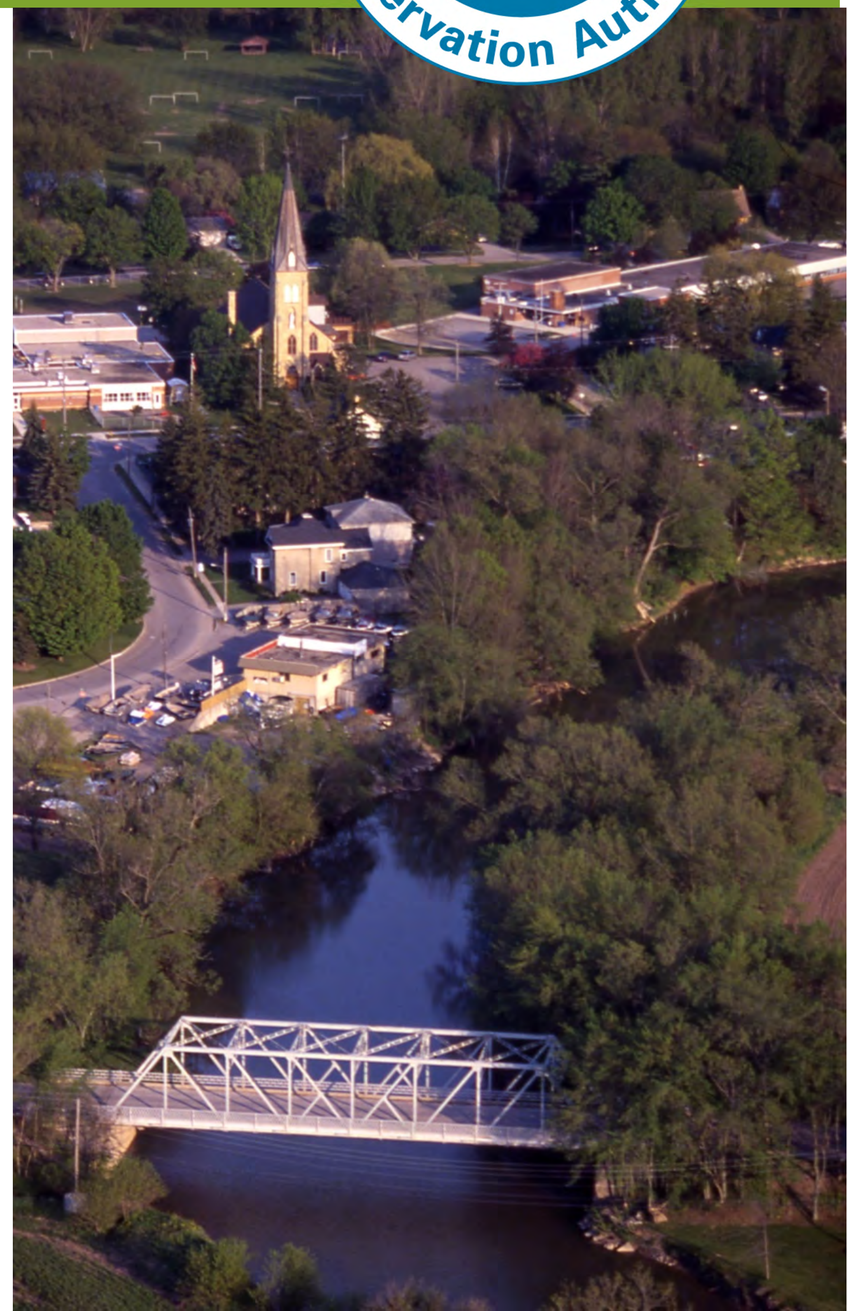
New Hamburg

Flood Mitigation Study

Welcome to the Public Information Centre

- Please sign in and join our project email list
- Review the posters and displays
- You are encouraged to share your experiences and fill out our survey and a comment sheet
- GRCA and Matrix Solutions staff are here to listen and answer your questions about this study



New Hamburg

Flood Mitigation Study

Purpose of the PIC

Meet the Project Team and learn more about:

- The Flood Mitigation Study
- Estimated flood damages for New Hamburg
- Next steps and opportunities for your participation

New Hamburg

Flood Mitigation Study

Background

- New Hamburg is one of 17 Flood Damage Centres in the Grand River watershed
- Flooding in February 2018 was caused by snowmelt and rainfall and reached levels not seen since 2008
- In September 2018, GRCA applied for funding under the federal National Disaster Mitigation Program (NDMP) to undertake the New Hamburg Flood Mitigation Study
- GRCA's funding application was approved in Spring 2019

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Flood Mitigation Study

Study Objectives

- Update flood mapping
- Estimate annual average flood damage costs
- Identify potential options for flood damage reduction, assess technical aspects, complete preliminary cost-benefit analysis

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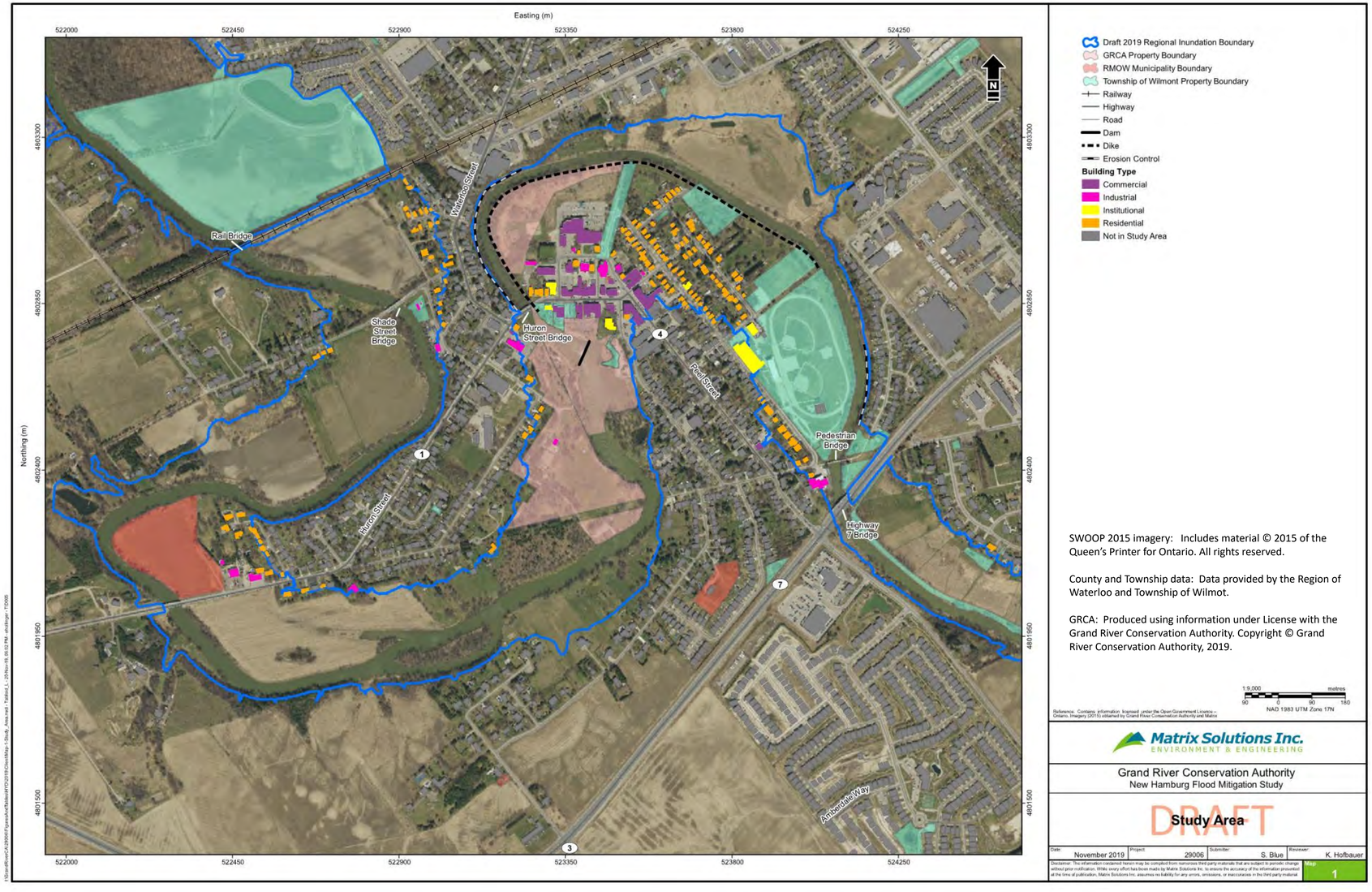
Flood Mitigation Study

