THE REGIONAL MUNICIPALITY OF NIAGARA
PUBLIC WORKS COMMITTEE
FINAL AGENDA

PWC 4-2019
Tuesday, April 16, 2019
9:30 a.m.
Council Chamber
Niagara Region Headquarters, Campbell West
1815 Sir Isaac Brock Way, Thorold, ON

Pages

1. CALL TO ORDER

2. DISCLOSURES OF PECUNIARY INTEREST

3. PRESENTATIONS

3.1 *Quality of Drinking Water*
Mary Lou Anguish, Resident, City of St. Catharines

The delegation on this matter has withdrawn their request to appear before Committee.

3.2 Reducing Litter and Waste in Our Communities: Discussion Paper
Jennifer Mazurek, Waste Management Program Manager, Public Works

To be distributed.

4. DELEGATIONS

4.1 *PW 24-2019 Transportation Infrastructure Means Protection Update (Agenda Item 5.2)*

4.1.1 *Stephanie Farquharson and Wendi Duggan, Niagara United*
This delegation request was received after the deadline. The request must be considered by Committee.

5. ITEMS FOR CONSIDERATION

5.1 PW 18-2019 — 3 - 30
Winter Maintenance Extension

5.2 PW 24-2019 — 31 - 105
Transportation Infrastructure Means Protection Update

6. CONSENT ITEMS FOR INFORMATION

7. OTHER BUSINESS

8. CLOSED SESSION

8.1 *Confidential Verbal Update*
A Matter of Litigation or Potential Litigation - Emterra Contract

9. BUSINESS ARISING FROM CLOSED SESSION

10. NEXT MEETING

The next meeting will be held on Tuesday, May 7, 2019, at 9:30 a.m. in the Council Chambers, Regional Headquarters.

11. ADJOURNMENT

If you require any accommodations for a disability in order to attend or participate in meetings or events, please contact the Accessibility Advisory Coordinator at 905-980-6000 (office), 289-929-8376 (cellphone) or accessibility@niagararegion.ca (email).

Subject: Winter Maintenance Extension

Report to: Public Works Committee

Report date: Tuesday, April 16, 2019

Recommendations

1. That the amending agreement option to extend the term of the Area Winter Maintenance Services Contract under 2008-RFP-40 for an additional one year term ending September 3, 2020, as outlined in Appendix 1 of Report PW 18-2019, **BE APPROVED**;

2. That an amending agreement with Steed and Evans Limited **BE PREPARED** by the Director of Legal and Court Services to exercise the one year option and extend the contract end date to September 3, 2020, following Council approval; and

3. That the Chief Administrative Officer **BE AUTHORIZED** to execute the amending agreement with Steed and Evans Limited.

Key Facts

- The purpose of this report is to seek approval to exercise the option agreed to as part of the first amending agreement to extend the terms of the Area Winter Maintenance Services Contract - 2008-RFP-40 (Contract) with Steed and Evans Limited for one additional winter season (2019-2020) for reasons outlined in this report.
- The Purchasing By-law 2016-02 requires that Council approve negotiation awards/extensions greater than $1,000,000.
- The Contract negotiated in 2008 with Steed and Evans Limited was scheduled to expire on September 6, 2018.
- Staff proceeded with an amending agreement to extend the Contract for an additional winter season (2018-2019) and include an option for a further one year extension (2019-2020).
- The negotiation award extension (2018-2019) to Steed and Evans Limited was done in accordance with Purchasing By-law 2016-02 Section 19 (a) (vi) - the extension of an existing Contract being more effective than undertaking a formal procurement process – approved by the CAO under delegated authority in the fall of 2018 pursuant to Report GM 8-2018 for a total amount of $2,599,822 before taxes and Consumer Price Index (CPI) increase.

