

Sussex Region Flood Risk Mitigation Master Plan

March 30, 2022



Public Presentation

Outline

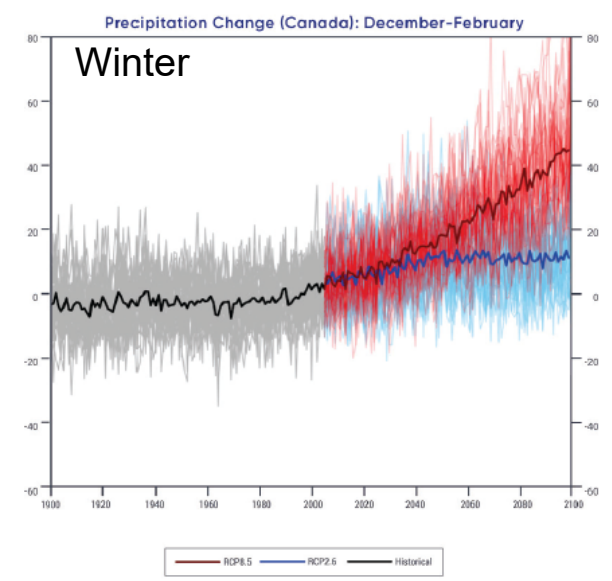
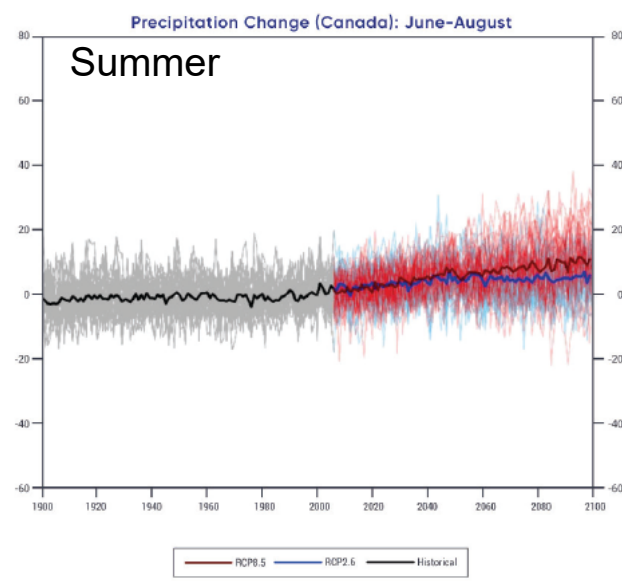
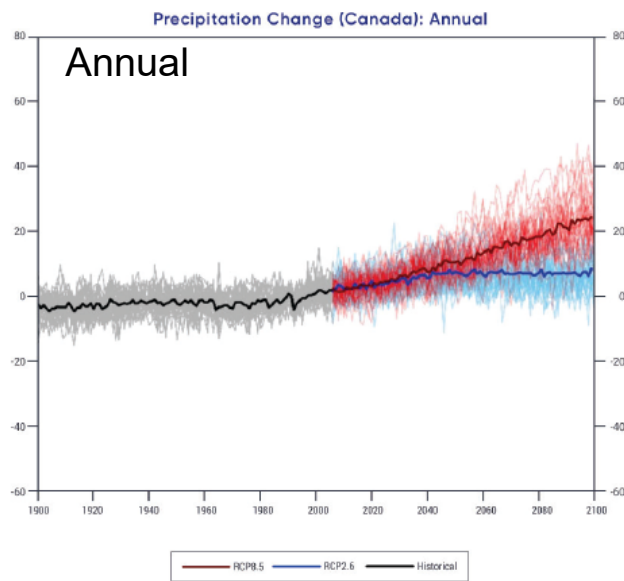
- Project History
- Flood Damage Estimates
- Flood Diversion Scenarios
- In Closing

Project History

- Repeated flooding culminating in 2014 and 2015 floods (2020)
- Quantified climate-change driven increase in precipitation

Project History cont'd

- Average Canadian precipitation changes (from 1948 – 2005)



Project History cont'd

- Changes in **observed** mean precipitation 1948 - 2012

REGION	CHANGE IN PRECIPITATION, %				
	Annual	Winter	Spring	Summer	Autumn
British Columbia	5.0	-9.0	18.2	7.9	11.5
Prairies	7.0	-5.9	13.6	8.4	5.8
Ontario	9.7	5.2	12.5	8.6	17.8
Quebec	10.5	5.3	20.9	6.6	20.0
Atlantic	11.3	5.1	5.7	11.2	18.2
Northern Canada	32.5	54.0	42.2	18.1	32.1
Canada	18.3	20.1	25.3	12.7	19.0