Study Area

- Annual average flood damages have been assessed for areas at risk of flooding in New Hamburg
- Potential mitigation options and impacts considered by the study may be located within New Hamburg or the broader Nith River watershed



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Flood Mitigation Study

Schedule

We are here

Background Review & Data Collection

Summer 2019
Public Information Centre #1

Update Flood Mapping and Damage Estimate

Summer and Fall 2019
Public Information Centre #2

Identify and Assess Potential Mitigation Options

- Fall 2019 and Winter 2020
- Public Information Centre #3
- Expected completion by Spring 2020

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Flood Mitigation Study

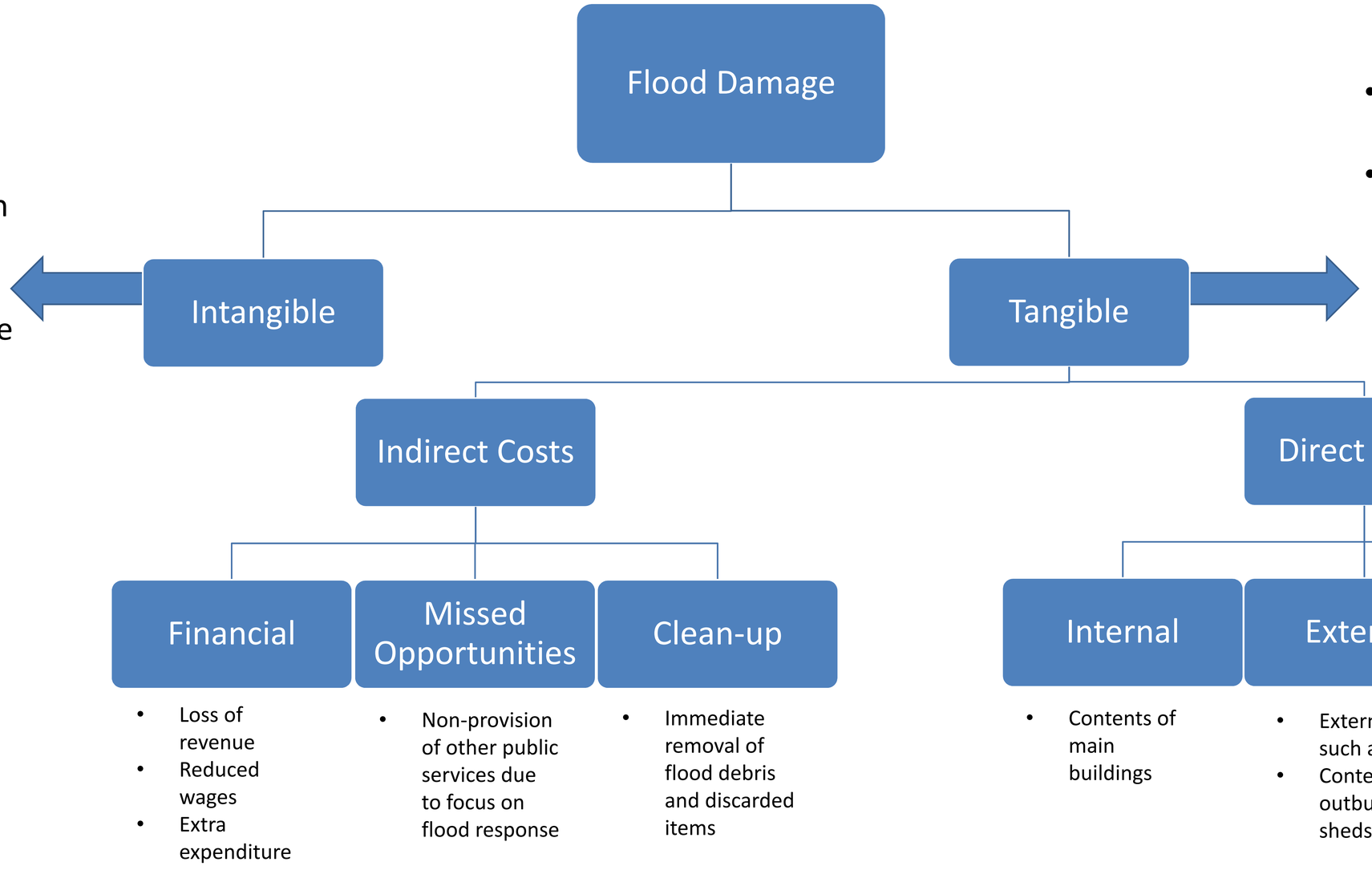
GRCA Tasks

- Create new hydraulic model and update flood inundation (water depth and extent) mapping - *complete*

Matrix Solutions Tasks

- Review background information - *complete*
- Update estimated flood damages – *draft complete*
- Develop and evaluate potential flood mitigation strategies - *underway*

What is included in flood damage estimates?



Social

- Mental health impacts
- General inconvenience in post flood phase

Financial

- Costs can be estimated in dollars
- Sources of costs include Survey of Household Spending and Statistics Canada price indexes

- Loss of revenue
- Reduced wages
- Extra expenditure

- Non-provision of other public services due to focus on flood response

- Immediate removal of flood debris and discarded items

- Contents of main buildings

- External items such as cars
- Contents of outbuildings, sheds

- Cleaning and repair of buildings, structures

This study estimates tangible damages only

Source: IBI Group/Golder Associates Ltd. Report: Flood Damage Assessment Study City of Calgary: Assessment of Flood Damages

Estimating Direct & Indirect Flood Damages to Buildings

Data Inputs

Buildings

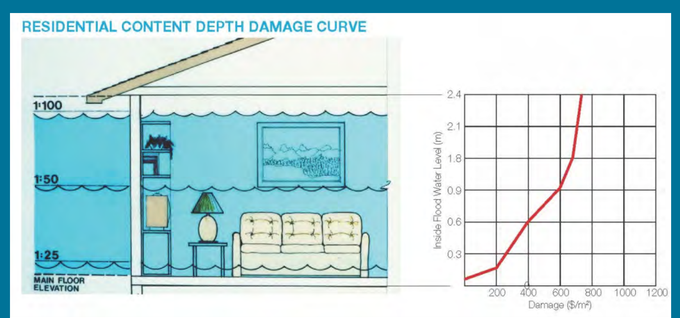
- Buildings are classified according to type:
  - Residential
  - Industrial
  - Commercial
  - Institutional
- Building characteristics are defined

Water Elevations

- Water surface elevations from flood events are output from the hydraulic model

Flood Depth & Damage Relationships

- Damages are based on flood levels in buildings, using the most up-to-date flood **depth-damage relationships** for building contents and structure



Natural Resources Canada (NRCAN). 2017. "Canadian Guidelines and Database of Flood Vulnerability Functions." Addendum to Canadian Floodplain Mapping Guidelines Series. March 2017.

