

Bridge & Culvert Prioritization Program

Municipality of West Grey

West Grey



**TRITON
ENGINEERING
SERVICES
LIMITED**

Consulting Engineers

Purpose of the Program

01

Identify bridges & culverts in poor structural condition with a BCI of 70 or lower with 10 or less services years remaining

02

Create an order of priority based on the **Total Probability of Failure** and the **Total Consequence of Closure/Failure**

03

Maintain an up-to-date list of structures with the highest replacement priority to best suit the needs of the transportation network within the Municipality

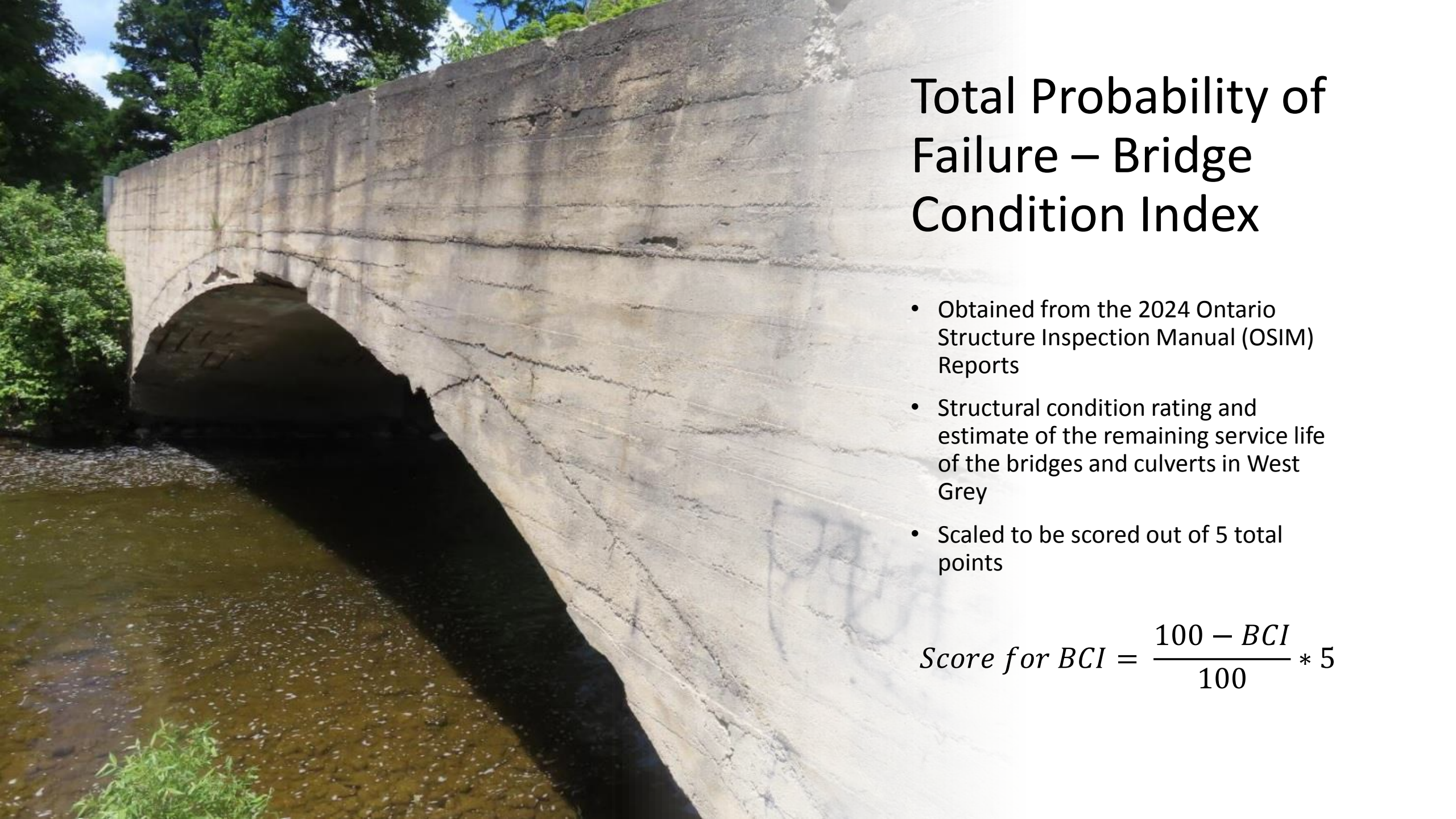
Total Probability of Failure

A higher number indicates higher probability of failure

The sum of the following components and scored out of 5 each

Bridge Condition Index (BCI) – Structural rating from the Ontario Structure Inspection Manual (OSIM) Report