Project History cont'd

- Changes in **projected** annual mean precipitation

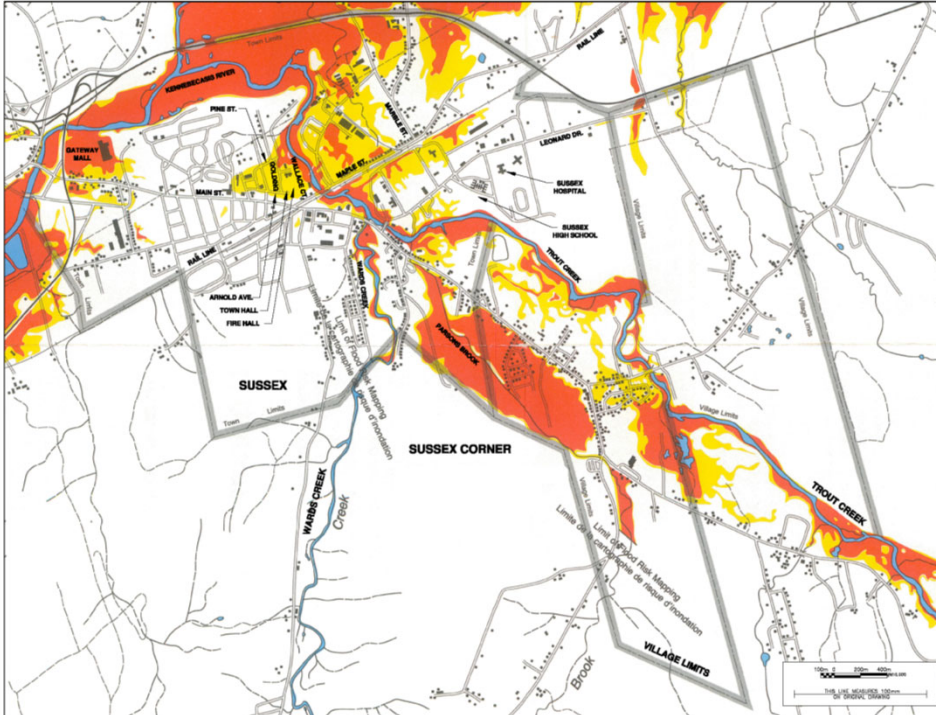
REGION ^b	SCENARIO; PERIOD; MEDIAN (25TH, 75TH PERCENTILE), %			
	RCP2.6		RCP8.5	
	2031–2050	2081–2100	2031–2050	2081–2100
British Columbia	4.3 (-0.4, 9.8)	5.8 (0.4, 11.9)	5.7 (0.0, 11.4)	13.8 (5.7, 22.4)
Prairies	5.0 (-0.7, 10.8)	5.9 (-0.2, 12.1)	6.5 (0.4, 13.1)	15.3 (6.3, 24.9)
Ontario	5.5 (0.4, 11.1)	5.3 (-0.1, 10.8)	6.6 (1.8, 12.4)	17.3 (8.5, 26.1)
Quebec	7.1 (2.0, 12.2)	7.2 (2.2, 13.0)	9.4 (4.5, 14.7)	22.5 (14.8, 32.0)
Atlantic	3.8 (-0.8, 9.1)	4.7 (0.3, 9.0)	5.0 (0.6, 9.9)	12.0 (5.7, 19.3)
North	8.2 (2.1, 14.6)	9.4 (2.8, 16.7)	11.3 (5.4, 18.1)	33.3 (22.1, 46.4)
Canada	5.5 (0.2, 11.2)	6.8 (0.4, 14.4)	7.3 (2.0, 13.2)	24.2 (13.7, 36.2)



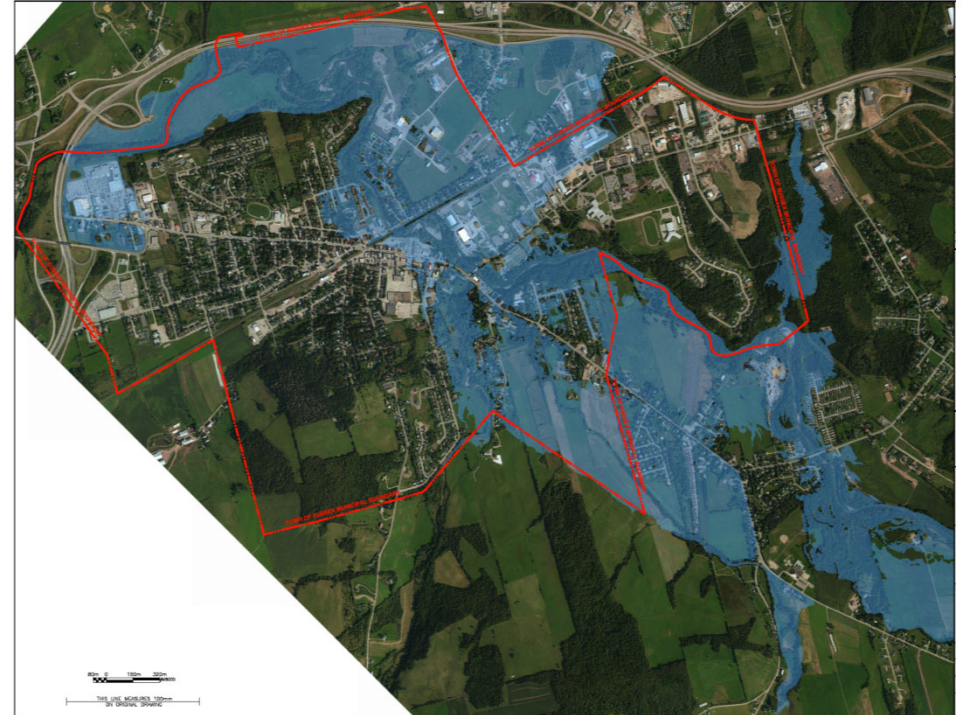
Project History

- Repeated flooding culminating in 2014 and 2015 floods (2020)
- Quantified climate-change driven increase in precipitation
- Studied historic flood risk (1985) and quantified future flood risks (2100)
 - Year 2100 precipitation increases by 20%
 - Year 2100 flood flows increase by 14.5% to 16.6%
 - Year 2100 increases in flood levels:
 - 20 year event: 0.18 m to 0.29 m
 - 100 year event: 0.25 m to 0.36 m
- Updated flood risk mapping

