10th International Conference of the International Institute for Infrastructure Resilience and Reconstruction (I3R2)
20–22 May 2014
Purdue University, West Lafayette, Indiana, USA

Data Preparation for Validation Study of Hazus Canada Flood Model

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ABSTRACT

As our climate changes, the occurrence of extreme weather events and heavier rainfall becomes more common. This change in weather patterns and precipitation results in a greater number of recorded flood events and a larger magnitude of flood events. Canadian municipalities are therefore facing a pressing demand to perform hazard assessments to identify communities at risk and measure potential economic and societal losses due to flood events. Federal Emergency Management Agency (FEMA) developed a standardized tool, Hazus-MH, for loss estimation from natural disasters for use in the US. Recently, Hazus has been adapted for use in Canada. This paper introduces the Hazus flood loss assessment model and the adaption and development required for the Canadian Hazus release. Furthermore, the steps followed with respect to data acquisition and preparation of the required exposure and hazard input data and attribute translation methodology to conform to Hazus classifications for the pilot study in Fredericton, NB, are presented. A subsequent paper will report the flood model results and compare them to actual expenditures from the 2008 flood in Fredericton to verify the validity of the model, depth damage curves, and parameters employed.

1. INTRODUCTION

In New Brunswick (NB), the chance of flooding due to snow melt, ice jams, and heavy rainstorms (Environment Canada, 2013a) is a concern as many residential areas and extensive infrastructure have been developed close to rivers. With observed changes in the earth's climate, including the atmospheric composition, global average temperature, and ocean conditions, local weather patterns are changing (Stocker et al., 2013). With this variability in the weather patterns, it is becoming increasingly important for municipal (and other levels of) government to perform accurate risk-assessments in flood prone and coastal communities. Knowing regions of vulnerability are important for disaster planning, mitigation and recovery, and preparedness response (Nastev & Todorov, 2013). The method being adapted by Natural Resources Canada (NRCan) to respond to this issue is to adapt the Federal Emergency Management Agency (FEMA) Hazus-MH (Hazus) software.

The objective, to compare the results of loss estimation software to the recorded expenditures in Fredericton to determine the accuracy and quality of Hazus, is identified in Section 4. The flood scenario (the 2008 flood in Fredericton) is described in Section 5. The cost of this flood, as reported by the Government of New Brunswick in the Flood History database exceeds $230,000,000. Model expectations and parameters which may be modified to best fit the true expenditures are discussed in Section 6.

2. FLOOD RISK: FREDERICTON

The selection of municipality for this first pilot study was a difficult one, as flooding has been reported and is of concern to many municipalities located along the Saint John River floodplain.

The Saint John River is a major waterway that runs throughout the province of New Brunswick. The source of the river is Lake Saint John, Maine. The Saint John River is 670 km long, drains an area of approximately 55,000 km^2, and has an elevation range of approximately 360 meters. The watershed includes parts of Maine, Quebec, and New Brunswick.

A comprehensive database of flood events dating back to the 1600s is available on the Government of New Brunswick (GNB) web site (GNB, n.d.a). The flood database records also indicate that many communities situated along the Saint John River

1	Clair/Fort Kent	7	Fredericton
2	Edmunston	8	Maugerville
3	Perth-Andover	9	Jemseg
4	Simonds	10	Quispamsis
5	Hartland/Somerville	11	Saint John
6	Woodstock	12	Lameque

Figure 1. Candidate location along the Saint John River floodplain with numerous recorded flood events from GNB in the past decade

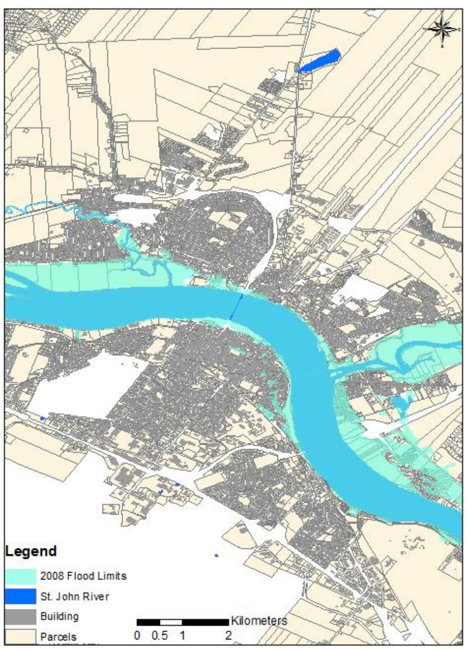

Figure 2. The City of Fredericton, with St. John River splitting the city and digitized flood boundary from 2008 flood