Average Daily Traffic (ADT) – Number of vehicles per day that use the road segment the structure is located



Total Probability of Failure – Bridge Condition Index

- Obtained from the 2024 Ontario Structure Inspection Manual (OSIM) Reports
- Structural condition rating and estimate of the remaining service life of the bridges and culverts in West Grey
- Scaled to be scored out of 5 total points

$$\text{Score for } BCI = \frac{100 - BCI}{100} * 5$$

Total Probability of Failure – Average Daily Traffic (ADT)

- Number of vehicles per 24-hour period counted on the road segment the structure is located
- Indicative of importance of a road segment to the overall transportation network within the Municipality
- More vehicular traffic increases the likelihood of failure
- Traffic count data is from 2016 , however is representative of traffic patterns prior to structure closers in West Grey

Average Daily Traffic Scoring System

Score	1	2	3	4	5
ADT	0 - 100	100 - 250	250 - 500	500 - 1000	1000+

Total Consequence of Closure/Failure

The sum of the following components and scored out of 5 each:

1. ADT – Consistent with Total Probability of Failure
2. Detour Length (km) – Distance from one side of the structure to the other without crossing
3. Emergency Response Time – Change in response time measured in minutes resulting from the closure of a structure
4. Local Access – Inconvenience of a structure closure to residents

A higher value indicates greater consequence to the public as a result of closure/failure



Total Consequence of Closure/Failure – Detour Length

- Based on shortest route, in kilometres, from one side of the structure to the other without crossing
- Weighted from 1 – 5 relative to other detour lengths analyzed in this program

Detour Length Score

$$= \frac{\textit{Structure Detour Length}}{\textit{Maximum Detour Length}} * 5$$

Total Consequence of Closure/Failure – Emergency Response Time



The greatest change in response time from the structure to the nearest hospital



Provided by the Grey County GIS and Data division, and confirmed by Grey County Paramedic Services



Emergency response time was multiplied by 2 to account for both segments of the trip (dispatch to structure and then structure to hospital) and scored out of 5 relative to all other response times analyzed

Emergency Response Time Example

- As shown on the right for B-009, travel time to the hospital from the structure was modelled
- The travel time difference was the greatest between the N/W Barrier and S/E Barrier scenarios
- This number was multiplied by 2 to account for both segments of the trip
- EMS response time for B-009 is 6.8 minutes



Structure: B-009

Travel Time Difference: 3.4 minutes

- Prioritized Structure
- Hospital
- Original (Fastest)
- N/W Barrier
- S/E Barrier

Name - Closest Hospital	Travel Time (min)	Kilometers	Scenario
B-009 - Durham	14.6	16.1	Original
B-009 - Durham	14.6	16.1	N/W Barrier
B-009 - Durham	17.9	21.3	S/E Barrier



Total Consequence of Closure/Failure – Local Access

- Local access represents the inconvenience created by the closure/failure of a structure

Local Access Scoring System	
Score	Description
1	No residential access located on the road segment resulting in minor access issues
2	less than 10 residents located on structures road segment
3	greater than 10 residents located on structures road segment
4	closed structure splits an owned parcel
5	closed structure isolates a property from access to road segment

Total Probability of Failure - Bontick

Structure ID	Average Daily Traffic (ADT)	ADT Score	Bridge Condition Index (BCI)	BCI Score	Total Probability of Failure
B-003	601	4.0	50.1	2.50	6.50
B-020	953	4.0	51.4	2.43	6.43
B-008	134	2.0	63.8	1.81	3.81
B-196	196	2.0	66.9	1.66	3.66
B-001	197	2.0	67.4	1.63	3.63
B-009	196	2.0	68.7	1.57	3.57
B-006	232	2.0	70	1.50	3.50
B-025	44	1.0	57.8	2.11	3.11
B-011	46	1.0	67.5	1.63	2.63