Project History cont'd



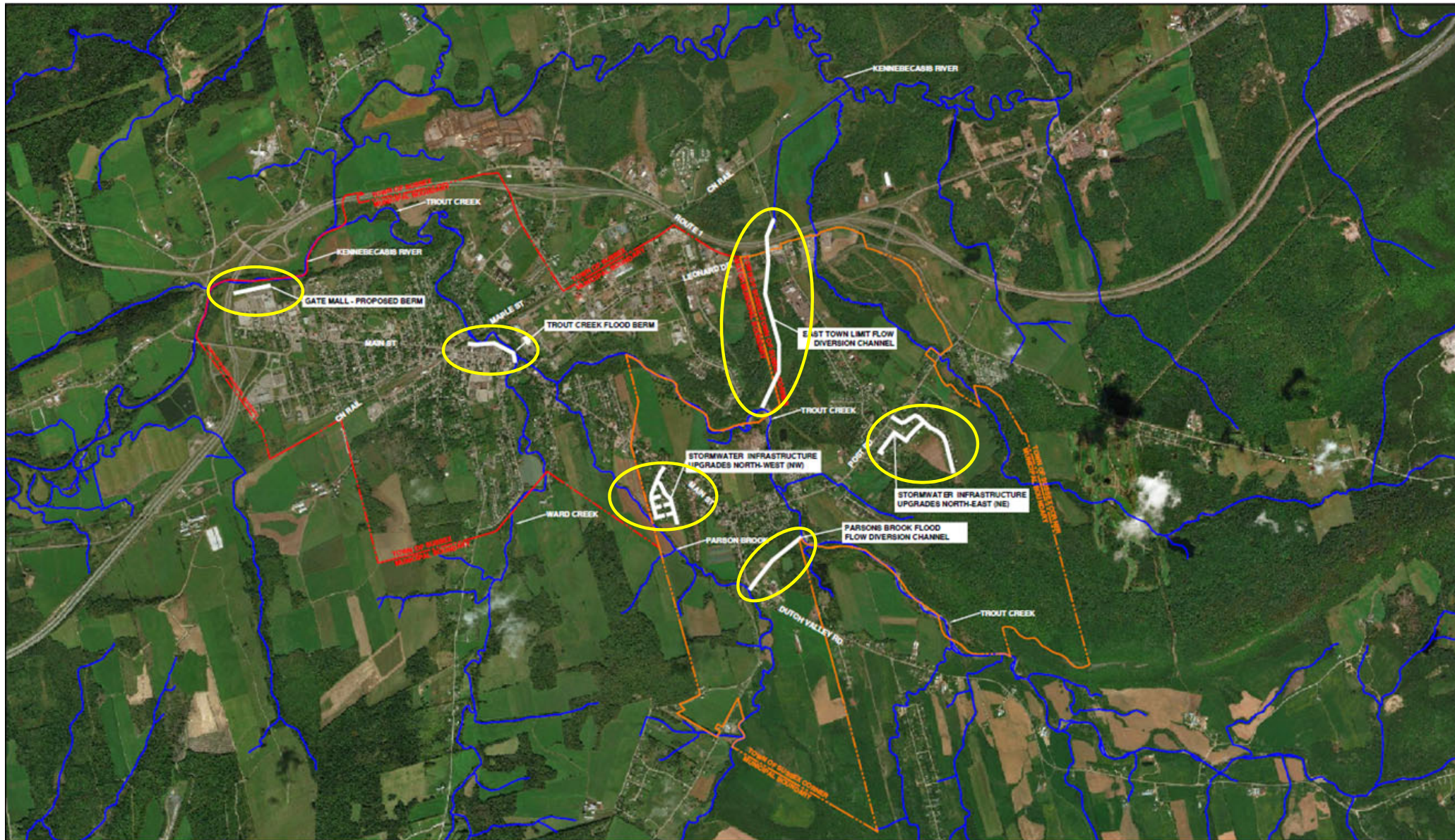
1985 Flood Risk

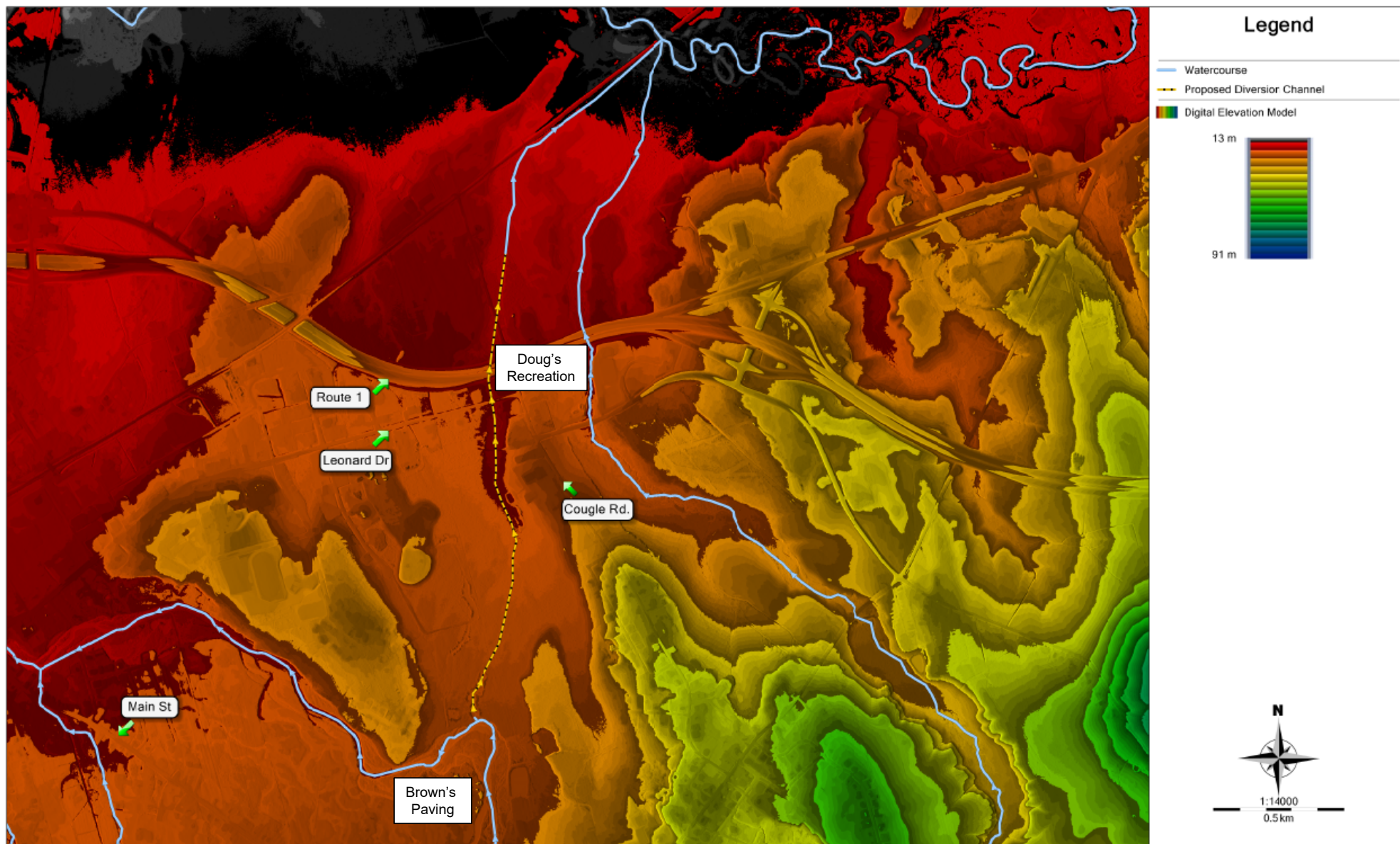


2100 Flood Risk

Project History cont'd

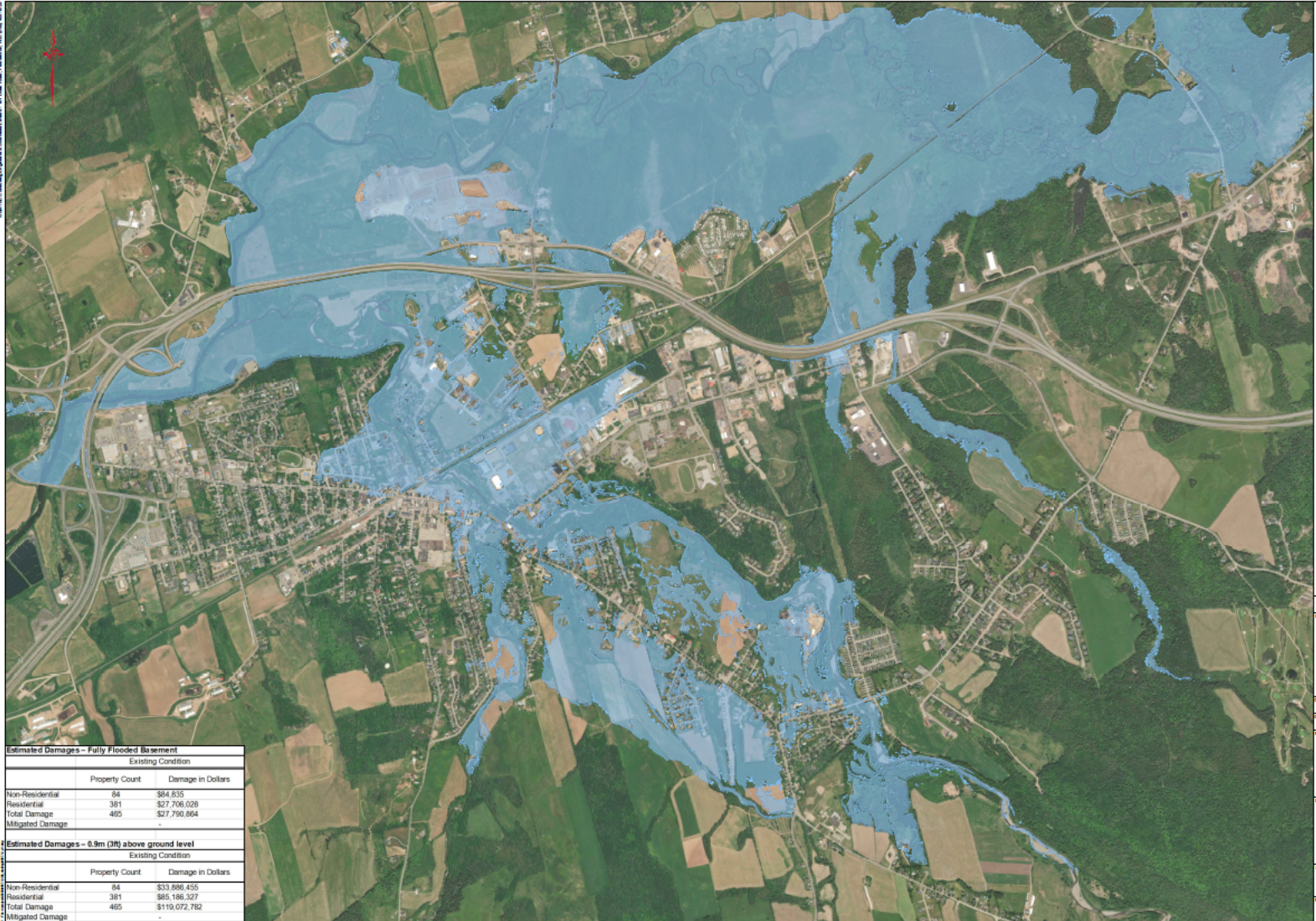
- Repeated flooding culminating in 2014 and 2015 floods
- Quantified climate-change driven increase in precipitation
- Studied historic flood risk and quantified future flood risks
- Updated flood risk mapping
- Identified and evaluated flood risk mitigation projects (app. 10)
- Developed regional flood risk mitigation plan (6 projects)





Flood Damage Estimates

- Constructed and refined hydraulic model
- Modelled year 2100 flood inundation limits



Estimated Damages - Fully Flooded Basement		
Existing Condition		
	Property Count	Damage in Dollars
Non-Residential	54	\$64,635
Residential	381	\$27,706,028
Total Damage	435	\$27,770,664
Mitigated Damage	-	-

Estimated Damages - 0.9m (3ft) above ground level		
Existing Condition		
	Property Count	Damage in Dollars
Non-Residential	54	\$33,686,435
Residential	381	\$85,186,327
Total Damage	435	\$119,072,762
Mitigated Damage	-	-