Flood Damage Calculations

Flood Depths

- **Flood depth** is determined for each building and each flood event

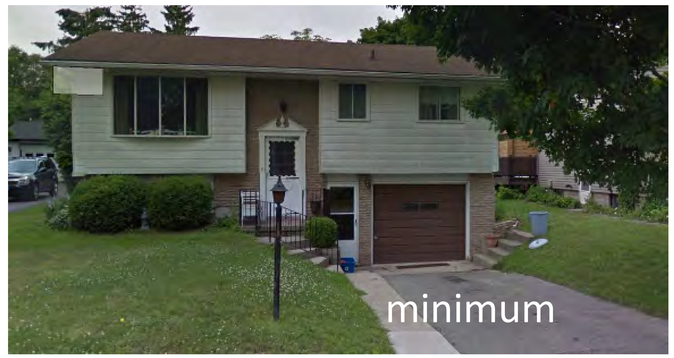
Flood Damages

- **Direct** damages are computed by adding up all content and structural damages
- **Indirect** damages are estimated as a percentage of direct damages
- **Total damages** are computed by adding direct + indirect damages

Field Visits

- We viewed all buildings in the study area from the road
- Purpose was to improve data quality and address data gaps
- Data we collected:
  - Building type (e.g., retail, grocery, industrial)
  - Presence of basement (residential)
  - Presence and size (# of cars) of attached garage
  - Presence of multi-storey and split level buildings
  - Number of risers (steps) to first floor
  - Elevation of first floor compared to ground surface surrounding the building (min/mean/max elevation)

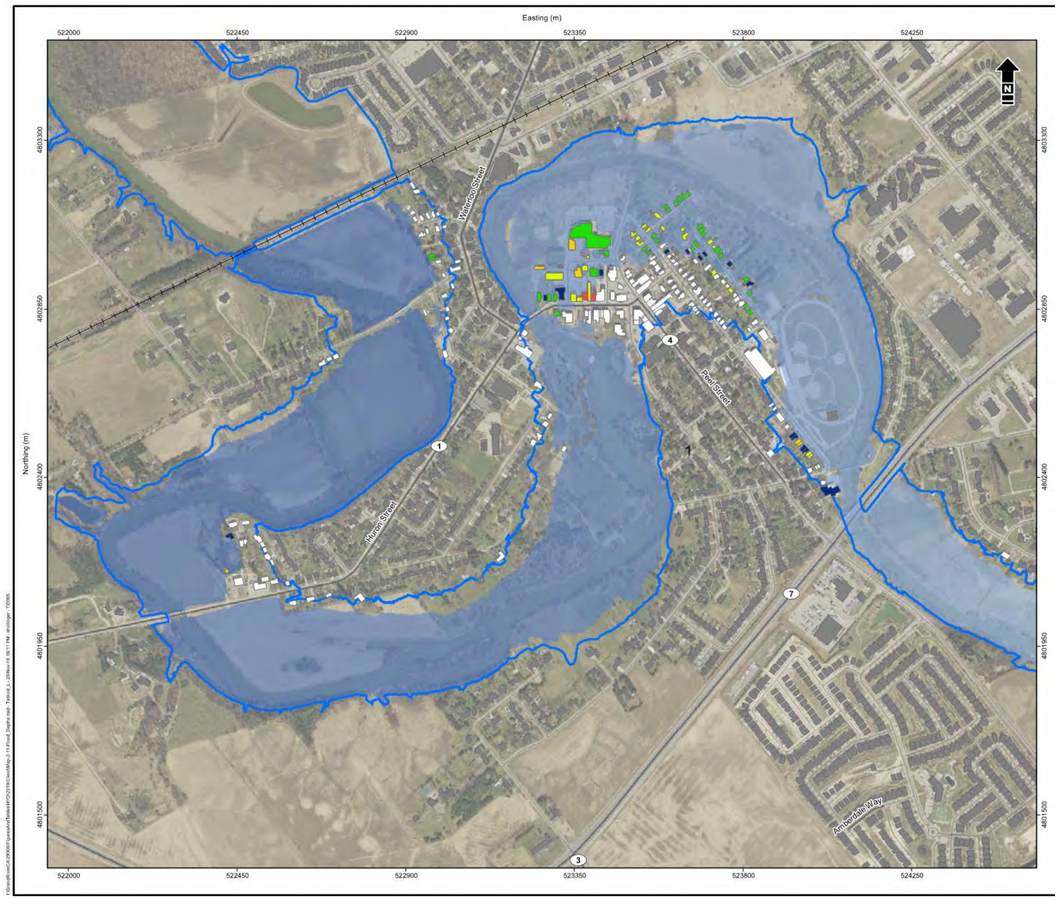
Examples of comparing elevation of first floor to surrounding ground surface



Flood Depths

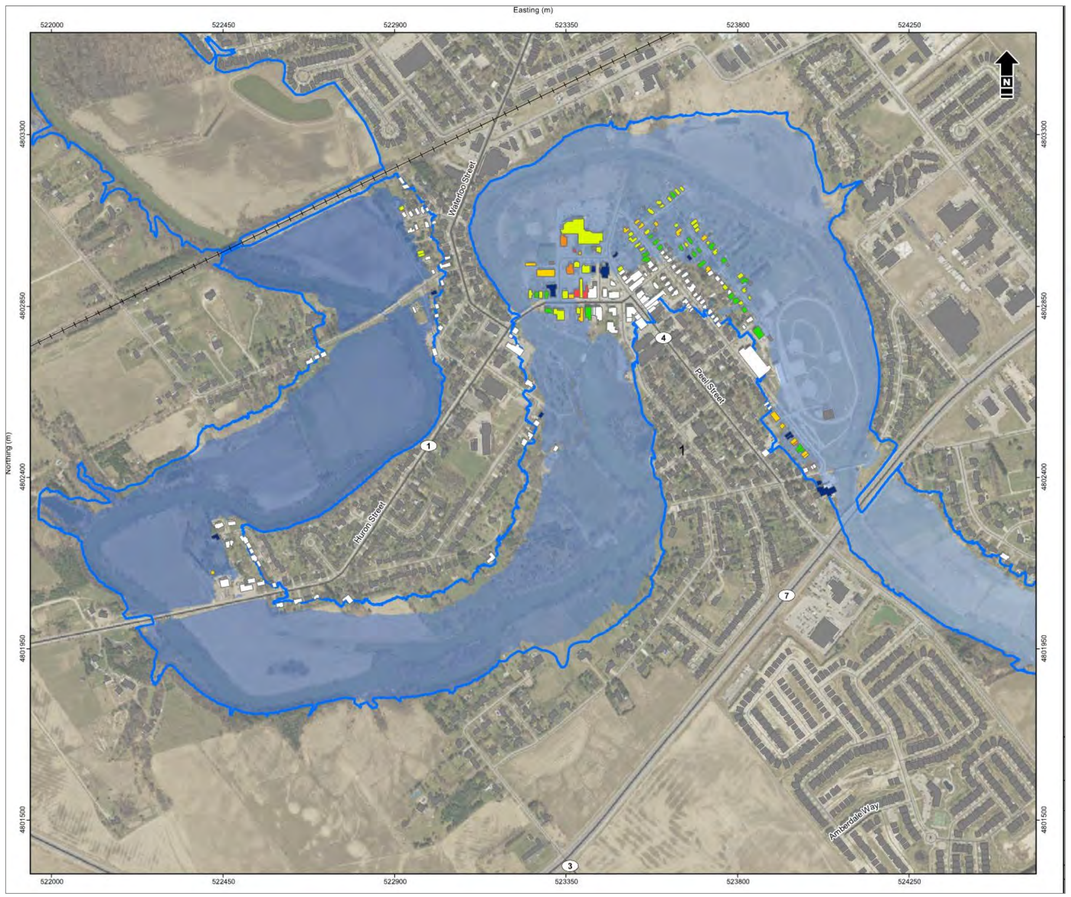
2-Year Storm Event (179 m^3/s)

10-Year Storm Event (322 m^3/s)



Flood Depths

25-Year Storm Event (394 m^3/s)