Total Consequence of Closure/Failure - Bentick

Structure ID	Average Daily Traffic (ADT)	ADT Score	Detour Length (km)	Detour Length Score	EMS Response Time (min)	EMS Response Score	Local Access Score	Total Consequence of Failure
B-020	953	4.0	16.2	5.00	4.8	2.22	3.0	14.22
B-011	46	1.0	8.7	2.69	10.8	5.00	2.0	10.69
B-003	601	4.0	8	2.47	3.8	1.76	2.0	10.23
B-009	196	2.0	6.7	2.07	6.8	3.15	3.0	10.22
B-196	196	2.0	6.7	2.07	6.2	2.87	3.0	9.94
B-006	232	2.0	12.1	3.73	4.2	1.94	2.0	9.68
B-001	197	2.0	7.8	2.41	5.8	2.69	2.0	9.09
B-008	134	2.0	6.6	2.04	2.6	1.20	2.0	7.24
B-025	44	1.0	6.5	2.01	0.4	0.19	2.0	5.19

Total Probability of Failure - Glenelg

Structure ID	Average Daily Traffic (ADT)	ADT Score	Bridge Condition Index (BCI)	BCI Score	Total Probability of Failure
G-038	54	1.0	44.3	2.79	3.79
G-040	119	2.0	67.5	1.63	3.63
G-033	74	1.0	48.7	2.57	3.57
G-041	119	2.0	69.6	1.52	3.52
G-037	54	1.0	57.7	2.12	3.12
G-132	44	1.0	61.8	1.91	2.91
G-133	78	1.0	65.5	1.73	2.73

Total Consequence of Closure/Failure - Glenelg

Structure ID	Average Daily Traffic (ADT)	ADT Score	Detour Length (km)	Detour Length Score	EMS Response Time (min)	EMS Response Score	Local Access Score	Total Consequence of Failure
G-132	44	1.0	16.2	5.00	10.8	5.00	5.0	16.00
G-037	54	1.0	16	4.94	3.6	1.67	5.0	12.60
G-038	54	1.0	16	4.94	3.4	1.57	5.0	12.51
G-040	119	2.0	7.9	2.44	3.4	1.57	4.0	10.01
G-041	119	2.0	7.9	2.44	3.2	1.48	4.0	9.92
G-033	74	1.0	9.2	2.84	5.2	2.41	3.0	9.25
G-133	78	1.0	5.5	1.70	2.2	1.02	3.0	6.72

Total Probability of Failure - Normanby

Structure ID	Average Daily Traffic (ADT)	ADT Score	Bridge Condition Index (BCI)	BCI Score	Total Probability of Failure
N-051	1018	5.0	57.8	2.11	7.11
N-060	1196	5.0	69.7	1.52	6.52
N-058	1196	5.0	70	1.50	6.50
N-188	165	2.0	54.1	2.30	4.30
N-055	130	2.0	63.2	1.84	3.84
N-184	61	1.0	46.8	2.66	3.66
N-061	134	2.0	68.5	1.58	3.58
N-070	25	1.0	67.4	1.63	2.63
N-185	61	1.0	67.4	1.63	2.63

Total Consequence of Closure/Failure - Normanby

Structure ID	Average Daily Traffic (ADT)	ADT Score	Detour Length (km)	Detour Length Score	EMS Response Time (min)	EMS Response Score	Local Access Score	Total Consequence of Failure
N-060	1196	5.0	11.7	3.61	6.4	2.96	4.0	15.57
N-058	1196	5.0	11.7	3.61	5.0	2.31	4.0	14.93
N-051	1018	5.0	10.7	3.30	7.4	3.43	3.0	14.73
N-070	25	1.0	6.8	2.10	9.6	4.44	2.0	9.54
N-061	134	2.0	11.4	3.52	2.8	1.30	2.0	8.81
N-055	130	2.0	8.3	2.56	4.0	1.85	2.0	8.41
N-184	61	1.0	7.9	2.44	5.4	2.50	2.0	7.94
N-188	165	2.0	8.5	2.62	2.8	1.30	2.0	7.92
N-185	61	1.0	7.9	2.44	4.8	2.22	2.0	7.66

A wooden truss bridge spans a river in a lush, green forest. The bridge has a complex truss structure with diagonal bracing. The river below is clear, showing rocks and some rapids. The sky is blue with light clouds.

