069	0.20292	0.20581	1.0	0.63928	1.00000	0.56261	0.57060
Thailand	0.30455	0.39251	0.17029	0.13265	1.0	0.77592	1.00000	0.43385	0.33795
Vietnam	0.27112	0.30286	0.22902	0.19700	1.0	0.89522	1.00000	0.75620	0.65048
China	0.28349	0.24957	0.23532	0.23162	1.0	1.00000	0.88034	0.83009	0.81702

Hoi An Flood Adaptation Strategy Asset Valuations

Present Value of Annualized Assets (50 yr simulation, $USD)

	Adaptation Strategies	Sustainability Pillar Asset Valuation: Environmental	Economic	Social	Cultural	Total (Unweighted) Assets (Millions$USD2010)
0	No Storms/No Adaptation	$27.40	$33.25	$8.40	$10.33	**$79.38**
1	No Adaptation	$18.30	$25.40	$7.47	$9.41	**$60.58**
2	Protect	$24.10	$32.00	$9.00	$11.30	**$76.40**
3	Accommodate	$23.95	$31.75	$8.65	$12.52	**$76.87**
4	Retreat	$19.60	$27.50	$8.00	$12.55	**$67.65**

Decision form - to be completed by selected nation

(0) No Storms/No Adaptation

Weighted Results	Sustainability Pillar Weighted Asset Valuation				Total (Weighted) Assets (Millions$USD2010)
National Group	Environmental	Economic	Social	Cultural	
China-ASEAN	$26.49	$33.25	$6.32	$7.10	$73.16

(1) No Adaptation

National Group	Environmental	Economic	Social	Cultural	(Millions$USD2010)
China-ASEAN	$17.69	$25.40	$5.62	$6.47	$55.18

(2) Protect

National Group	Environmental	Economic	Social	Cultural	(Millions$USD2010)
China-ASEAN	$23.30	$32.00	$6.77	$7.77	$69.84

(3) Accommodate

National Group	Environmental	Economic	Social	Cultural	(Millions$USD2010)
China-ASEAN	$23.15	$31.75	$6.50	$8.61	$70.02