Draft 2019 Regional Inundation Boundary
Railway
Highway
Road

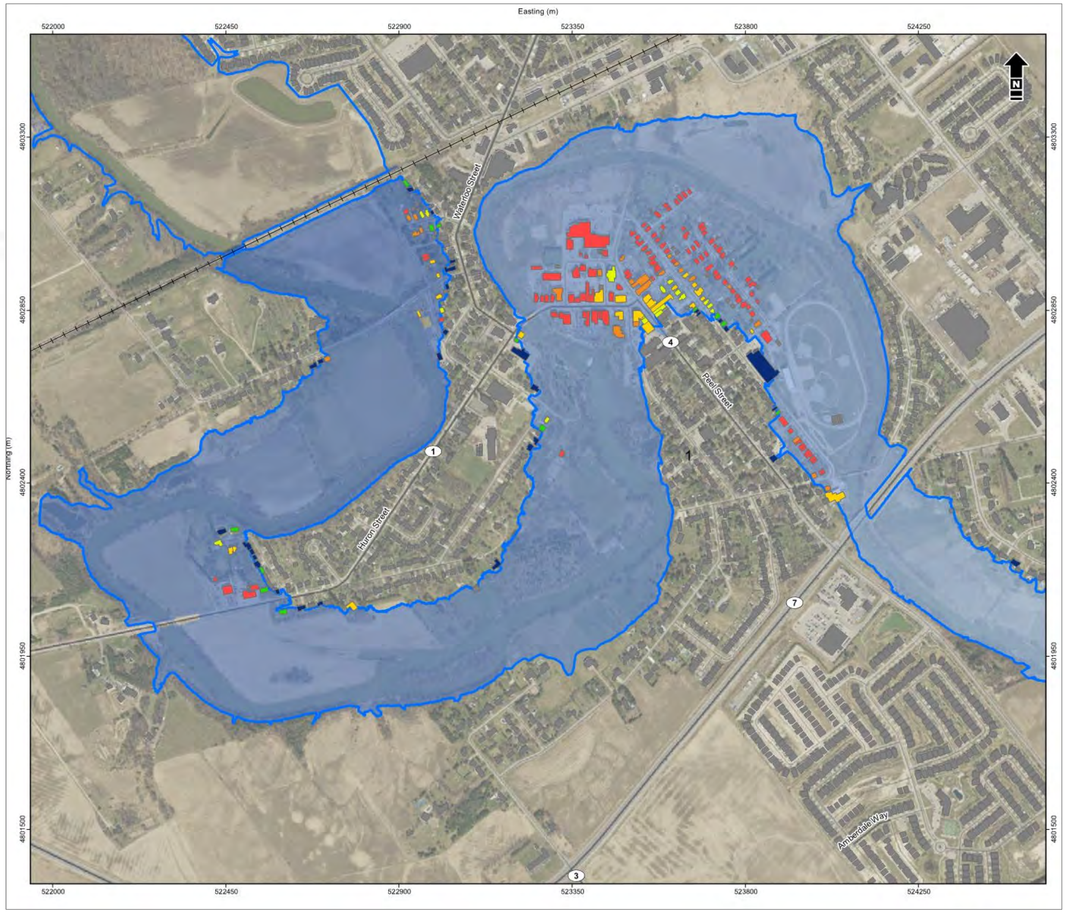
Flood Depth (m) Relative to First Floor Elevation

- < -1.0
- -1.0 to -0.50
- -0.50 to 0.0
- 0.0 to 0.50
- 0.50 to 1.0
- > 1.0
- Building - Not Flooded
- Building - Not in Study Area

Water Surface Elevation (m)

- High : 338.6
- Low : 328.4

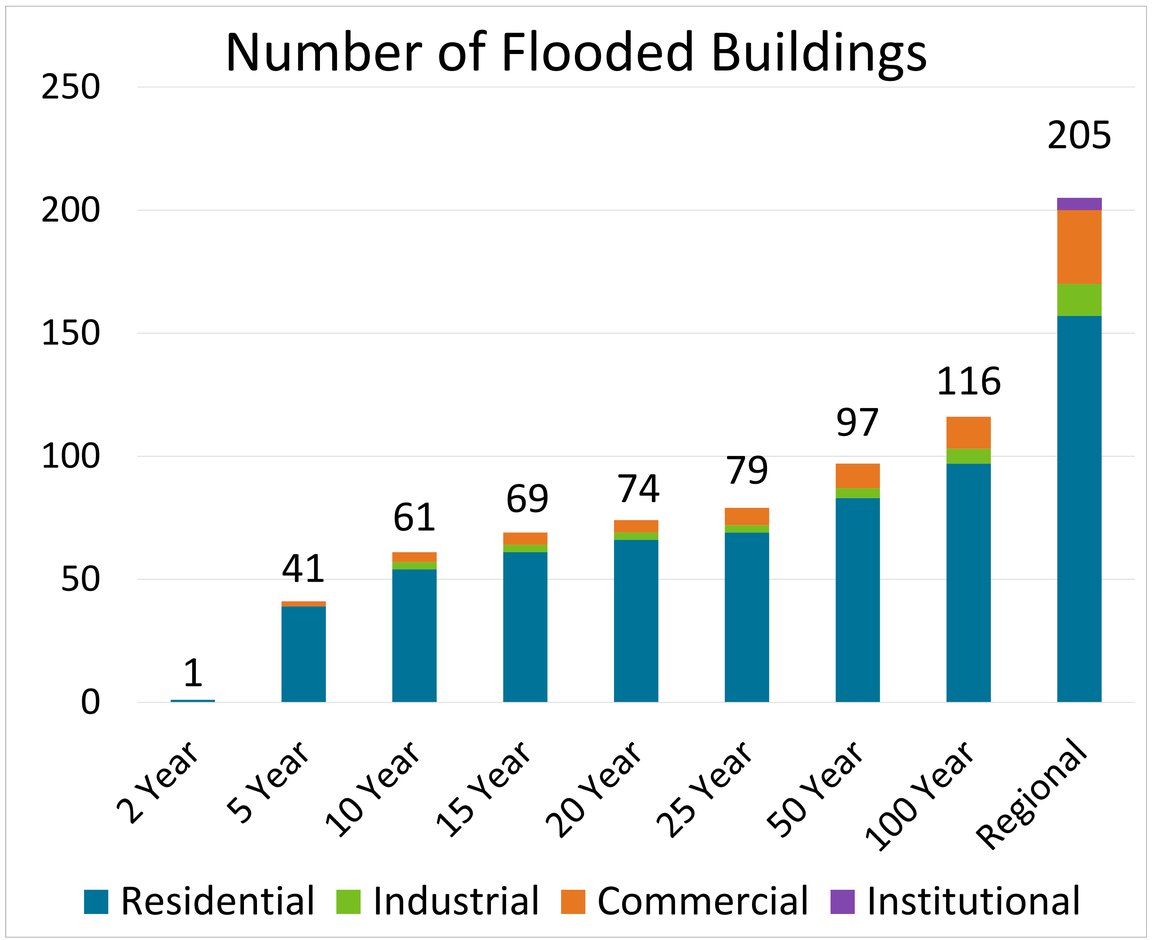
Regional Storm Event (1011 m^3/s)