Figure 3. Circled in red, the roof of the public restroom and utility building in Officers Square is just visible above the waterline from the 2008 flood. Source: http://www.fredericton.ca/en/publicsafety/2008May1FloodUpdate.asp

floodplain have experienced flooding. Those which were identified and considered for this pilot study are shown in Figure 1.

After reviewing the candidate locations, Fredericton was chosen as the first location to study with Hazus. Fredericton was chosen for a number of reasons, including: (a) capital of the province, (b) open data policy, (c) the aging Mactaquac Dam, and (d) the recorded flood history.

The City of Fredericton is the capital of New Brunswick, and, as a result, there are a significant number of government offices and service locations in the city. The community of Fredericton is the third largest in the province with a population of 56,224 (Canadian Encyclopedia, n.d.) and approximately 22,000 households. There is, therefore, a mix of public (municipal, governmental) and private infrastructure at risk of flooding. In addition, the downtown core of Fredericton contains a number of historically significant buildings: City Hall, the Legislative Assembly, Wilmot United Church, York County Gaol, the Justice Building, the Soldiers' Barracks and Officers' Quarters, Christ Church Cathedral, and Old Government House (1828) (Canadian Encyclopedia, n.d.). Beyond these government buildings, some residences (especially in the eastern section of town) date back to the late 1700s.

The Saint John River flows through the city, dividing the “North” and “South” sections. Figure 2 illustrates the city layout, indicating the exposure, density, Saint John River, and 2008 flood boundary.

Today, Fredericton is not only the capital of the Province; it is an information technology hub. This has resulted from the combination of the University of New Brunswick, NB Tel (Bell Aliant), the provincial government, and private entrepreneurs (Canadian Encyclopedia, n.d.).

In 2011, the City of Fredericton announced an open data policy. The data collected by the city is available to the public via the City of Fredericton (Fredericton.ca/open). This open data policy facilitated locating appropriate datasets for Hazus inventory.

In the 1960s, the Mactaquac Dam was constructed approximately 15 km upstream from Fredericton along the Saint John River (Canadian Rivers Institute, n.d.). The dam was built to generate hydroelectric power, and it supplies power to 12% of NB homes (NB Power, n.d.). The service life of the dam is 2030. Options are presently being reviewed for the future of this station, including: rebuilding the station with a new powerhouse and spillway, maintaining the earthen dam and spillway only, or removal (restoring the rivers natural state

[NB Power, n.d.]). Each of these options could significantly affect river levels and flow downstream of Mactaquac.

Flooding occurs in Fredericton when the river level exceeds flood stage, which is 6.5 m above sea level. A number of flood events have been reported in Fredericton, dating back to the 1750s (GNB, n.d. a). The highest flood levels ever recorded were in 1973 when the water level was 2.04 m above flood stage. In 2008, the second highest water levels were recorded, 1.86 m above flood stage. The water level was so high that many roads in the downtown core were inundated with water, and many buildings were flooded (Figure 3).

A summary of flood events as recorded in the Flood History Database is found in Table 1. Over 70 records list damage within Fredericton city limits, illustrating floods are a common and costly occurrence.

3. HAZUS

Hazus, developed by FEMA, is a standardized methodology for estimating potential losses from disasters (FEMA, 2012). Originally developed in the 1990s as a toolset aimed at getting a regional understanding of the impact of hazards, it has evolved to offer community level results (FEMA 2012). Users of Hazus are able to: (a) identify vulnerable areas, (b) estimate potential losses, (c) assess how ready they are to respond to a natural disaster, (d) decide how to allocate resources, and (e) prioritize mitigation measures. Hazus includes models for estimating potential losses from earthquakes, hurricanes, and floods as basic models; it also includes the ability to model storm surges along the coast as a combination of the hurricane and flood models. This is accomplished through the use of GIS technology to estimate the physical, economic, and social impacts of the disaster (FEMA, 2012). Free of charge, Hazus is an extension of ArcGIS and will not function without the underlying architecture map engine and analytical processes of ArcGIS. In the next subsection, we briefly describe the Hazus Flood Model.