Financial Considerations

The amending agreement (Appendix 1) entered into with Steed and Evans Limited extended their contract to cover one additional winter season (2018-2019) and included an option for a further one year extension (2019-2020). Staff are now recommending to exercise the second one-year option on the 2019-2020 winter season. In year 11 (2018-2019), Steed and Evans Limited's contract increased by $40,000 to cover increases to their insurance premiums plus the annual CPI increase of 2.5% (approximately $63,995). In year 12 (2019-2020), only an annual CPI increase would be applied.

Funding for the Contract and anticipated Contract increases is provided for in the approved 2019 Transportation Services operating budget and will be provided for in the 2020 operating budget.

Transportation Operations winter maintenance budget totalling $7,971,739 in 2016, $8,482,487 in 2017 and $8,301,562 in 2018 is divided into four (4) sections. A detailed budget breakdown is outlined in Appendix 2 comparing actuals to budget for calendar years 2016 - 2018. A summary of 2018 actual costs are noted below by section:

1) Niagara Region utilizes regional staff and equipment to provide winter maintenance to 990 lane kilometers of roadway with an actual cost of $3,995,834 for the 2018 calendar year. It is important to note that this cost represents all vehicles and equipment, over a five-month period, within the Transportation Operations section. A more precise figure will be made available in the coming months once staff are further able to isolate work-specific tasks for each vehicle/equipment.

2) Area Winter Services Maintenance Contract utilizes Steed and Evans Limited staff and equipment to provide winter maintenance to 674 lane kilometers of roadway with an actual cost of $2,821,368 for the 2018 calendar year.

3) City of St Catharines utilizes city staff and equipment to provide winter maintenance to 126 lane kilometers of roadway at a cost of $348,617 for the 2018 calendar year.

4) Supporting winter services activities are delivered across the entire regional road network of 1790 lane kilometers with a budget of $852,498 for the 2018 calendar year. Services such as snow fence erection and removal, winter sand cleanup and winter drainage are delivered through a combination of Niagara Region staff and outside contractors.

Niagara Region's actual costs in 2016 and 2017 are significantly lower than budgeted cost due to the milder winter conditions resulting in lower overtime costs and lower fuel usage. The 2018 calendar year costs are higher due to the increase in winter events

from January to April. The City of St. Catharines' actual costs are relatively constant from 2016 - 2018. The Contract, with Steeds and Evans Limited, (a fixed price plus contract) actual costs are relatively flat to budget costs with the slight variance attributed to adjustments for fuel and salt usage.

Analysis

Niagara Region operates within a "hybrid" business model during the winter season utilizing the Niagara Region, City of St. Catharines and an Area Maintenance Contractor (currently Steed and Evans Limited) forces.

- Niagara Region Staff maintain 19 plow routes covering 990 lane kilometers of roadway.
- City of St. Catharines maintain 126 lane kilometers of Regional Roads through an amalgamation of Region Roads within in the City's own routing system.
- Steed and Evans Limited maintains 10 plow routes covering 674 lane kilometers.

As outlined in the Corporate Value for Money Audit of Snowplowing, Road Maintenance and Land Scaping Services eight (8) recommendations were provided concerning value-for-money, effective risk management and operational Improvement for winter control.

Several of these recommendations required staff to collect the necessary data, which will influence the terms of a new Area Winter Maintenance Services Contract.

- **R1: Document the end time of winter events so it is possible to measure the time it takes to reclaim bare pavement.**
  - Starting in 2016, Staff have collected this information and at the end of the 2018-2019 winter season will have three (3) complete winter seasons to analyse. This information measures timeframes for reclaiming bare pavement as per winter Maintenance Standards contained in Ontario Regulation 366/18.This data will be used to update our Level of Service documents to be included in the tendering of a new Area Maintenance Services contract.

- **R2: Restructuring budgeting/ accounting to separate core winter services from supporting services and allow accurate comparisons of the costs of direct delivery versus contracted delivery for winter control.**
  - The implementation of The Enhanced Financial Management Service has allowed Staff to streamline finance processes and provide comprehensive reporting capabilities. As shown in Appendix 1, Niagara Region winter control costs are in line with Steed and Evans Limited costs. At the end of the 2018-2019 winter season, Staff will have three (3) full years of data to analyse.