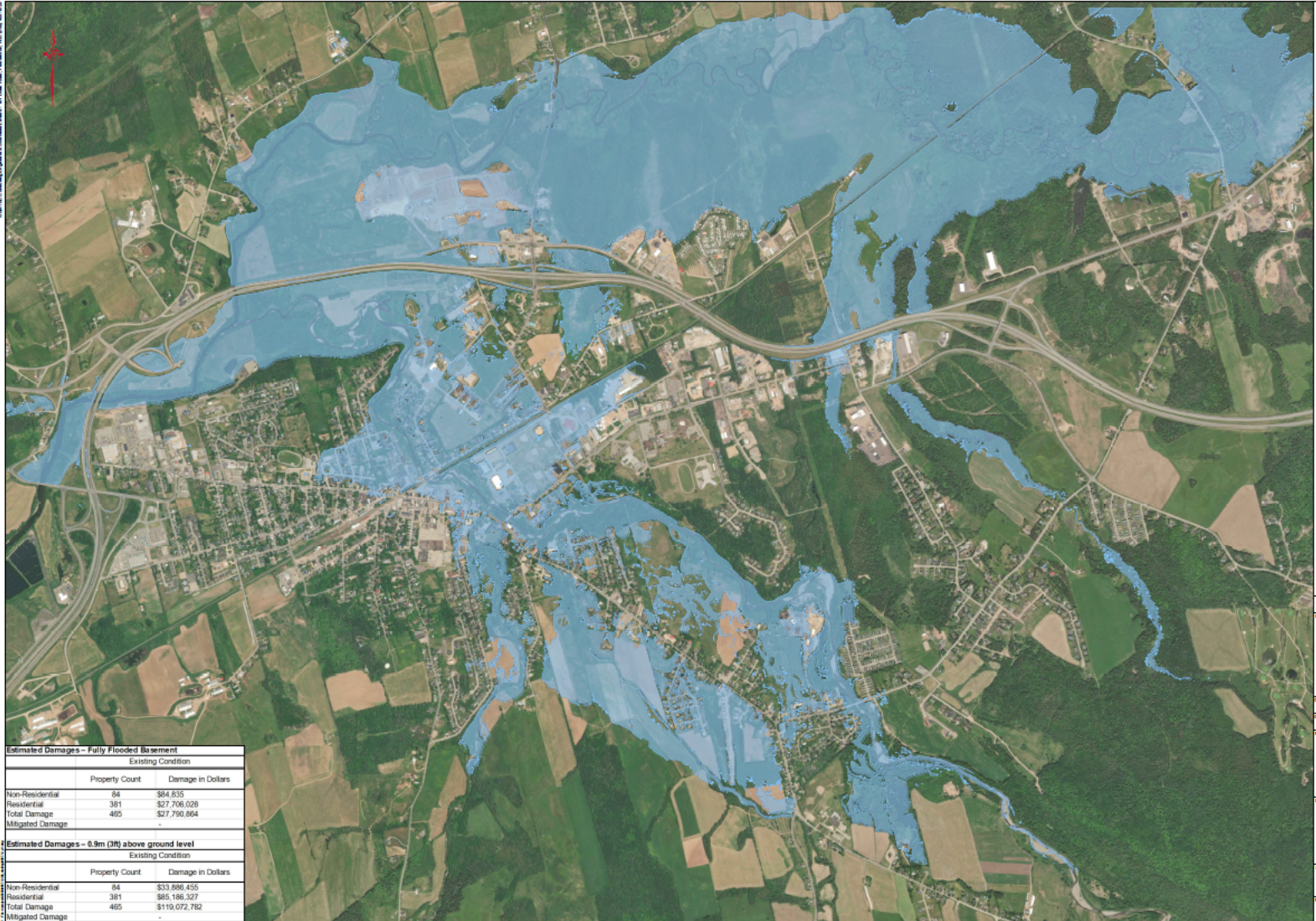
EXISTING CONDITIONS

NUMBER	0657.12	DATE	07/24/2023
PROJECT'S NAME			
DRAWN BY	TLR	CHECKED BY	NA
CALCULATED BY	NA	CHECKED BY	NA
PROJECT			
TOWN OF SUSSEX REGIONAL FLOOD RISK MITIGATION			
SOURCES			
EXISTING CONDITIONS			
SCALE 1:10000 0 200 400 600m			
FILE NO.	0657.12	SHEET NO.	D1



Flood Damage Estimates

- Constructed and refined hydraulic model
- Modelled year 2100 flood inundation limits
- Identify flooded buildings (GEMTEC Geographic Information System)
- Split into residential and non-residential (SNB Assessment Online Tool)



Estimated Damages - Fully Flooded Basement		
Existing Condition		
	Property Count	Damage in Dollars
Non-Residential	54	\$64,635
Residential	381	\$27,706,028
Total Damage	435	\$27,770,664
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Total Damage	435	\$119,072,762
Mitigated Damage	-	-

EXISTING CONDITIONS

PLANNED BY	DATE
DESIGNED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

TOWN OF SUSSEX REGIONAL
FLOOD RISK MITIGATION

EXISTING CONDITIONS

SCALE
1:10000
0 200 400 600m

FILE NO. 0657.12 SHEET NO. D1



Flood Damage Estimates cont'd

- Flooded properties (GEMTEC modelling results)
- Split into residential and non-residential (SNB Assessment Online Tool)
- 2014 Calgary flood damage curves (IBI Group 2015)
 - Basement flooding: residential: \$ 658/m² & non-residential \$ 2/m²
 - 1st floor flooding (0.9 m): residential: \$2,023/m² & non-residential \$799/m²
- Adjust for inflation 2014 to 2022 (1.28 - Building CPI, Statistics Canada)
- Adjust to NB (0.648 - AB and NB Real Estate Associations)
- Adjust to Sussex region (0.785 - SNB Assessment Online Tool)

Flood Damage Estimates cont'd

- Average residential unit 164 m² & average non-residential unit 822 m²
- Average basement flooding damage
 - Residential: \$ 73,000
 - Non-residential: \$ 1,000
- Average 1st floor flooding damage (0.9 m):
 - Residential: \$224,000
 - Non-residential: \$403,000

465 Flooded Buildings
\$27.8M to \$119M Damages

Flow 323 m³/s


Flow 97 m³/s

Flow 90 m³/s

Flow 220 m³/s

Estimated Damages - Fully Flooded Basement		
Existing Condition		
	Property Count	Damage in Dollars
Non-Residential	84	\$84,835
Residential	381	\$27,798,026
Total Damage	465	\$27,799,864
Mitigated Damage	-	-

Estimated Damages - 0.9m (3ft) above ground level		
Existing Condition		
	Property Count	Damage in Dollars
Non-Residential	84	\$33,886,455
Residential	381	\$85,186,537
Total Damage	465	\$119,072,782
Mitigated Damage	-	-

OWNER	DATE
PROJECT'S NAME	
DRAWN BY	CHECKED BY
CALCULATED BY	DESIGNED BY
PROJECT	
TOWN OF SUSSEX REGIONAL FLOOD RISK MITIGATION	
DRAWING	
EXISTING CONDITIONS	
SCALE	0 200 400 800m
FILE NO.	SHEET NO.
0857.12	D1
 GEMTEC COMPREHENSIVE ENGINEERING AND SCIENTISTS	