3.1. Hazus Flood Model

Hazus is used extensively in the US by government planners, GIS specialists, and emergency managers for predisaster planning to break the cycle of disaster, damage, and reconstruction. Potential disasters are modeled, and the results can be visualized to spatially identify relationships between populations and other permanently fixed assets. Additionally, tables and reports of inventory loss, replacement, and depreciation value are generated.

The loss estimation methodology employed by Hazus can be thought of as a multilevel approach. The first level uses the out-of-the-box functionality and inventory data and requires minimal user knowledge or input. National level datasets for each US state have been developed and considered default inventory (demography and built environment). Users can run a Hazus flood model scenario and analysis simply by selecting a study area (census blocks of interest) using this default inventory data; however, the results will be crude. A more detailed analysis is undertaken as part of the Level 2 analysis. In this level, users import their own more detailed local level data of the flood hazard scenario and inventory. A Level 3 analysis includes local level data and also modification to the existing parameters and damage assumptions built into

Table 1. Flood history database records for Fredericton

Cause key (R = heavy rain, IJ = Ice jam, W = mild weather, T = high tides, SM = snowmelt, F= freshet, SF = snowfall, U = unknown) Damage amount in thousand dollars spent across all communities affected.

Year	Damage Amount (thousand $)	Cause	Flood Stage
1759	-	U	
1887	$500	IJ, T, R, SM	
1901	$40	IJ, R	
1902	$51	IJ, W, R	
1909	$100	IJ, W, R	
1912	$1.3	R	
1913	$30	IJ, W, R	
1922	$1000	R	
1923	$10,000	IJ, R,T, SM, W	
1934	$250	IJ, SM, R	7.38
1951	$65	IJ, R, F	
1954	$466	R	
1958	$290	R, SM	7.59
1961	$1,000	S, W	7.41
1973	$11,877	R,SM	8.54
1974	$325.6	IJ, R	7.38
1979	$1,332	R, SM	7.90
1983	$300	R, W, SM	7.16
1986	$258	IJ, W, SM, R	
1987	$30,000	IJ, W, SM, R	7.42
1993	$194	R	
1994	$4,130	IJ, R	7.74
2000	$2,400	R,W, SF	
2005	$5,600	IJ, R, W	7.75
2008	$23,288	R,F,SM,W, SF	8.36
2010	$13,830	R	
2013	$350	IJ, R	

Hazus. As the level of analysis increases, the level of user knowledge is increased, as is the quality of the Hazus loss estimates.

For more sophisticated analyses of the flood hazard, the user can apply the Flood Information Tool (FIT). In FIT, flood frequency, discharge, and ground elevation are used to model the spatial extent and velocity of the flooding. Within FIT, the selection of coastal, riverine, or a combination of the two is available. The other option is that the flood hazard is calculated outside Hazus and imported as a user provided input.

While other loss estimation software has been limited to repair and replacement costs, Hazus extends its output to include consequential losses (FEMA, 2012). These consequential losses give an indication of the impact of the flood on the community. This combination gives a greater approximation to the overall impact of the flood. The flood model, however, is limited to loss estimation derived directly from building and infrastructure damage.

Direct economic losses with respect to buildings calculated by Hazus include structural repair and replacement and costs related to contents damage. Figure 4 illustrates how the direct economic loss module fits within the Hazus methodology. In the case of aggregated inventory, Hazus performs an area-weighted assessment of damage and losses within the census block. Within the census block, the inventory is assumed to be equally distributed (the percentage of buildings of a given type impacted by given flood depth is equal to the percentage of the census block inundated by that depth), and damage and losses are computed proportionally to the flood depth distribution computed for the census blocks.

Other direct economic losses include time-dependent income losses, such as relocation expenses, wage loss, rental income loss, and capital related income loss.Specific to the flood module is loss estimation to vehicles and agriculture.