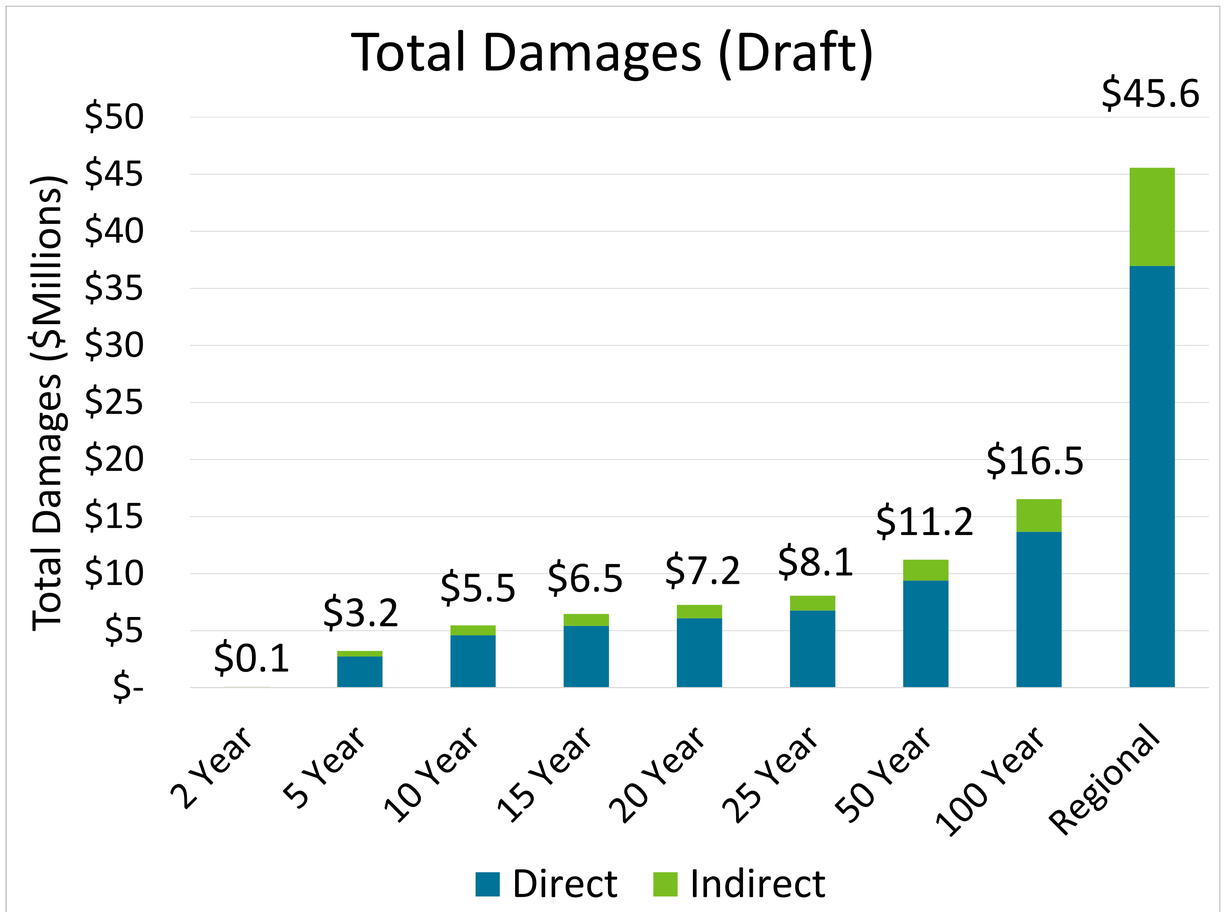


- Regional storm event shows land that would be flooded from the rainfall experienced during Hurricane Hazel (1954)

Results Overview

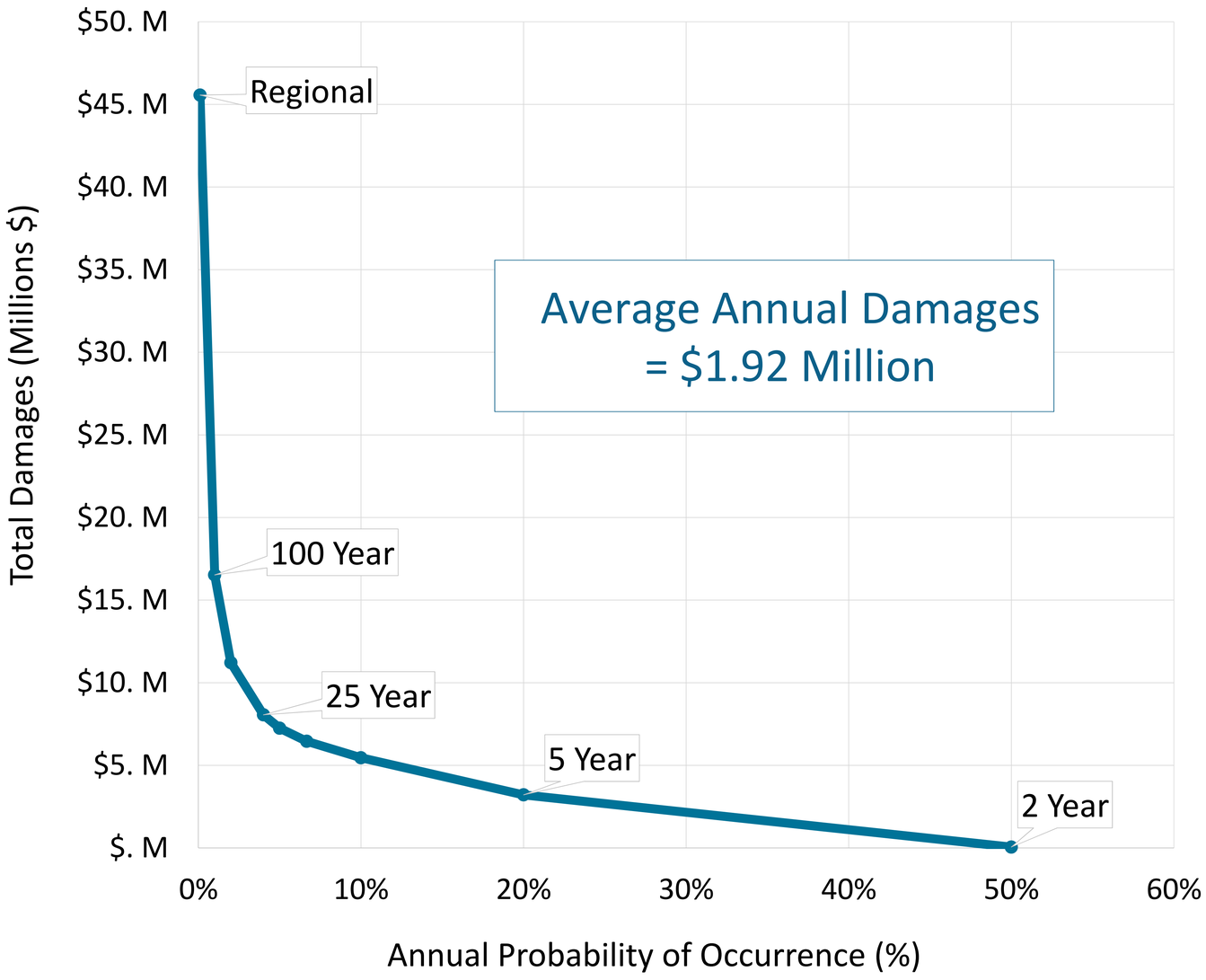
- The number of flooded buildings and the total direct and indirect damages were estimated for a range of flood events of varying severity
- Estimated damages are highest for less frequent flood events