Total Risk of Asset Failure

- The total risk of an asset incorporates both the Total Probability of Failure and the Total Consequence of Closure/Failure

Total Risk of Asset Failure

*= Probability of Failure
* Consequence of Failure*

- A higher numeric value for the Total Risk of Asset Failure Indicates a potentially higher priority in the **Bridge Prioritization Program**

Total Risk of Asset Failure – Highest Risk

- These structures have potential to significantly impact the transportation network of West Grey if they require closure or are currently closed

Structure ID	Structure Status (open/closed)	Total Probability of Failure	Total Consequence of Failure	Total Risk of Asset Failure
N-051	Closed	7.11	14.73	104.72
N-060	Open	6.52	15.57	101.47
N-058	Open	6.50	14.93	97.02
B-020	Closed	6.43	14.22	91.45
B-003	Open	6.50	10.23	66.43
G-038	Closed	3.79	12.51	47.36
G-132	Open	2.91	16.00	46.56
G-037	Open	3.12	12.60	39.26
B-009	Open	3.57	10.22	36.42
B-196	Open	3.66	9.94	36.32
G-040	Open	3.63	10.01	36.29
G-041	Open	3.52	9.92	34.92

Total Risk of Asset Failure – Lowest Risk

- This group of structures are either still structurally capable of performing as designed and/or will have less of an impact if they require closure, or are already closed

Structure ID	Structure Status (open/closed)	Total Probability of Failure	Total Consequence of Failure	Total Risk of Asset Failure
B-025	Closed	3.11	5.19	16.15
G-133	Open	2.73	6.72	18.30
N-185	Open	2.63	7.66	20.15
N-070	Closed	2.63	9.54	25.10
B-008	Open	3.81	7.24	27.59
B-011	Open	2.63	10.69	28.05
N-184	Open	3.66	7.94	29.05
N-061	Open	3.58	8.81	31.51
N-055	Closed	3.84	8.41	32.31
G-033	Closed	3.57	9.25	32.97
B-001	Open	3.63	9.09	33.01
B-006	Open	3.50	9.68	33.88
N-188	Open	4.30	7.92	34.02

Years of Service Life

- These structures have the lowest remaining service life in the Municipality of West Grey
- 0 Years of service indicates the structure is currently closed

Structure ID	Total Probability of Failure	Total Consequence of Failure	Total Risk of Asset Failure	Years of Service
N-051	7.11	14.73	104.72	0
B-020	6.43	14.22	91.45	0
G-038	3.79	12.51	47.36	0
G-033	3.57	9.25	32.97	0
N-055	3.84	8.41	32.31	0
N-070	2.63	9.54	25.10	0
B-025	3.11	5.19	16.15	0
B-003	6.50	10.23	66.43	1 to 5
G-132	2.91	16.00	46.56	1 to 5
G-037	3.12	12.60	39.26	1 to 5
N-188	4.30	7.92	34.02	1 to 5
N-184	3.66	7.94	29.05	1 to 5
B-001	3.63	9.09	33.01	6 to 10
B-011	2.63	10.69	28.05	6 to 10
B-008	3.81	7.24	27.59	6 to 10

Structure Priority List

- Derived from the highest risk ranking as well as estimated remaining service life from 2024 OSIM
- This list will be kept up to date with new structures analyzed and added to this list as they approach the end of their service life

Rank	Structure ID	Discussion	Cost (2024 Dollar Value for Concrete)
1	N-051	Closed due to significant deterioration. ADT of 1018 was the highest amongst structures with less than 5 service years remaining and a high change in EMS response time.	\$ 2,944,000
2	G-038	Potential isolation of properties from flooding known to occur on this road segment. Structure is currently closed.	\$ 2,001,000
2	G-037	Potential isolation of properties from flooding known to occur on this road segment.	\$ 1,794,000
4	B-003	High ADT of 601 with limited service life remaining. It is Currently recommended for inspection every 6 months.	\$ 2,600,000
5	G-132	While the use is minimal, a property becomes isolated if closed.	\$ 1,334,000
6	B-020	Although B-020 has been closed for almost 6 years now, the 2016 ADT indicates this road segment has a high ADT of 953.	\$ 3,197,000
7	N-060	This structure has a high ADT of 1196 and reported in fair to poor condition with no signs of structural distress.	\$ 1,127,000
8	N-058	This structure has a high ADT of 1196 and reported in fair to poor condition with no signs of structural distress.	\$ 1,725,000
9	B-009	This structure is reported to be in fair condition with no signs of structural distress.	\$ 2,185,000
10	B-196	This structure is reported to be in fair condition with no signs of structural distress.	\$ 736,000