- **R3: Collect and use pass kilometer data to better monitor and report on winter control activities.**

- In 2016 staff began to collect this information and determined that comparing costs against actual lane kilometers was a more productive measure because it could be calculated utilizing our existing plow routes. This GIS data could be updated yearly to reflect any additions or subtractions of road segments throughout the year as indicated in Appendix 2.

- **R4: Implement winter control achievement reports for winter storm events.**
  - Niagara Region Staff have collected this information starting in the 2016–2017 winter season. In the 2017-2018 winter season Steed and Evans Limited also began collecting this data. This data measures the event responses by Niagara Region and its contracted service providers.
    - System wide winter event responses > 24 hours in duration;
    - System wide winter event responses < 24 hours in duration
    - Significant localized winter event responses > hours in duration.

    This data will be used to update our Level of Service documents to be included in the tendering of a new Area Maintenance Services contract.

- **R5: Provide Annual reports to Council on the level of service achievement for the winter season.**
  - Staff have developed a process to collect the necessary data recommended over the last two winter seasons and will provide a report outlining these findings at the end of the 2018 - 2019 winter season.

- **R6: Reduce the Winter Control Budget to the level required for a typical winter instead of a severe winter.**
  - Through the annual budget approval process over the last three (3) years, staff have adjusted the budgets accordingly based on Council guidance.

- **R7: Prepare in advance for forecasted winter storm events by rescheduling staff shifts within the two-week pay period.**
  - Staff have adjusted winter shift schedules accordingly based on weather forecasts and the conditions outlined in the CUPE 1287 Collective Agreement.

- **R8: Conduct a competitive service delivery exercise at the end of the current winter contract encompassing all established routes.**
  - This analysis will be completed after the 2018 – 2019 winter season. Yard replacement/rehabilitation decisions at Niagara Region's Smithville and Pelham patrol yards will have to be taken into consideration as part of this analysis.

Staff have been in communication with the MTO on their new Contractor Directed Maintenance Contract model that commenced in August 2018. Staff will be reviewing

the effectiveness of this new contract throughout the 2018-2019 winter season with MTO staff in order to see if the principle concepts in this contract can be applied to Niagara Region's next Area Maintenance Services contract.

The Transportation Master Plan has put more emphasis on street scaping and active transportation. In the short term, by 2021, the Region will focus on implementing policies that will transform its approach to transportation, addressing existing constraints in the road system, filling in gaps in the active transportation network, and taking the next steps to plan for the major network needs for the future. Specifically, the early actions to be undertaken in the first five (5) years of the program include incorporating the Complete Streets approach in the Region's design process. Staff are gathering information on how these changes will impact winter maintenance costs.

The major objective for winter operations are to meet or exceed the Minimum Maintenance Standards for Municipal Highways (Ontario Provincial Regulation 239/02 – Municipal Act 2001). This regulation was amended May 3, 2018 to the Minimum Maintenance Standards for Municipal Highways O. Reg. 366/18 (Appendix 3). These amendments added maintenance sections on snow accumulation on bicycle lanes. Staff will be compiling data on additional maintenance costs associated with this change that will be incorporated into a new winter maintenance services contract to ensure compliance with the Act.

Alternatives Reviewed

In 2017, staff considered issuing a two year contract to cover the 2018-2019 and 2019 – 2020 winter seasons. When reviewing this option, Staff felt it was an unreasonable expectation to ask a contractor to capitalize a fleet in a competitive procurement process for this short duration (2 years). It is Staff's recommendation to go forward with a procurement in the fall of 2019 for a new 10-year winter maintenance contract once the data collection analysis identified in the Value for Money Audit, as noted above, is completed, and staff can incorporate necessary changes in the new Area Maintenance Services Contract document. The new contract will commence in October 2020.