EXISTING CONDITIONS

Flood Diversion Scenarios


339 Flooded Buildings (-126)
\$21.2M to \$84.4M Damages
-\$6.6M to -\$34.6M (-24%)

Flow 93 m³/s

20 m Wide

Estimated Damages - Fully Flooded Basement				
Existing Condition		Scenario #4		
Property Count	Damage in Dollars	Property Count	Damage in Dollars	
Non-Residential	84 \$84,835	48	\$48,477	
Residential	381 \$27,706,028	291	\$21,161,287	
Total Damage	465 \$27,790,864	339	\$21,209,774	
Mitigated Damage	-	126	\$6,581,089	

Estimated Damages - 0.9m (3ft) above ground level				
Existing Condition		Scenario #4		
Property Count	Damage in Dollars	Property Count	Damage in Dollars	
Non-Residential	84 \$33,586,455	48	\$19,363,688	
Residential	381 \$85,186,327	291	\$65,063,573	
Total Damage	465 \$118,772,782	339	\$84,427,261	
Mitigated Damage	-	126	\$34,645,521	

NAME	DATE
PROJECT	DATE
DESIGNED BY	DESIGNED BY
CALCULATED BY	CHECKED BY
PROJECT	PROJECT
TOWN OF SUSSEX REGIONAL FLOOD RISK MITIGATION	
CONSTRUCTION OF A 20M WIDE DIVERSION CHANNEL ON TROUT CREEK WITH NO FLOW LIMIT ON TROUT CREEK, NO DIVERSION CHANNEL OR FLOW LIMIT ON PARSONS BROOK.	
SCALE 1:10000	
0 200 400 600m	
FILE NO.	DATE
0857.12	D5
 GEMTEC Consulting Engineers and Scientists	

SCENARIO #4

200 Flooded Buildings (-265)
\$12.3M to \$50.3M Damages
-\$15.5M to -\$68.8M (-56%)


Flow >210 m³/s

Flow <10 m³/s

Estimated Damages – Fully Flooded Basement				
	Existing Condition		Scenario #1	
	Property Count	Damage in Dollars	Property Count	Damage in Dollars
Non-Residential	84	\$84,835	31	\$31,308
Residential	381	\$27,706,038	169	\$12,289,951
Total Damage	465	\$27,790,864	200	\$12,300,859
Mitigated Damage	-	-	265	\$15,470,005

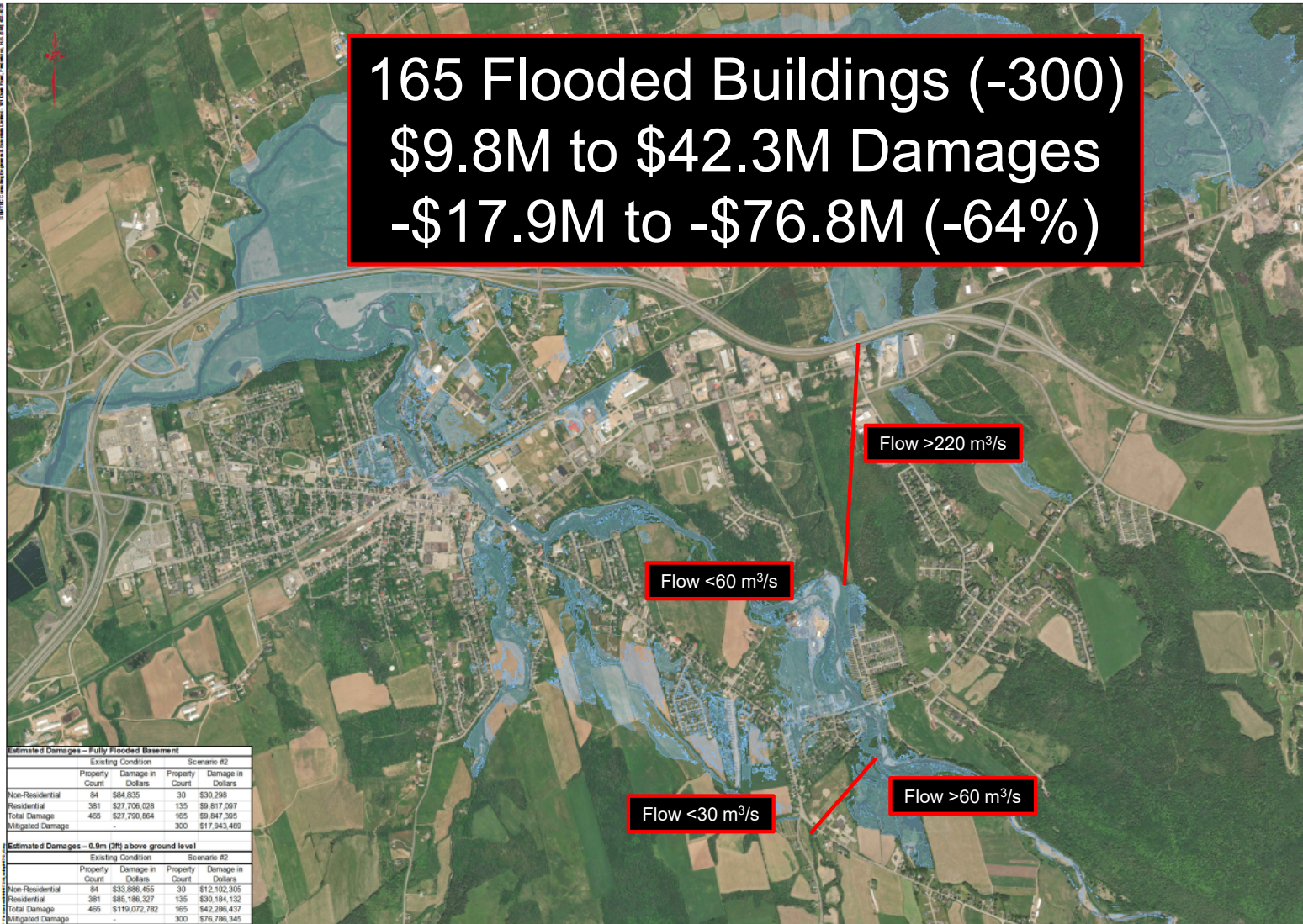
Estimated Damages – 0.9m (3ft) above ground level