Assumes all basements are finished

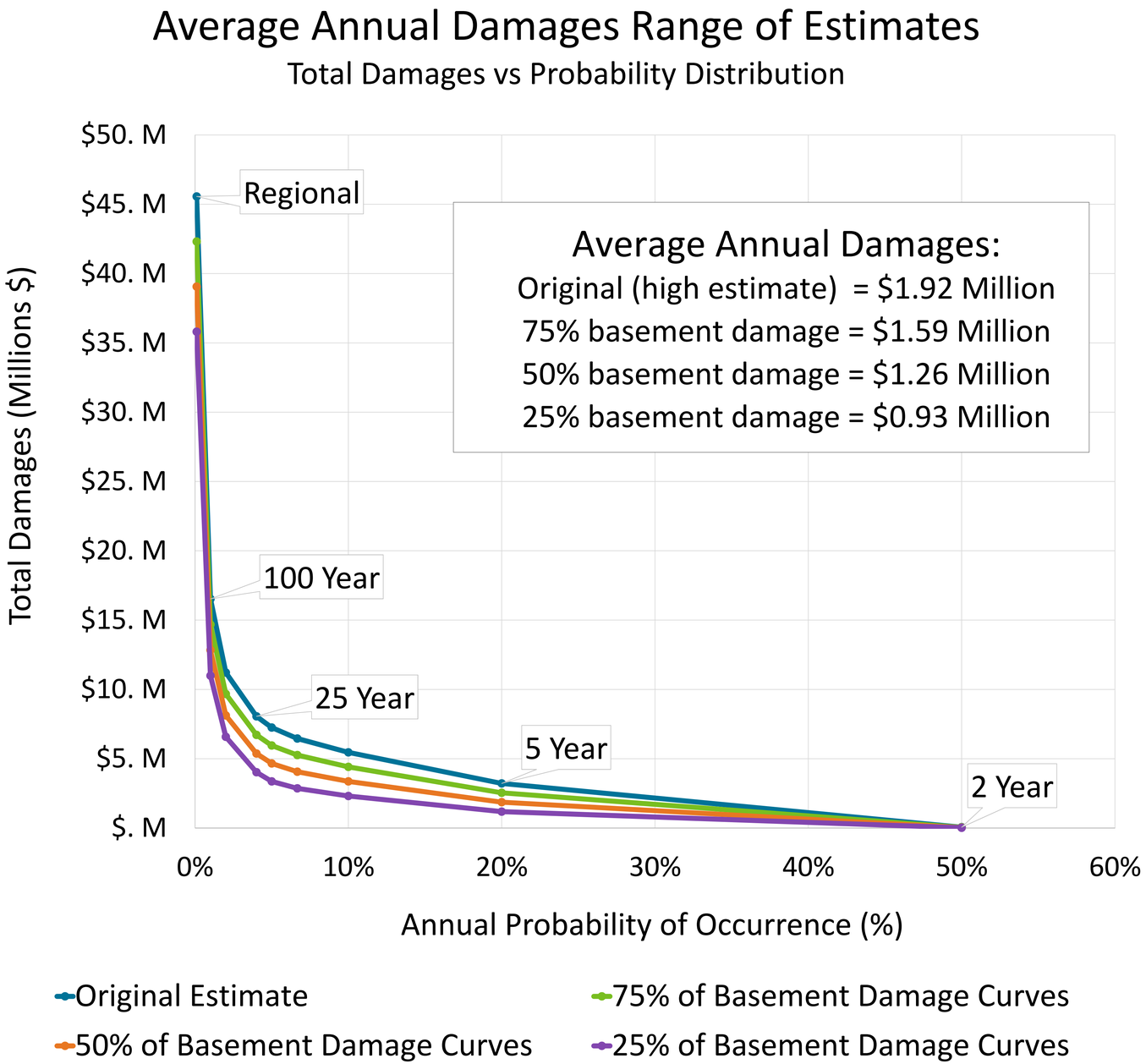
Average Annual Damages



- Average Annual Damages:
  - Damages that could occur on an average annual basis
  - Calculated as the area under the damage-probability curve
  - We will consider how mitigation options reduce the average annual damages
  - Relationships for flood depth and damages include finished basements and do not reflect adaptation measures by home owners (e.g., flood proofing, raising contents off basement floor)

Fill out a **survey** to help inform the study

Average Annual Damages



- Depth-damage relationships don't consider for unfinished basements
- We can apply a reduction factor to see how much basement damages are driving the overall average annual damages
- We reduced basement depth-damage curves to 75%, 50%, and 25% of original damages

Changes from 1983 Study

- A direct comparison of flood damage estimates between studies is not valid as a number of assumptions and inputs are different.

Component	1983 Study	2019 Study
Regulatory Event		
Flow Rate	756 m^3/s	1,011 m^3/s
Number of Buildings in Floodplain	122	205
Regulatory Floodplain Mapping Update	Pre-1985 floodplain mapping update	2019-2020 floodplain mapping update
Depth-Damage Curves		
Source of data	• 2 residential curves for either frame or brick houses with basements developed in 1960s • 4 curves for industrial/ commercial/ institutional buildings developed in 1970s	• most up-to-date curves available in Canada • adapted for use in Ontario by Toronto and Region Conservation Authority • based on 2015 Alberta Provincial Flood Damage Assessment by IBI Group • 40 residential and 25 industrial/ commercial/ institutional curves
Basement Assumptions	• All homes have basements • Some commercial units have basements	• Field verified homes with/without basements • All basements are finished • No industrial/ commercial/ institutional units have basements
Total Damages		
Indirect Damages	% of direct damages	% of direct damages
Public Damages	4% of direct + indirect damages	Not included
Average Annual Damages		
Average Annual Damages ($2016)	$77,500	$0.9 – 1.9 Million

Source: Grand River Implementation Committee (GRIC). 1983. "Flood Damages in the Grand River Basin Technical Report No. 39." Addendum to Grand River Basin Water Management Study Technical Report Series. Cambridge, Ontario. 1983.

Potential Impacts to Infrastructure

Infrastructure damages are difficult to estimate

- amount of damage is a function of both the flood water characteristics (depth, velocity, debris, ice), and
- ability of the infrastructure (e.g., a road) to withstand flood conditions (road surface, life span, state of repair)

Inventory of potential at-risk infrastructure

- Length of roads (km) flooded for each storm event
- Bridges requiring repair or replacement if the water surface elevation reaches the ground surface elevation at any point along the bridge

Storm Event	Flooded Roads (km)	Inundated Bridge (repairs or full replacement)				
		Railway	Shade St	Huron St	Pedestrian	Hwy 7
2 Year	0.6	No	No	No	No	No
5 Year	1.7	No	No	No	No	No
10 Year	2.2	No	No	No	No	No
15 Year	2.4	No	No	No	No	No
20 Year	2.5	No	No	No	No	No
25 Year	2.5	No	No	No	No	No
50 Year	2.7	No	No	No	No	No
100 Year	2.9	No	No	No	Yes	No
Regional	5.2	No	Yes	Yes	Yes	No

Huron St Bridge on Feb 21, 2018 (source: A. Loeffler, GRCA)

Dec 28, 2008 (source: GRCA)

Identify & Assess Flood Mitigation Options

Next steps:

- Identify potential options for reducing (mitigating) flood damages and their costs
- Estimate reduction in annual average flood damages for each potential mitigation option
- Assess costs and benefits of investing in potential mitigation options
- Document project findings and recommendations

Identify & Assess Flood Mitigation Options

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Grand River Conservation Authority

We're considering these options to reduce flooding

Potential Mitigation Options
• Channel widening • Channel lowering • Channel naturalization and floodplain creation • Dam removal • Dam modifications • Bridge replacement/improvements • Vegetation management • Floodplain improvements
• Dike improvements (extension in height & length) • Floodwall
• Flow diversion
• Upstream flood control (e.g., reservoir) • Online storage
• Landowner floodproofing initiatives • Land acquisition • Flood warning system improvements

We're evaluating the options using these criteria

Evaluation Criteria
1. Economic
1.1 Return on investment
1.2 Capital costs
1.3 Operation and maintenance costs
2. Technical
2.1 Flood risk improvements
2.2 Ice jam resiliency
2.3 Climate change resiliency
2.4 Upstream impacts
2.5 Technical feasibility/constructability
3. Stakeholder
3.1 Public acceptance
3.2 Property impacts
3.3 Land ownership
3.4 Safety
4. Environmental
4.1 Ecology and aquatic habitat
4.2 Geomorphology (e.g., erosion and sediment transport)
4.3 Heritage and archaeology
5. Policy
5.1 Regulatory approvals
5.2 Special Policy Area amendments
5.3. Township considerations