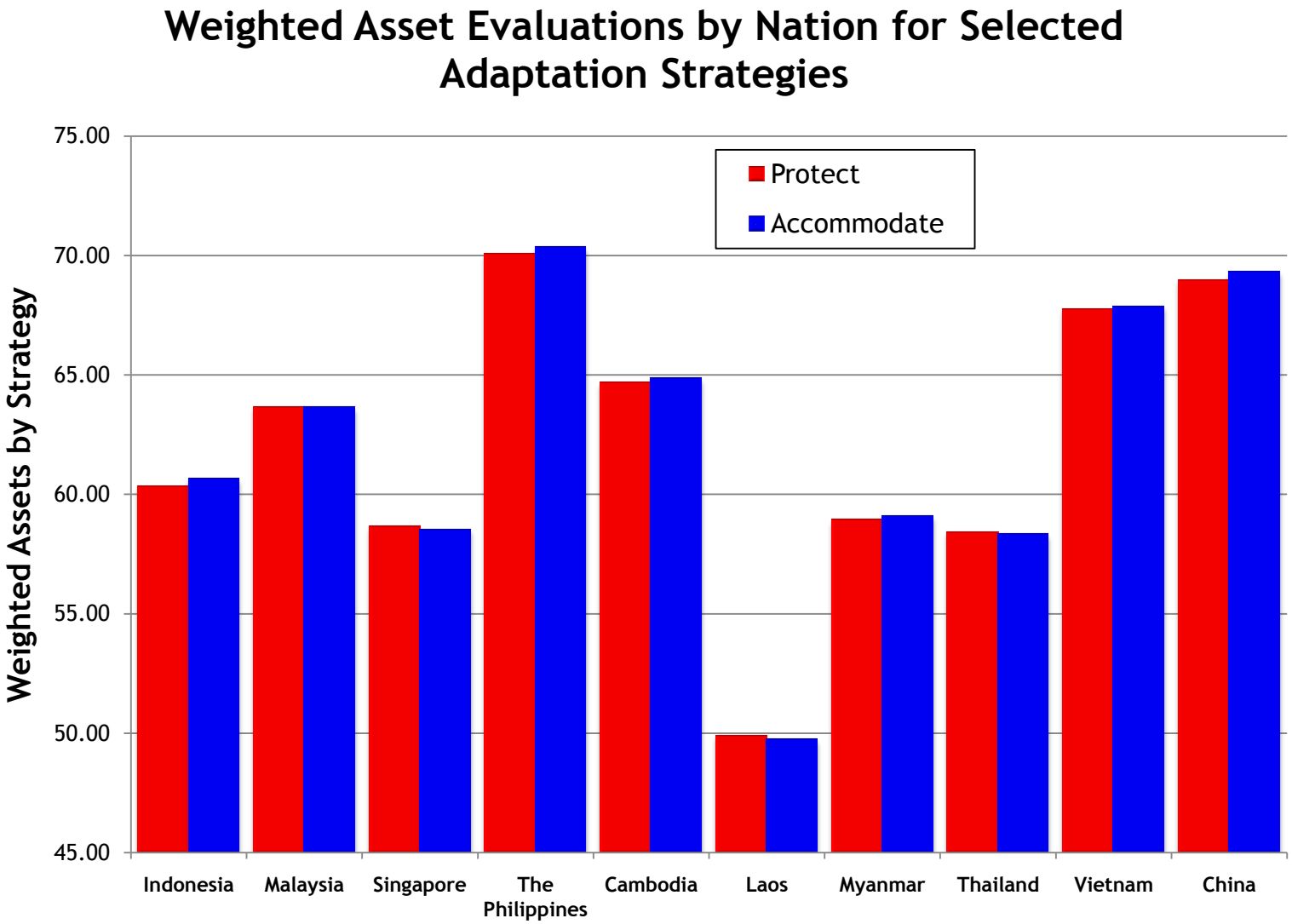
(4) Retreat

National Group	Environmental	Economic	Social	Cultural	(Millions$USD2010)
China-ASEAN	$18.95	$27.50	$6.02	$8.63	$61.09

Weighted Results

National Group	No Storms/ No Adaptation	No Adaptation	Protect	Accommodate	Retreat	Preferred Assets Value	Preferred Decision
China-ASEAN	$73.16	$55.18	$69.84	$70.02	$61.09	$70.02	Accommodate

* Weighted Nationals Evaluation

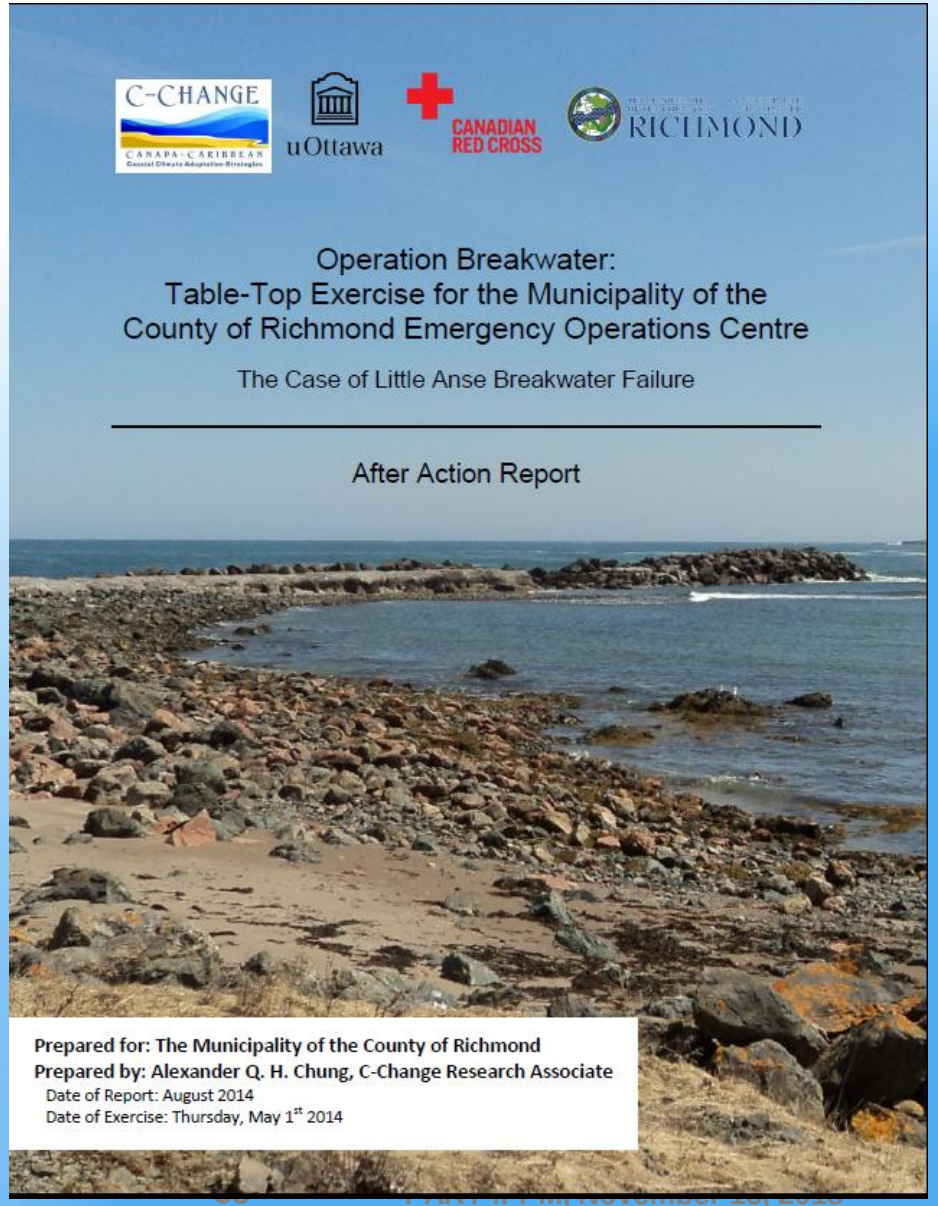


C-Change Little Anse Breakwater Workshop, May 1, 2014
Chung (2014)