	Existing Condition		Scenario #1	
	Property Count	Damage in Dollars	Property Count	Damage in Dollars
Non-Residential	84	\$33,886,455	31	\$12,205,715
Residential	381	\$85,186,327	169	\$17,786,061
Total Damage	465	\$119,072,782	200	\$30,291,777
Mitigated Damage	-	-	265	\$68,781,005

CLIENT	WRC	DATE	07/17/2023
PROJECT			
DESIGNED BY	TLR	CHECKED BY	NA
CALCULATED BY	NA	DRAWN BY	NA
PROJECT			
TOWN OF SUSSEX REGIONAL FLOOD RISK MITIGATION			
CONSTRUCTION OF A DIVERSION CHANNEL ON TROUT CREEK AND LIMITING THE FLOW TO 10 CMG. NO FLOW LIMITS OR DIVERSION CHANNELS ON PARSONS BROOK.			
SCALE	0 200 400 600m		
FILE NO.	0857.12	SHEET NO.	D2
 GEMTEC Comprehensive Engineering AND SCIENTISTS			


SCENARIO #1

165 Flooded Buildings (-300)
\$9.8M to \$42.3M Damages
-\$17.9M to -\$76.8M (-64%)



Estimated Damages - Fully Flooded Basement				
	Existing Condition		Scenario #2	
	Property Count	Damage in Dollars	Property Count	Damage in Dollars
Non-Residential	94	\$84,635	30	\$30,298
Residential	381	\$27,706,028	135	\$9,817,097
Total Damage	465	\$27,790,664	165	\$9,847,395
Mitigated Damage	-	-	300	\$17,943,469

Estimated Damages - 0.9m (3ft) above ground level				
	Existing Condition		Scenario #2	
	Property Count	Damage in Dollars	Property Count	Damage in Dollars
Non-Residential	94	\$33,896,455	30	\$12,102,305
Residential	381	\$85,186,327	135	\$30,184,132
Total Damage	465	\$119,072,782	165	\$42,286,437
Mitigated Damage	-	-	300	\$76,786,345

NAME	DATE
PROJECT	DATE
DESIGNED BY	DESIGNED BY
CALCULATED BY	CHECKED BY
PROJECT	PROJECT
TOWN OF SUSSEX REGIONAL FLOOD RISK MITIGATION	
CONSTRUCTION OF DIVERSION CHANNELS ON TROUT CREEK AND PARSONS BROOK AND LIMITING THE INFLOWS RESPECTIVELY TO 60 CMS AND 30 CMS.	
SCALE	0 200 400 600m
FILE NO.	D3
 GEMTEC Consulting Engineers AND SCIENTISTS	

SCENARIO #2

133 Flooded Buildings (-332)
\$8.5M to \$32.8M Damages
-\$19.3M to -\$86.3M (-71%)

Flow >245 m³/s

Flow <40 m³/s


Flow <25 m³/s

Flow >65 m³/s

Estimated Damages - Fully Flooded Basement				
Existing Condition		Scenario #3		
Property Count	Damage in Dollars	Property Count	Damage in Dollars	
84	\$54,835	17	\$17,560	
Non-Residential				
381	\$27,706,028	116	\$8,435,431	
Residential				
465	\$27,790,866	133	\$8,452,600	
Total Damage		332	\$19,338,263	
Minigated Damage	-			

Estimated Damages - 0.9m (3ft) above ground level				
Existing Condition		Scenario #3		
Property Count	Damage in Dollars	Property Count	Damage in Dollars	
84	\$33,896,450	17	\$9,857,973	
Non-Residential				
381	\$85,186,327	116	\$25,935,995	
Residential				
465	\$119,072,792	133	\$32,703,968	
Total Damage		332	\$68,275,614	
Minigated Damage	-			

SCENARIO #3

NAME	DATE
PROJECT	DATE
DESIGNED BY	CHECKED BY
DRAWN BY	DATE
CALCULATED BY	DATE
PROJECT	
TOWN OF SUSSEX REGIONAL FLOOD RISK MITIGATION	
DESCRIPTION CONSTRUCTION OF DIVERSION CHANNELS ON TROUT CREEK AND PARSONS BROOK AND LIMITING THE INFLOWS RESPECTIVELY TO 40 CMS AND 25 CMS.	
SCALE	0 200 400 600m
REVISION	0857.12 D4
 GEMTEC CONSULTING ENGINEERS AND SCIENTISTS	