We will be selecting 5 mitigation option scenarios to study further

5 mitigation option scenarios for further evaluation

Fill out a **comment sheet** to share your suggestions

New Hamburg

Flood Mitigation Study

How You Can be Involved

- Fill out and submit a **Survey** to improve our understanding of the prevalence of finished basements and extent of actual flood damages you've experienced
- Fill out and submit a **Comment Sheet** to share suggestions about potential mitigation options
- All information provided will be kept confidential and will provide broad context for the study
- Attend the Public Information Centres for project updates and findings or visit our project webpage: www.grandriver.ca/NHFloodStudy

To comment or request information, please call or email us at:

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History of Studies and Works

- 1962 Grand River Hydraulics Report
- 1966 GRCA acquires New Hamburg dam
- 1970 New Hamburg dike built
- 1978 Preliminary Engineering Study – Nith River at New Hamburg
- 1978-1982 Nith River Erosion Protection Works
- 1983 Grand River Basin Water Management Study – Flood Damages Report
- 1985 Nith River Flood Line Mapping Study
- 1989 New Hamburg dam rebuilt
- 2017 New Hamburg dike maintenance (tree and brush removal)

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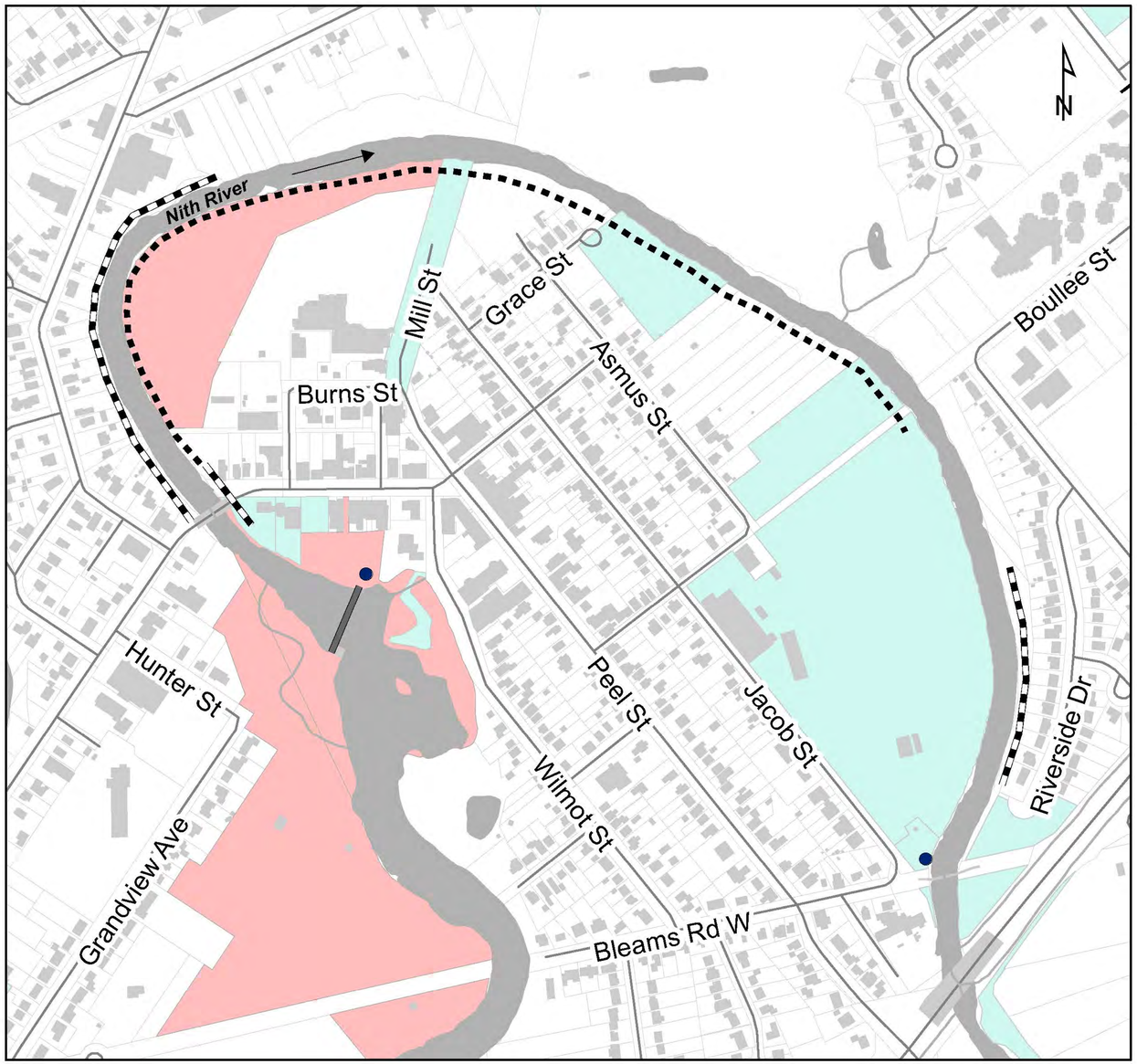
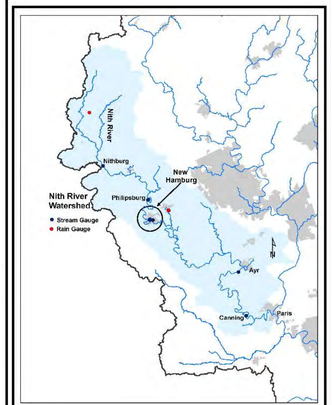
Water Management Infrastructure



NEW HAMBURG

Legend

- Stream Gauge
- Watercourse
- Dike
- Erosion Control
- Dam
- Road
- Waterbody
- Property (GRCA)
- Property (Township)



County and Township data: Data provided by the Region of Waterloo and Township of Wilmot.