Indirect economic losses are also calculated in Hazus, including employment losses, postflood change in the demand and supply of products, employment, and changes in tax revenues. For a detailed description of the Hazus methodology and software, visit http://www.fema.gov/hazus and http://hazus canada.ca/ for the Canadian application of Hazus.

3.2. Hazus Canada

In 2011, a Hazus adaption and codevelopment agreement was signed by Natural Resources Canada (NRCan), Defence Research and Development Canada (DRDC), and FEMA. An adaption of the program was necessary as Hazus was designed for use in the US. A number of components needed to be modified for Canadian use.

One of the first steps required in the adaption was the creation of a boundary polygon. This polygon represents the coast of Canada to identify areas which can be used in the coastal flood analysis.

Another preliminary step was the generation of administrative units. In the US Hazus system, a four-tiered system is used: State, County, Census Track, and Census Block, each containing a smaller geographic area (FEMA, 2012). The Canadian census (2001) data were used in the generation of these geographic units in Canada. Canada does not use census blocks; instead, NRCan has implemented the use of dissemination blocks (DB). The DB is the smallest geographic unit of analysis and is an area equivalent to a city block, bounded by intersecting streets (Statistics Canada, 2012). The four geographic tiers are therefore: Province, County, Census Track, and Dissemination Block. A naming convention for all geographic boundaries needed to be created, as well, which identified each parcel and conformed to the Hazus database structure.

Canadian inventory databases were also required to perform analysis. The Canadian default inventory databases contain aggregated buildings including seven occupancies (residential, industrial, commercial, educational, governmental, agriculture and religious). This represents Level 1 inventory data; however, users should be aware of the limited accuracy of the inventory. User input is needed for essential facilities, transportation, and utilities. Additionally, importing local building data with own coordinates is recommended.

The demographic data in the Canadian 2011 census has been input into the Hazus default databases. The census attributes used in Canada, do not match exactly to the US, and calculations

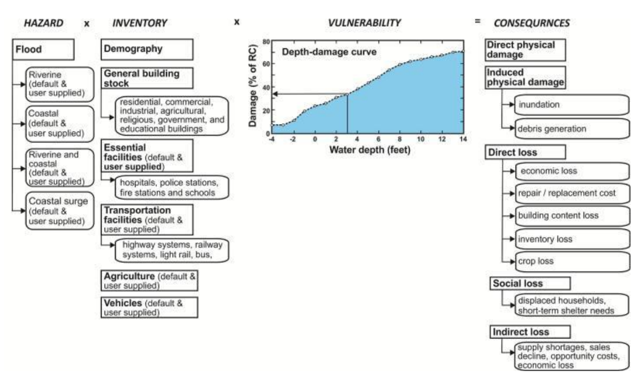

Figure 4. Schematic Representation of Hazards, Inventory, Damage Functions, Risks in Hazus. Source: Nastev & Todorov, 2013

Table 2. Derivation of demographic inventory into Hazus US classification

Hazus Attribute	Canadian Census Attribute
Male16to65	Male Ages, (4/5*"15-19") + "20-24" + "25-29" + "30-34" + "35-39" + "40-44" + "45-49" + "50-54" + "55-59" + "60-64" + (1/5* "65-69")

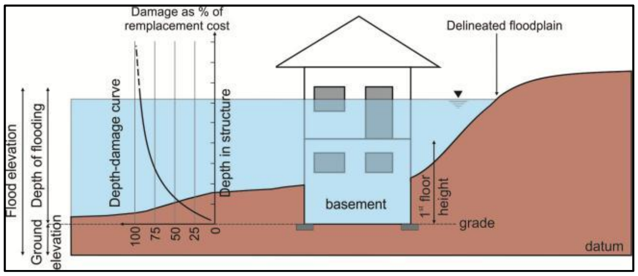

Figure 5. Schematic representation of the hazard parameters for a typical Canadian house with a basement [1st floor in Hazus] Source: Nastev & Todorov, 2013

were completed based on the US Hazus attributes (Nastev & Todorov, 201). Table 2 represents how the Canadian male census data were fitted to the "Male16to65" category in Hazus.