Steed and Evans Limited has indicated they have no concerns utilizing their existing fleet throughout the proposed extension.

Relationship to Council Strategic Priorities

Moving people and goods: winter maintenance activities allow for the safe movement of vehicles and pedestrians throughout the Niagara Region.

Other Pertinent Reports

- Value for Money Audit of Snowplowing, Roads Maintenance, and Landscaping Services – Final Report 15-2387

Prepared by:
Shawn McCauley, CRSS, C-Tech, B.B.E.
Associate Director Transportation

Recommended by:
Catherine Habermebl
Acting Commissioner
Public Works Department

Submitted by:
Ron Tripp, P.Eng.
Acting Chief Administrative Officer

This report was prepared in consultation with Brian McMahon Program Financial Analyst, reviewed by Carolyn Ryall, Director Transportation Services and Curt Anderson, Manager Road and Bridge Operations.

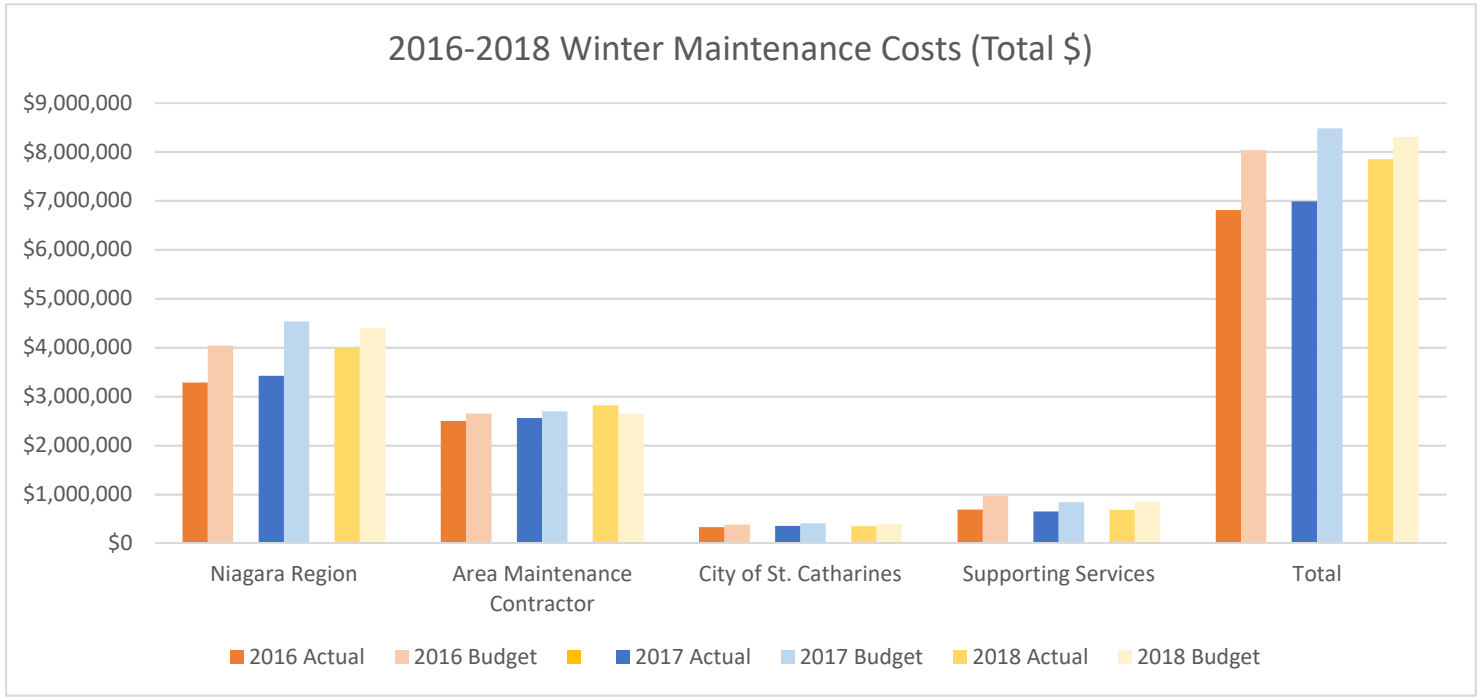
Appendices

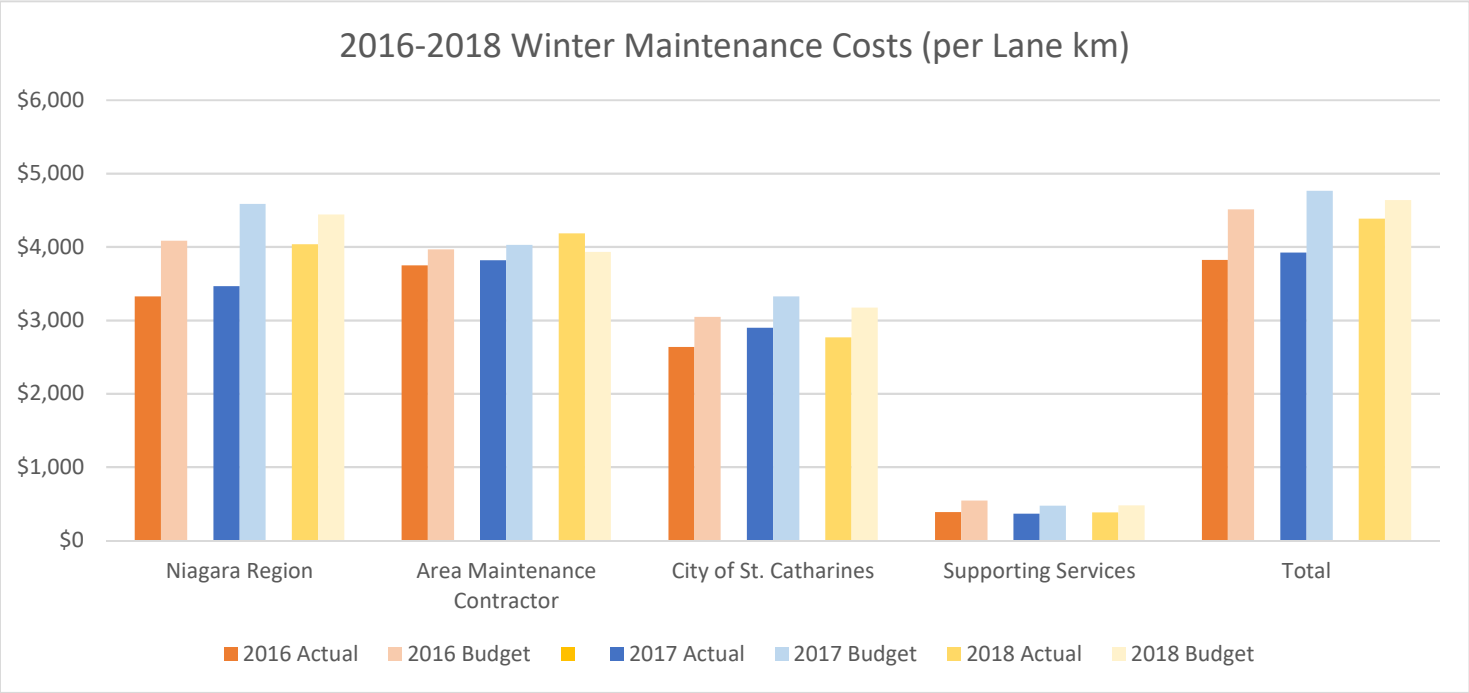
Appendix 1	Winter Maintenance Costs
Appendix 2	Amending Agreement 2008-RFP-40
Appendix 3	Minimum Maintenance Standards for Municipal Highways O. Reg. 366/18