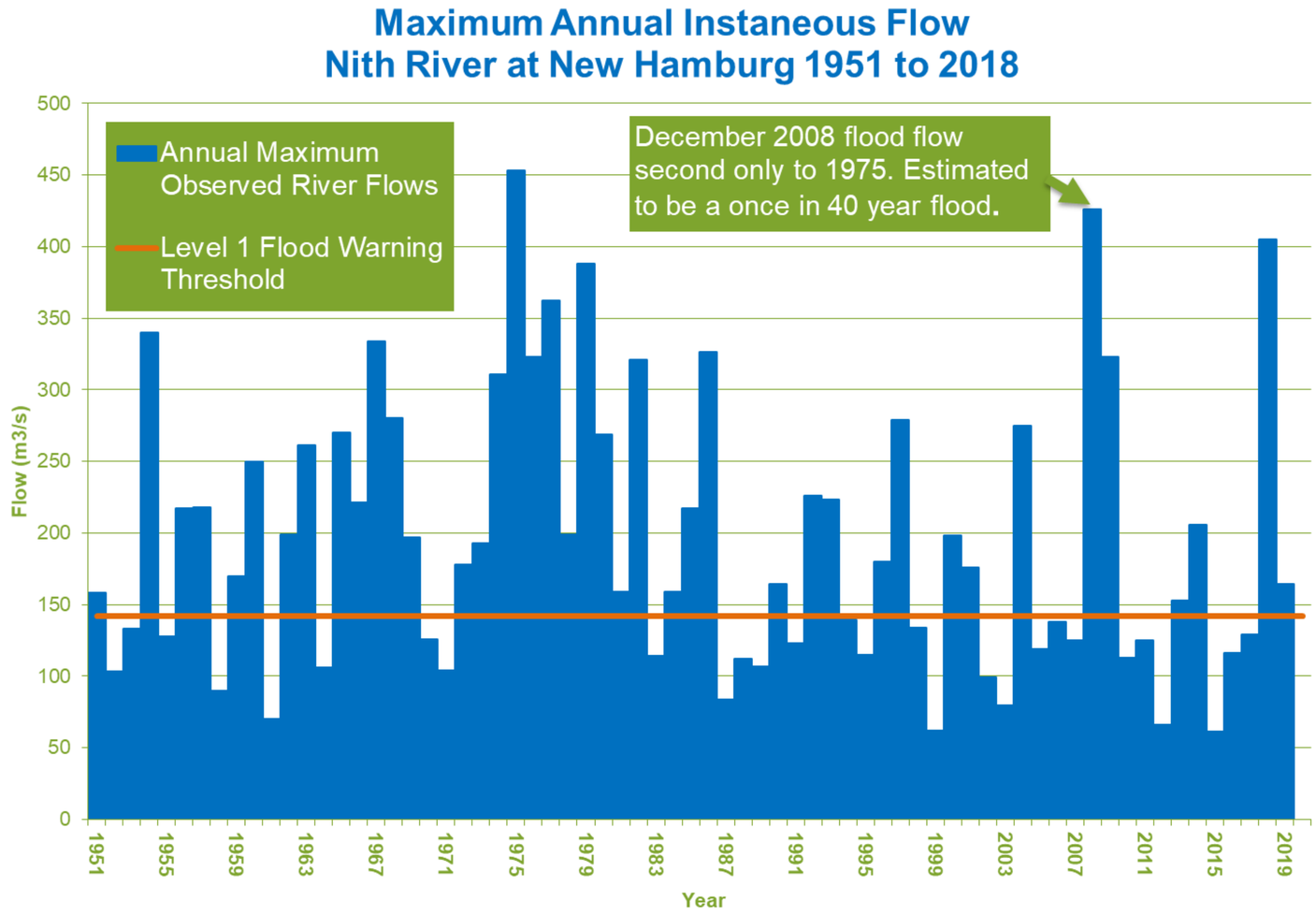
Meters

0 30 60 120 180 240

Nith River

Flooding History

- Highest flood flows on record in 1975
- Other notable floods – December 2008, February 2018
- Floods can occur during any season
- Larger floods have resulted from combined snowmelt and rainfall
- The highest annual flows are trending earlier in the year



GRCA Roles in Managing Floods

Flood Response

1. Monitor watershed and weather conditions to predict flooding.
2. Operate dams and reservoirs to reduce the effects of flooding.
3. Issue flood warning messages to municipal flood coordinators.

GRCA Roles in Managing Floods

Regulation of Development in Floodplains

- Flooding can threaten lives and cause property damage
- Floodplains are areas near rivers and streams that are subject to flooding
- Under the Conservation Authorities Act and Ontario Regulation 150/06, development within floodplains and other hazard lands requires a permit from GRCA
- The regulated floodplain (or riverine flooding hazard) is the land that would be inundated under a flood resulting from the rainfall experienced during Hurricane Hazel (1954)
- Floodplain mapping is created using river flows (from hydrologic models), flood elevations (from hydraulic models), and land surface mapping
- Updates to modeling and mapping undertaken for the New Hamburg Flood Mitigation Study may result in future amendments to GRCA's regulated area mapping

Municipal Roles in Managing Floods

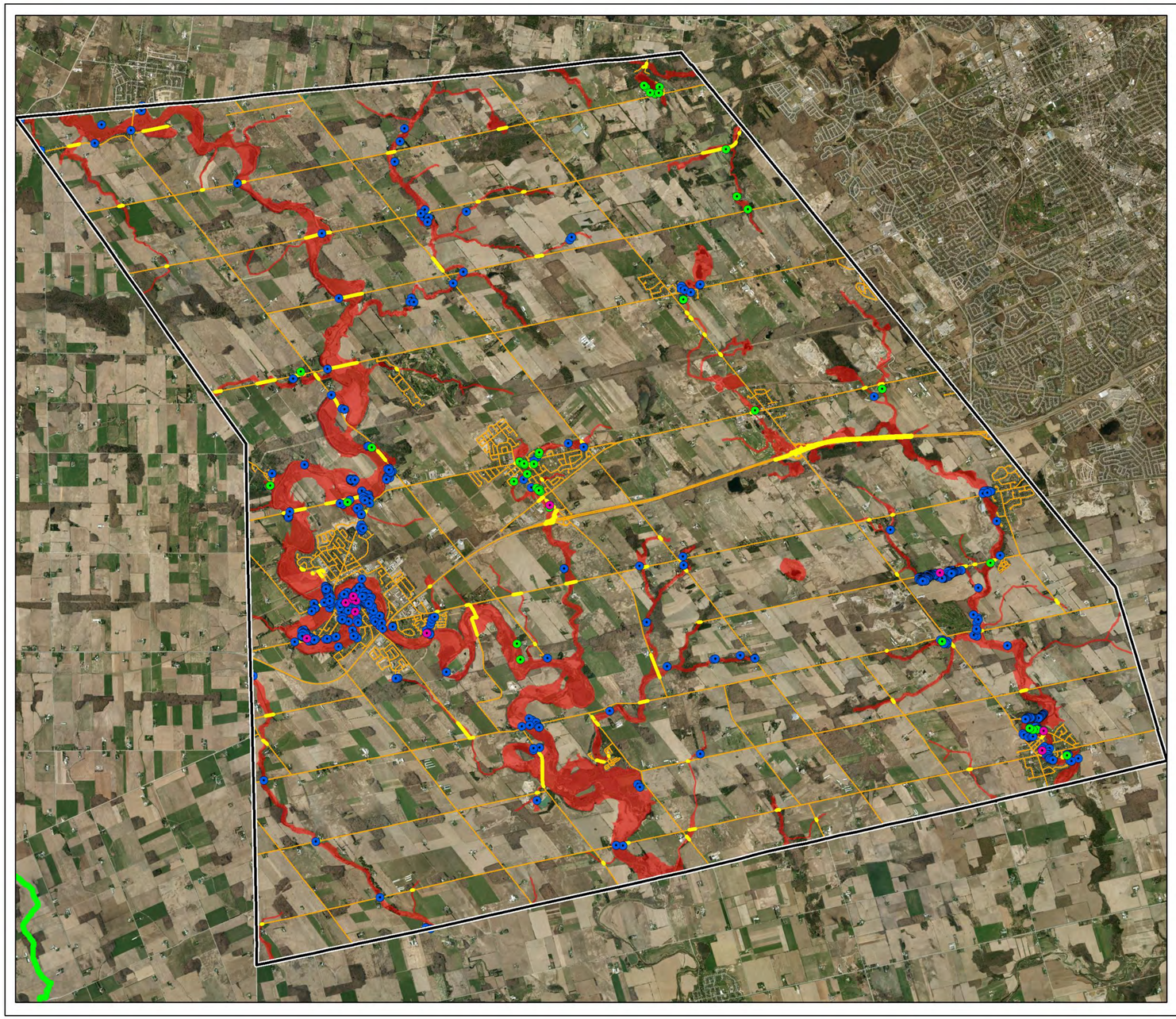
Flood Response

Upon receipt of a Flood Message, Municipal Officials:

1. Warn staff, affected citizens, businesses, and the general public in the forecast flood hazard area.
2. Coordinate and enact Municipal Emergency Flood Response Plans.
3. Monitor the flood situation and liaise with GRCA Flood Coordinators.

Nith River

Wilmot Township Flood Preparedness Mapping



Grand River Conservation Authority

Flood Emergency Map
Township of Wilmot

Legend

- Critical Infrastructure
- Buildings in Floodplain
- Footprints in Floodplain
- Roads in Floodplain
- Roads
- Floodplain
- Township of Wilmot
- Watershed Boundary

Overview Statistics

Count of features in the floodplain:
Buildings in Floodplain: 41
Footprints in Floodplain: 753
Critical Infrastructure: 12
Roads in Floodplain (seg): 213
Roads in Floodplain (km): 32.4
Surface area of Floodplain: 26.23 sq km
Proportion Floodplain of Study: 9.9%

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This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.

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