Additionally, Hazus uses flood mapping schemes and tables to identify the types and occupancy of the exposed buildings. For the Canadian Hazus, assumptions have been made based on the mapping schemes of the nearest US state (Nastev & Todorov, 201). Differing from the US, in Canada, these calculations of standard damage curves and identification of how structures respond to flooding could not be found, and, at present, the same USACE derived values remain as the default. The users can, however, introduce their own damage curves. Parameters which comprise the depth damage curve for vulnerability assessment include the foundation type, the elevation of the first floor from grade, and age of structure (Figure 5).

Before Hazus Canada is released, a series of test projects per province will be created and the results compared to actual spending and affected areas.

The Canadian earthquake model was released nationally and has been in use since 2012. The flood model is released in a beta version for the western portion of the country. A full national release is expected in August 2014.

3.3. Hazus Inventory

As discussed earlier, Hazus requires two major inputs: inventory and flood hazard (extent, depth). The more accurate and up to date the inventory, the better the resulting loss estimate will be. Hazus inventory is categorized and divided across a number of databases. These include building stock, essential facilities, transportation, and utilities. The building stock dataset contains seven major occupancy categories (residential, commercial, industrial, governmental, educational, agricultural, and religious) classified further into 33 specific occupancies. These occupancy classifications, along with building attribute information such as building age, foundation type, height of the first floor, and the presence of a basement, are utilized by the flood model to estimate damage to structure and content. The inventory information necessary for determining the given percentage of damage is given by the relationship between specific occupancy classifications and the building types (FEMA, 2009).

The loss estimation may be run on aggregated building stock data at the census-dissemination level to represent dollar exposure or calculated at the building-by-building level for data provided by the user. The essential facility database contains assets such as police stations, fire stations, hospitals, and schools.

The impact to the functionality of these essential facilities is determined when the model is run. Highway and railway bridges, as well as other transportation facilities, such as bus and port facilities, are included in Hazus. Default inventory for population demographics is used to determine population at risk, shelter needs, and cost of relocation or wage loss estimates (in case of aggregated building damage). Specific to the flood model is a consideration of vehicle inventory as well as agriculture data and crop fields. Depending on the time of day, duration, and time of year, a flood may cause more or less damage to crop yield.

4. DATA PREPARATION FOR NB INVENTORY

Collection of data to perform a Level 2 analysis had its challenges. While the open data policy in the City of Fredericton made available many datasets, there were some which were not acquired (to date) due to sharing or privacy concerns. The key databases required to be populated for analysis include: (a) building square footage by occupancy type, (b) full replacement value, (c) building count by occupancy (for aggregated data), (d) building coordinates (for user provided data), (e) occupancy, and (f) demographics (FEMA, 2012). For this pilot study, data were not collected; rather it was assembled from a number of municipal and provincial sources.

4.1. Data Sources

Working closely with Public Safety Canada (PSC), information regarding datasets was managed and availability at various organizations was facilitated (Table 3). In addition to data sourced through PSC, an agreement between the University of New Brunswick and provincial agencies has yielded inventory data for Level 2 analysis in Hazus.

Table 3 Hazus inventory dataset source locations in New Brunswick

Department / Municipality	Available Datasets
City of Fredericton	Building Footprints
City of Fredericton	Fire Stations
City of Fredericton	Police Offices
City of Fredericton	Parking Facilities
City of Fredericton	Street Centreline
City of Fredericton	Wastewater, potable water
City of Fredericton	LiDAR data (2008)
New Brunswick Department of Environment	Flood depth grids
New Brunswick Department of Education and Early Childhood Development	Public Schools
Public Safety New Brunswick	Local infrastructure
Public Safety New Brunswick	Cell Towers
Public Safety New Brunswick	Disaster financial assistance
Service New Brunswick	Property Assessment
SNB - GeoNB	Digital Property Maps (DPM)
SNB – GeoNB	Flood risk areas & historical floods
SNB - GeoNB	National Railway Network
SNB - GeoNB	Pipelines
SNB - GeoNB	Road Network

Table 4. Hazus occupancy codes and associated New Brunswick building classifications