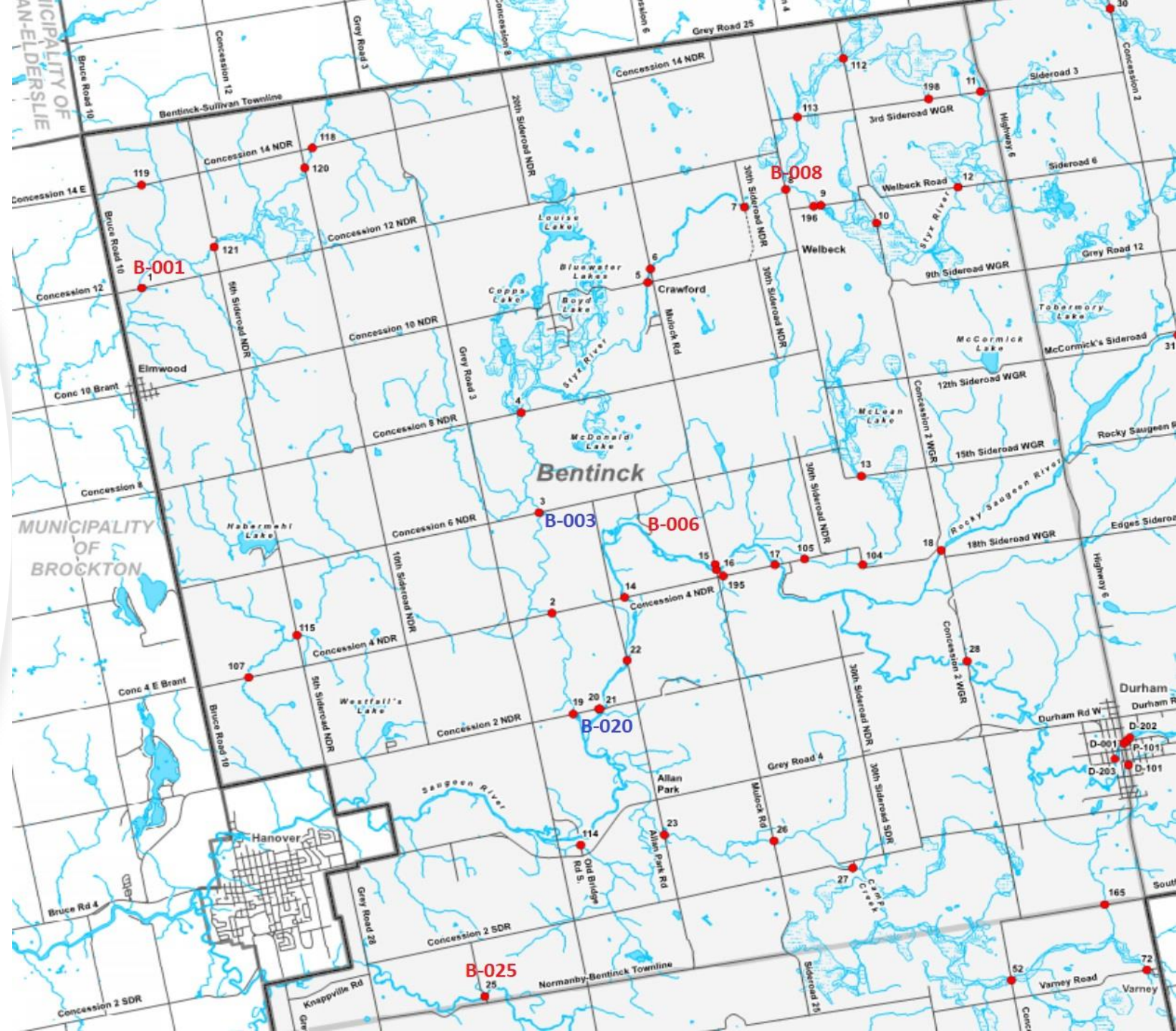
Candidate Structures for Long-Term Closure

- Highlighted structures are currently closed
- Based on their Total Consequence of Closure/Failure to the Municipality, these structures can be considered for long-term closure at the end of their service life
- Permanent closure would result in a replacement capital and life cycle cost savings up to \$30 million based on typical 2024 concrete construction values