Operation Breakwater:
Tabletop Exercise for the Municipality of the County of Richmond Emergency Operations Centre

The Case of Little Anse Breakwater Failure

Alexander Q.H. Chung
Telfer School of Management
University of Ottawa



Community Prepared-ness Index

Chung, Mercer Clarke and Lane (in progress)

Dimension	Attribute	Charlottetown	Isle Madame	Gibsons	Iqaluit
(1) Plans, Local Governance & Social Services (0.129)	Preparedness Planning (0.60)	0.734	**0.464**	0.339	0.339
	Local Governance (0.20)	0.750	**0.450**	0.450	0.450
	Social Services (0.20)	0.200	**0.800**	0.800	0.000
(2) Training, Education & Community Awareness (0.259)	Capacity Building (0.50)	0.500	**0.500**	0.250	0.375
	Public Awareness (0.50)	0.467	**0.305**	0.263	0.473
(3) Resources & Emergency Services (0.195)	Incident Command Sys. (0.333)	1.000	**1.000**	1.000	1.000
	Resources (0.333)	0.567	**0.279**	0.279	0.246
	Emergency Operations (0.333)	0.334	**0.334**	0.334	0.334
(4) Communication & Collaboration (0.195)	Early Warning & Public Information (0.666)	0.647	**0.500**	0.433	0.373
	Community Collaborative Networking (0.333)	0.600	**0.800**	0.500	0.700
(5) Monitoring & Forecasting (0.221)	Data Collection & Management (0.20)	0.333	**0.111**	0.167	0.056
	Hazard & Vulnerability Analysis (0.40)	0.820	**0.489**	0.410	0.302
	Environmental Forecasting (0.40)	0.778	**0.389**	0.389	0.611
Aggregate Preparedness & Response	**Index Value**	0.609	**0.477**	0.396	0.427

Conclusions toward improved community resilience:

- Enable community collaboration
  - Designing ‘community neighborhoods’; cell phones to inform community members or their neighbors’ status and needs Lu(2013)
- Encourage social networking activities
  - increasing access and basic training of community members in electronic and other social networking and communication activities (e.g., Facebook, Twitter)
- Support wellness, recreational lifestyle activities (Anielski, 2009)
- Develop community logistics for emergency events Liu(2014)
- Emergency preparedness workshops Chung(2014)
  - Table Top exercise to inform local residents of the available emergency procedures and support, engage volunteer contributions and participation of community members
- Disseminate preparedness to local schools to inform families

*9. Climate Change Governance

Climate Change Management

- Global Governance
  - UNFCCC, IPCC, COP21 (Paris), COP22 (Marrakech), COP23 (Bonn), COP24 (Katowice) – Dec 2018
  - Sendai Framework on SIDR
- International Protocols
- Canadian Initiatives
- Community Participation and Response

COP 24 - Katowice, Poland

- Dates: December 2-14, 2018
- Re the latest special report Global Warming of 1.5C of the IPCC - without rapid climate action by all, temperature increases would be difficult to keep in check.
- Success at COP24 means finalizing the Paris Agreement Work Program
- Agreeing to the implementation guidelines at COP24 was essential and finalizing the implementation guidelines was critical to maintaining the credibility of the process.
- The full implementation of the Paris Agreement means that practical actions will be unlocked with respect to all elements of the climate regime that countries are building:
  - adaptation to climate change impacts
  - ambitious emission reductions,
  - with strong means of implementation to support developing countries, in the form of technology cooperation, capacity building, and, especially financial support.

*Climate Change in the Pacific

2nd Symposium on Climate Change in the Pacific Region (Pacific Adapt 2019)
Lautoka, Fiji, 21st-22nd August 2019

International Climate Change Information Programme (ICCIRP)

organised in cooperation with the University of the South Pacific, the University of Fiji, the National University of Fiji and various partners from across the Pacific Region

The main aim of the event is to contribute towards the documentation and dissemination of climate change initiatives in the Pacific Region, which may lead to a greater resilience, and contribute to an increased adaptation capacity.

Local Community Response

- Resource needs
- Bottom up
- Community participation - recycling, reusing, good practices
- 'Teach the children well'!

Questions/Discussions