Hazus Category	Hazus Description	NB Code	NB Code Description	Property Description contains
RES1	Single Family Home	120	Residential Improved	House & Lot
RES2	Mobile Home	104	Mobile Home Parks	Mobile Home Lots, Pine Grove LLC
		105	Mobile/ Mini Home w/ Land	Mini Home, Mobile & Lot
RES3A	Duplex 1-2 units	120	Residential Improved	Duplex
RES3C	Apartment 5 -9 units	120	Residential Improved)	Apt. Bld
COM1	Retail trade	202-207, 210, 214	Service stations, restaurant	
EDU1	Grade School	402	Schools	EDU1
IND2	Light industrial	304 - 310	Food, Fish, Textile, Apparel Processing Plants, Lumber Mills	

4.2. Building Classification

Through a data-sharing agreement between the University of New Brunswick and Service New Brunswick (SNB), access to the assessment data for all parcels in New Brunswick is available. The assessment database is available as MDB and contains the following attributes used by Hazus: (a) address, (b) description of property, (c) building category, (d) first assessment year, (e) assessment value. Additionally, a Parcel Identifier (PID) is contained in the database which was joined with a Land Parcel shapefile (available from the SNB GeoNB web site). This join enabled geographic visualization of the assessment data. A spatial join was made with a building polygon shapefile which was available through the City of Fredericton Data Catalogue, as this shapefile did not contain property of parcel data. The building category codes, as used in New Brunswick, do not match the system as used in Hazus. It was necessary to create a table identifying how each NB occupancy category fit into the Hazus data structure. Then SQL queries were run on the data to populate the Hazus occupancy code field. A sample of this table is shown in Table 4.

4.3. Replacement Costs (Values)

Assessment value as found in the SNB database is not equivalent to replacement value as required by Hazus. The replacement values for buildings are calculated based on industry standard models published by R. S. Means Company in *Means Residential Square Foot Costs*, 2009, (FEMA, 2012). The single family residential (RES1) replacement cost is the most complex, utilizing a combination of socioeconomic data from census, square footage, Federal Insurance Agency (FIA) credibly weighted functions, construction classes, etc. The valuation algorithm is below (FEMA, 2012):

$$V \quad = (A_{RES1,k}) * [\sum^4 \sum^4 * \quad * \quad] + RES1,k=1=$$

$$(A_{RES1,k})* * [\sum^4 \sum^4] + (RES1Cnt_k)*[\sum^4 \sum^4]$$

Where:

$V_{RES1,k}$: Total estimated valuation for RES1 for a given census dissemination area (k)

$A_{RES1v,k}$: Total RES1 floor area for given (k)

i: Means construction class

$w_{i,k}$: Means construction class weighting factor

j: Number of stories of RES1

wj,k: Means number of stories weighting factor

Cij: RES1 cost per square foot

l: Basement status (yes [1] or no [2])

wl,k: Means basement status weighting factor

$C_{i,j,l}$: Additional cost per square foot for a finished basement

M: Garage combination (1 car, 2 car, etc.)

$w_{m,k}$: Weighting factor for garage type

$c_{i,m}$: Additional replacement cost for a given garage type

RES1Cnt: Count of RES1 structures within a given census block

Replacement cost calculated for the downtown area of Fredericton is shown in Figure 6.

The replacement cost of mobile homes and other residential structures is much simpler, using just the square footage multiplied by a constant cost per square foot. The costs per square foot are based on values derived from the *Means Cost* (2009) as found in the Hazus Technical Manual. These values are editable within the Hazus software, and it is expected that these values will need to be revised to reflect Canadian and NB valuation.

The contents replacement value was estimated as a percentage of the structure replacement value. The default structure value ratios per each occupancy class given in the Flood Technical Manual (Table 14.6) were used. These defaults are 50% of the replacement value for all residential structures and between 50% and 150% for commercial and industrial occupancy classes. These default values will be input for the initial run and, as above, will be modified as needed to better estimate the actual replacement expenditures.

4.4. Essential Facility Data

Essential facility data for police and fire stations were downloaded from the data catalogue on the City of Fredericton web site. Parking locations, street centreline, and trails were also downloaded.