2016-2018 Winter Maintenance Costs
Budget vs Actuals

Budget vs Actual $	Niagara Region			Area Maintenance Contractor			City of St. Catharines			Supporting Services			Total		
Total Lane Km's Maintained	989	989	990	668	670	674	125	122	126	1782	1781	1790	1782	1781	1790
Year	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Winter Budget	4,037,881	4,533,599	4,399,064	2,650,000	2,700,000	2,650,000	381,000	406,000	400,000	968,289	842,888	852,498	8,037,170	8,482,487	8,301,562
Winter Actual	3,287,709	3,425,507	3,995,834	2,504,624	2,559,293	2,821,368	329,728	353,490	348,617	687,276	648,681	686,215	6,809,336	6,986,972	7,852,034
Budgeted Cost per lane Km	4,083	4,584	4,443	3,967	4,030	3,932	3,048	3,328	3,175	543	473	476	4,510	4,763	4,638
Actual Cost per Lane Km	3,324	3,464	4,036	3,749	3,820	4,186	2,638	2,897	2,767	386	364	383	3,821	3,923	4,387

Appendix 1: Table 2




2016-2018 Winter Maintenance Costs (per Lane km)
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Niagara Region
Area Maintenance Contractor
City of St. Catharines
Supporting Services
Total
2016 Actual
2016 Budget
2017 Actual
2017 Budget
2018 Actual
2018 Budget

PW 18-2019 Appendix 2

AMENDING AGREEMENT

THIS AGREEMENT made as of the 4th day of September, 2018.

BETWEEN:

THE REGIONAL MUNICIPALITY OF NIAGARA

(Hereinafter called the "**Region**")

- and -

STEED AND EVANS LIMITED

(Hereinafter called the "**Contractor**")

WHEREAS by an Agreement dated the 6th day of October, 2008 (hereinafter called the "Original Agreement"), the Region and the Contractor agreed that the Contractor shall provide Area Winter Maintenance Services under 2008-RFP-40 (hereinafter called the "Project");

AND WHEREAS the parties hereto desire to amend the Original Agreement to extend the term of the Original Agreement;

NOW THEREFORE this in consideration of the sum of TWO DOLLARS ($2.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties agree as follows:

1. The Original Agreement shall be amended as of the date set out above for one additional year ending on September 3, 2019 with the option in favour of Niagara Region and at Niagara Region's sole and absolute discretion to extend the term for one additional one year term ending on September 3, 2020.

2. Payment to the Contractor shall be in accordance with the terms and conditions outlined in the Original Agreement, save an except for a one-time increase to the annual payment of $40,000.00 to cover increased insurance premiums. The parties agree the applicable aggregate fee, inclusive of the $40,000.00 increase, for the period September 4, 2018 to September 3rd, 2019, is $2,599,822.11.

3. Section 2.5 Contract Security in 2008-RFP-40 forming part of the Original Agreement shall be amended by requiring the substitution of a Performance Bond in the amount of $2,000,000.00 in place of the Original Agreement requirement of a combination Performance Bond and Letter of Credit, which replacement Performance Bond shall will remain in effect for the duration of the contract.

4. The terms, covenants, provisos, and stipulations in the Original Agreement are hereby confirmed in full force save and except such modifications only as are necessary to make them applicable to this Amending Agreement.

IN WITNESS WHEREOF the parties hereto have duly executed this Agreement.

THE REGIONAL MUNICIPALITY OF NIAGARA

Per: _____

Name: Carmelo D'Angelo, BSC, MPA
Title: Chief Administrative Officer

I have the authority to bind the Corporation.

STEED AND EVANS LIMITED

Per: Bob Hunter

Name:
Title: Construction Mgr

Name:
Title:

We have the authority to bind the Corporation.