Structure ID	Total Probability of Failure	Total Consequence of Failure	Total Risk of Asset Failure	Years of Service
B-025	3.11	5.19	16.15	0
G-133	2.73	6.72	18.30	10+
B-008	3.81	7.24	27.59	6 to 10
N-185	2.63	7.66	20.15	10+
N-188	4.30	7.92	34.02	1 to 5
N-184	3.66	7.94	29.05	1 to 5
N-055	3.84	8.41	32.31	0
N-061	3.58	8.81	31.51	10+
B-001	3.63	9.09	33.01	6 to 10
G-033	3.57	9.25	32.97	0
N-070	2.63	9.54	25.10	0
B-006	3.50	9.68	33.88	10+
G-041	3.52	9.92	34.92	10+

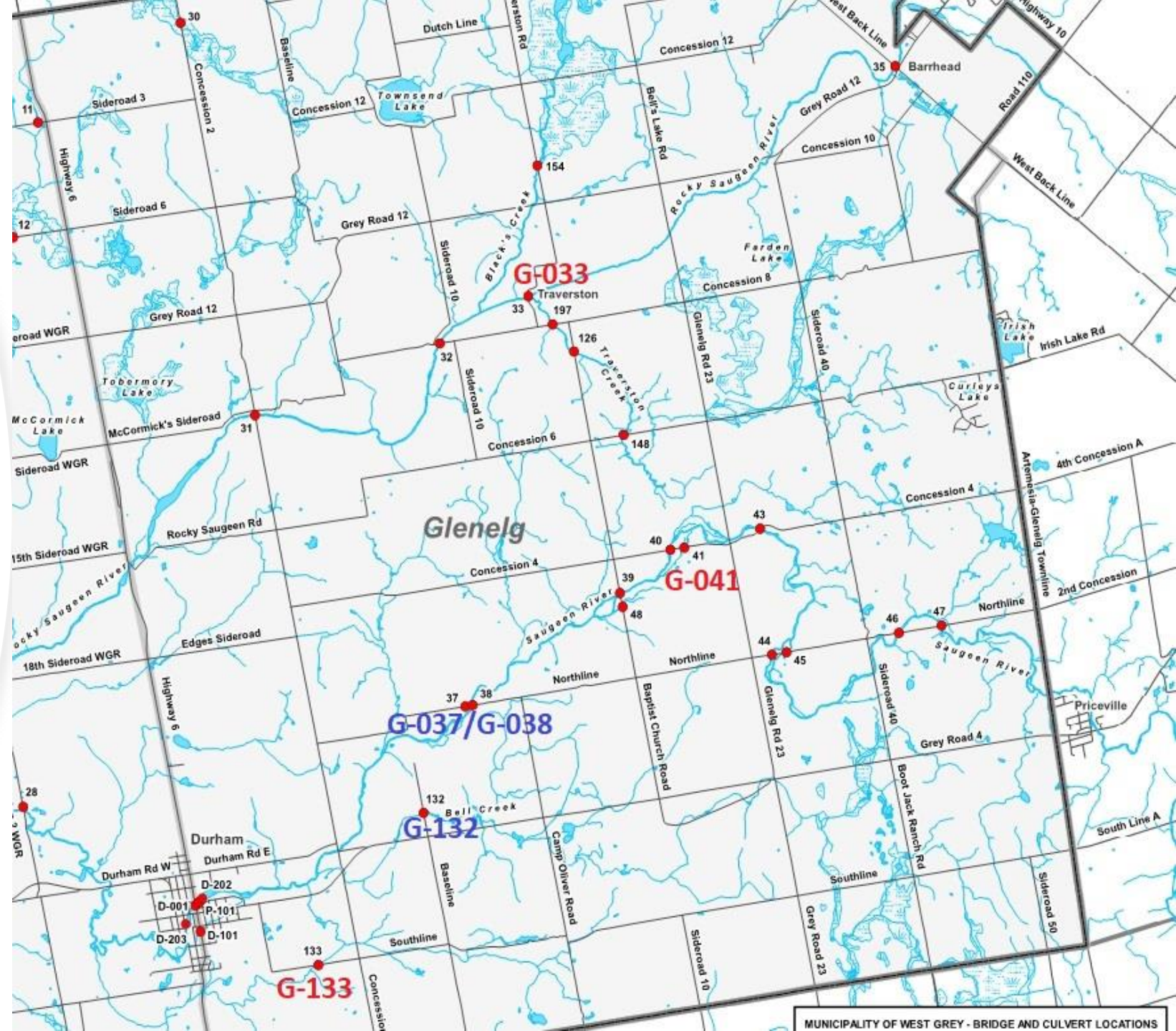
Bentick Structure Locations

- Red text indicates a candidate for closure
- Blue text indicates a structure on the high priority list