In order to input to Hazus, the data needed to be converted to the ArcGIS feature class. Additionally, the files needed to be reprojected, as Hazus will only accept data in geographic coordinates (Latitude and Longitude, NAD1983). Template datasets distributed with Hazus were used to merge the City of Fredericton data into Hazus-acceptable format. The datasets were loaded into the provincial database using the Comprehensive Database Management System (CDMS). Attributes which were unknown were set to "0," or default values were used, where applicable, as the CDMS import will fail if there are <NULL> values in the data.

Figure 6. Fredericton building stock, classified by replacement cost (thousand dollars)

Schools—primary, secondary, universities and colleges—are input into Hazus as part of the Essential Facility classification. Public school information was available from the New Brunswick Department of Education and Early Childhood Development web sites. This information was downloaded and saved as a tab delimited text file. There were many attributes which Hazus uses found in this file (Figure 7). There was an address; however, there were no geographic coordinates listed for the schools. The "What's Here?" function within Google Maps was used to determine the latitude and longitude for each of the schools. This database was then imported into the ArcGIS feature class within a personal geodatabase. This feature class was merged with the *hz_SchoolData* template from Hazus. This template contains the appropriate field naming convention, type, and field lengths for successful import into CDMS. Finally, the *Field Calculator* function within ArcGIS was used to populate the Hazus-appropriate fields. A similar database of postsecondary education facilities was not found. However, the government of NB maintains a site listing postsecondary education facilities. The links to these universities and colleges were used to manually key in the associated attributes per institution.

5. FLOOD SCENARIO

The second major input in Hazus is the flood hazard. The 2008 flood level was used as the flood scenario in Hazus. Other scenarios, deterministic or probabilistic with a given return period, will also be considered in the second phase of the study. The

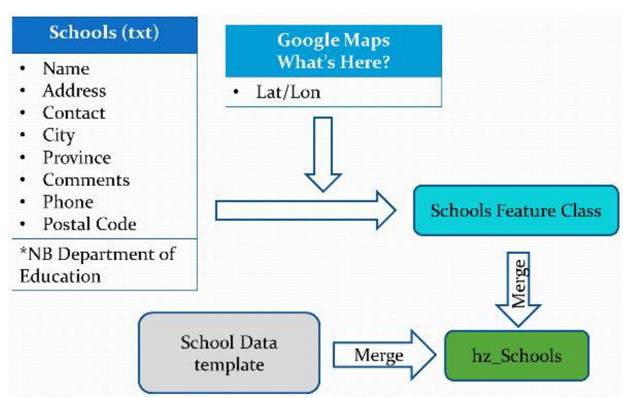

Figure 7. Data preparation steps followed to import school essential facility data from New Brunswick into Hazus

hydrometric data from the flood gauge (Station:01AK003) in Fredericton indicated the highest water level of 8.359 m at 00:11 AST on May 02, 2008 (Environment Canada, 2010b). Reports from the City of Fredericton "Flood News Releases," indicate the following regarding the 2008 flood:

- On April 30, the city had closed 22 roads and by May 1, 50 roads were closed
  - Including off ramps at the city's two bridges
- 680 evacuees registered with the Canadian Red Cross
- 304 customers were without power (as of May 3)
- Drinking water remained safe

The Canadian Disaster Database reports the estimated total cost of the 2008 flood to be $23 million. A further breakdown of spending in response to the flood is desired. Additionally, records of houses with flood claims exist, though access to these records has not yet been granted. As financial information is restricted, accessing this data has its challenges. Though, the benefits of comparing actual spending to a model will help with future flood mitigation and minimization of future losses.

6. CONCLUSIONS

A brief description of the Hazus flood loss assessment model and ongoing efforts on acquisition of required exposure and hazard input data for the pilot study in Fredericton (NB) is presented. The release of the flood model for Hazus is set for August 2014. This gives more time to source private and restricted datasets. It is expected that the input model for Fredericton will yield only approximate economic and social losses. These may not agree with the observed real expenditures and adjustments to the default calculations and parameters will be required. These adjustments include appropriate depth damage curves followed by calculation of replacement and contents value, demographics with respect to those requiring shelter, utility system valuations, etc. Though the focus of this study was on data collection and technology, the collaborative efforts of a range of partners across the province was a necessary component of this initiative. Through this collaboration beyond data collection, areas of mutual interest across partners have been identified and new relationships have formed.

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