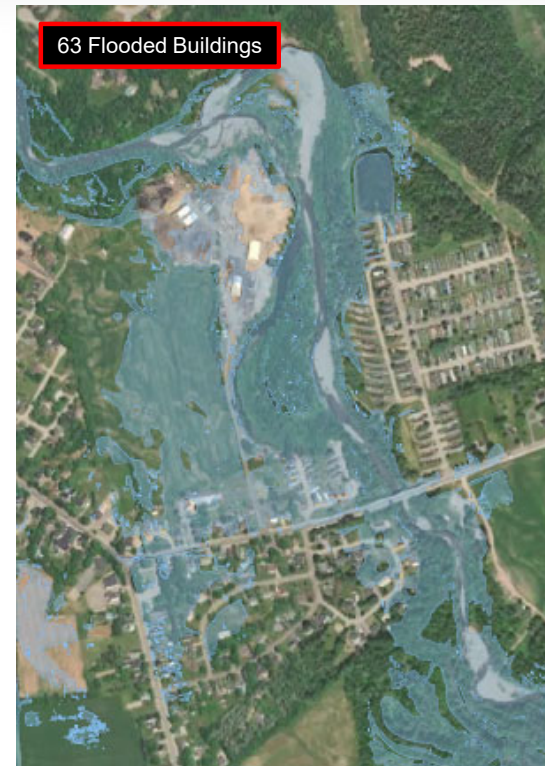
Post Road Area



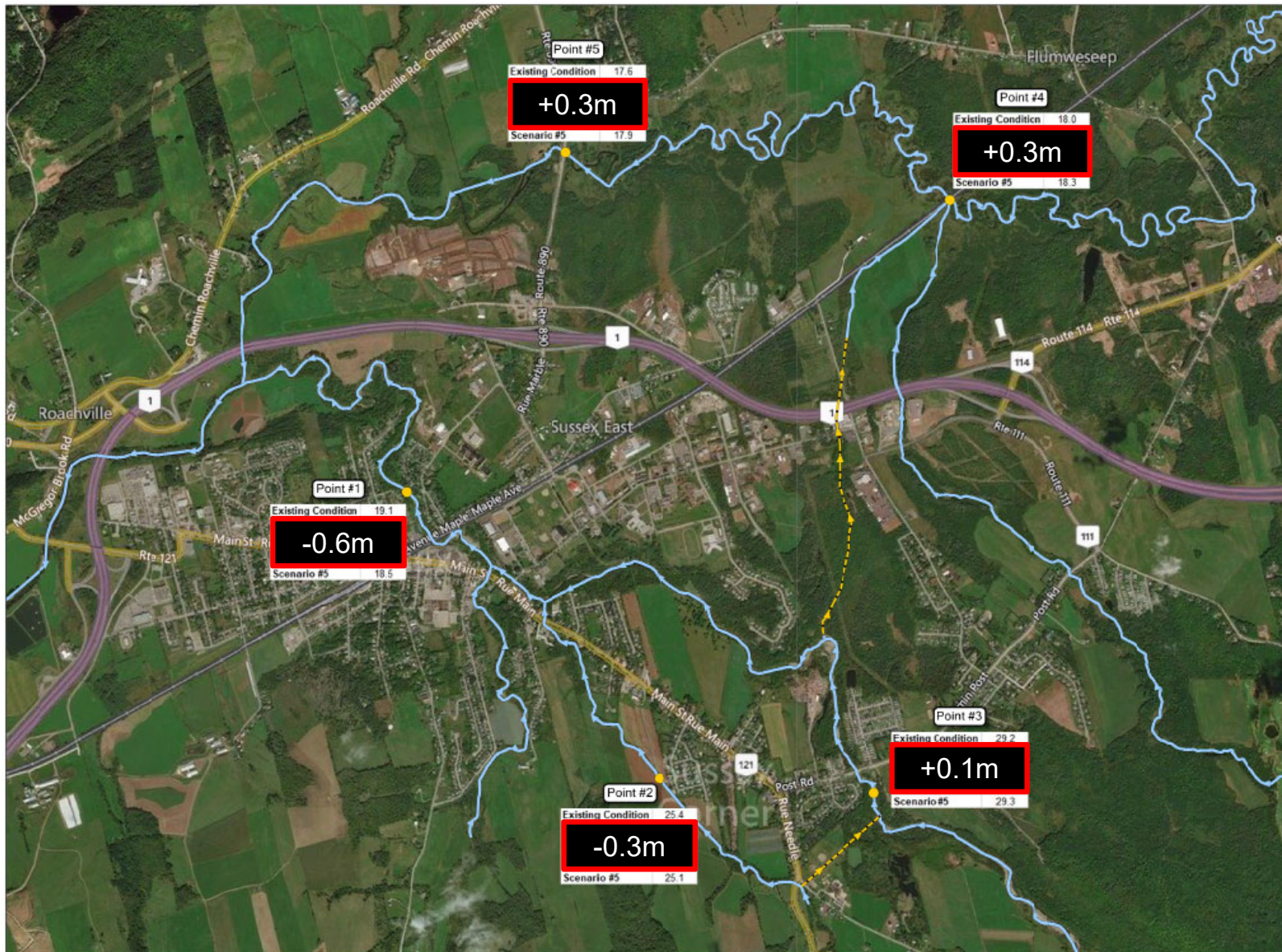
Existing Conditions



Scenario #2/#5

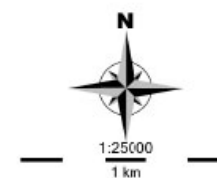


Scenario #3



Legend

- Watercourse
- Proposed Diversion Channel
- Digital Elevation Model



Cost – Benefit Summary

	Properties Flooded	Delta Properties	Basement Flooding	1st Floor Flooding	Delta Basement	Delta 1st Floor	Delta Average	2022 Cost*
Existing Conditions	465	0	\$27.8M	\$119M	\$0M	\$0M	\$0M	\$0M
Scenario #4	339	-126	\$21.2M	\$84.4M	-\$6.6M	-\$34.6M	-24%	\$20M
Scenario #1	200	-265	\$12.3M	\$15.3M	-\$15.5M	-\$68.8M	-56%	\$25M
Scenario #2	165	-300	\$9.9M	\$42.3M	-\$17.9M	-\$76.8M	-64%	\$27M
Scenario #3	133	-332	\$8.5M	\$32.8M	-\$19.3M	-\$86.3M	-71%	\$32M
Scenario #5	114	-351	\$6.9M	\$28.9M	-\$20.9M	-\$90.2M	-75%	\$28M

* Excludes Post Road mitigation measures and current fuel cost escalation

In Closing

- Existing Conditions (do nothing) will all but kill future development
- Parson Brook diversion is needed to protect the south part of Sussex Corner
- Trout Creek diversion negates the need for Main Street Berm
- Address increase in Post Road area flooding
- Some buildings (up to 114) require individual flood protection
- Return on Investment (ROI) is likely above 6

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- Address increase in Post Road area flooding
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- Return on Investment (ROI) is likely above 6

Is Option #5 the right choice?

Cost – Benefit Summary

	Properties Flooded	Delta Properties	Basement Flooding	1st Floor Flooding	Delta Basement	Delta 1st Floor	Delta Average	2022 Cost*
Existing Conditions	465	0	\$27.8M	\$119M	\$0M	\$0M	\$0M	\$0M
Scenario #4	339	-126	\$21.2M	\$84.4M	-\$6.6M	-\$34.6M	-24%	\$20M
Scenario #1	200	-265	\$12.3M	\$15.3M	-\$15.5M	-\$68.8M	-56%	\$25M
Scenario #2	165	-300	\$9.9M	\$42.3M	-\$17.9M	-\$76.8M	-64%	\$27M
Scenario #3	133	-332	\$8.5M	\$32.8M	-\$19.3M	-\$86.3M	-71%	\$32M
Scenario #5	114	-351	\$6.9M	\$28.9M	-\$20.9M	-\$90.2M	-75%	\$28M

* Excludes Post Road mitigation measures and current fuel cost escalation