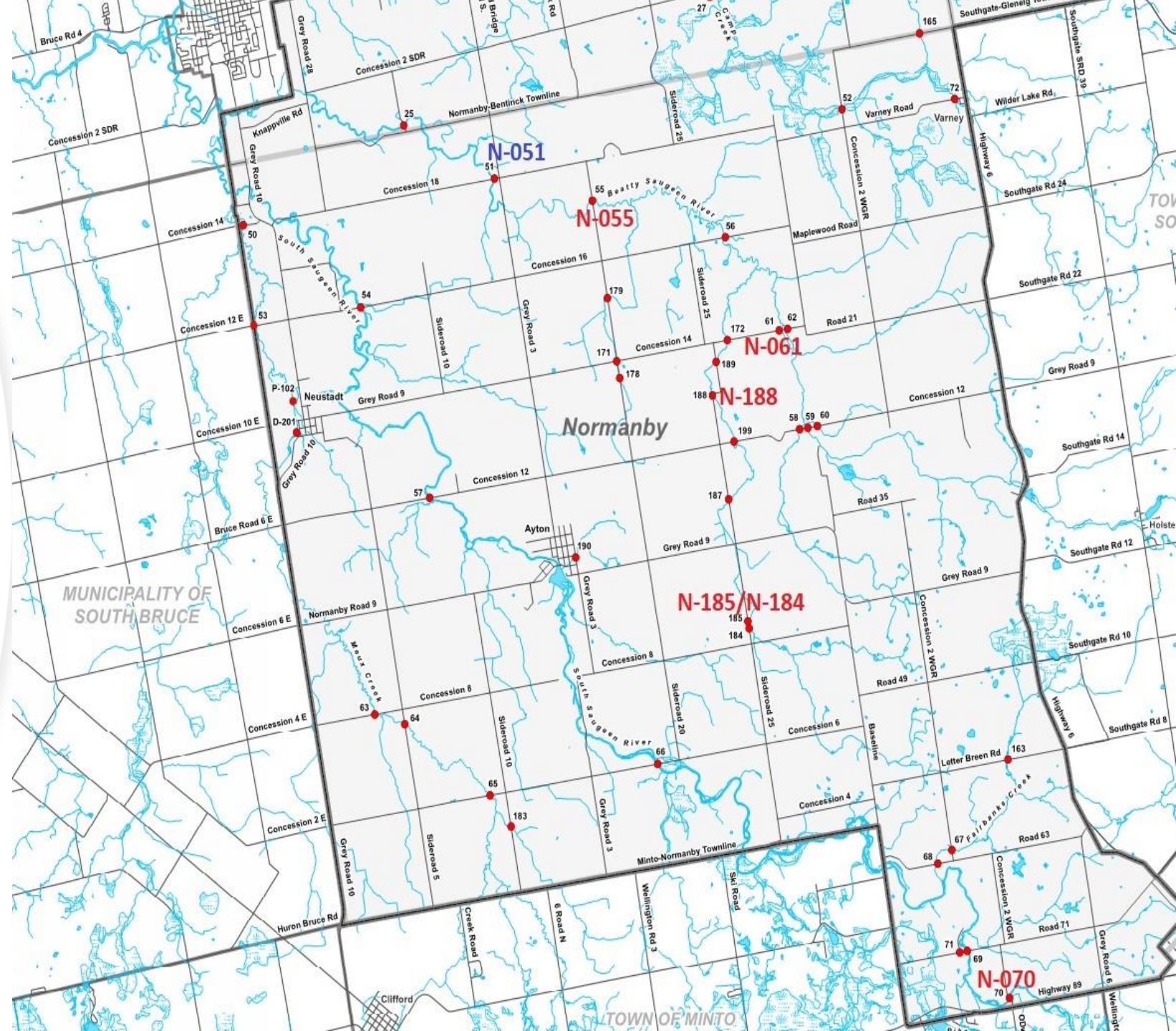
Glenelg Structure Locations

- Red text indicates a candidate for closure
- Blue text indicates a structure on the high priority list



Normanby Structure Locations

- Red text indicates a candidate for closure
- Blue text indicates a structure on the high priority list



Questions