PW 18-2019 Appendix 3

O. Reg. 366/18: MINIMUM MAINTENANCE STANDARDS FOR MUNICIPAL HIGHWAYS

filed May 3, 2018 under *Municipal Act, 2001, S.O. 2001, c. 25*

Skip to content
Print Download

ontario regulation 366/18

made under the

Municipal Act, 2001

Made: May 2, 2018
Filed: May 3, 2018
Published on e-Laws: May 3, 2018
Printed in *The Ontario Gazette*: May 19, 2018

Amending O. Reg. 239/02

(MINIMUM MAINTENANCE STANDARDS FOR MUNICIPAL HIGHWAYS)

1. (1) The definition of "surface" in subsection 1 (1) of Ontario Regulation 239/02 is amended by striking out "roadway or shoulder" and substituting "sidewalk, roadway or shoulder".

(2) Subsection 1 (1) of the Regulation is amended by adding the following definitions:

"bicycle facility" means the on-road and in-boulevard cycling facilities listed in Book 18 of the Ontario Traffic Manual;

"bicycle lane" means,

(a) a portion of a roadway that has been designated by pavement markings or signage for the preferential or exclusive use of cyclists, or

(b) a portion of a roadway that has been designated for the exclusive use of cyclists by signage and a physical or marked buffer;

"encroachment" means anything that is placed, installed, constructed or planted within the highway that was not placed, installed, constructed or planted by the municipality;

"pothole" means a hole in the surface of a roadway caused by any means, including wear or subsidence of the road surface or subsurface;

"sidewalk" means the part of the highway specifically set aside or commonly understood to be for pedestrian use, typically consisting of a paved surface but does not include crosswalks, medians, boulevards, shoulders or any part of the sidewalk where cleared snow has been deposited;

“significant weather event” means an approaching or occurring weather hazard with the potential to pose a significant danger to users of the highways within a municipality;

“utility” includes any air, gas, water, electricity, cable, fiber-optic, telecommunication or traffic control system or subsystem, fire hydrants, sanitary sewers, storm sewers, property bars and survey monuments;

“utility appurtenance” includes maintenance holes and hole covers, water shut-off covers and boxes, valves, fittings, vaults, braces, pipes, pedestals, and any other structures or items that form part of or are an accessory part of any utility;

“weather hazard” means the weather hazards determined by Environment Canada as meeting the criteria for the issuance of an alert under its Public Weather Alerting Program.

(3) Subsections 1 (2) and (3) of the Regulation are amended by striking out “annual” wherever it appears.

(4) Subsection 1 (4) of the Regulation is revoked and the following substituted:

(4) For the purposes of this Regulation, unless otherwise indicated in a provision of this Regulation, a municipality is deemed to be aware of a fact if, in the absence of actual knowledge of the fact, circumstances are such that the municipality ought reasonably to be aware of the fact.

(5) The Table to section 1 of the Regulation is revoked and the following substituted:

TABLE
CLASSIFICATION OF HIGHWAYS

Column 1 Average Daily Traffic (number of motor vehicles)	Column 2 91 - 100 km/h speed limit	Column 3 81 - 90 km/h speed limit	Column 4 71 - 80 km/h speed limit	Column 5 61 - 70 km/h speed limit	Column 6 51 - 60 km/h speed limit	Column 7 41 - 50 km/h speed limit	Column 8 1 - 40 km/h speed limit
53,000 or more	1	1	1	1	1	1	1
23,000 - 52,999	1	1	1	2	2	2	2
15,000 - 22,999	1	1	2	2	2	3	3
12,000 - 14,999	1	1	2	2	2	3	3
10,000 - 11,999	1	1	2	2	3	3	3
8,000 - 9,999	1	1	2	3	3	3	3
6,000 - 7,999	1	2	2	3	3	4	4
5,000 - 5,999	1	2	2	3	3	4	4
4,000 - 4,999	1	2	3	3	3	4	4
3,000 - 3,999	1	2	3	3	3	4	4
2,000 - 2,999	1	2	3	3	4	5	5
1,000 - 1,999	1	3	3	3	4	5	5
500 - 999	1	3	4	4	4	5	5
200 - 499	1	3	4	4	5	5	6
50 - 199	1	3	4	5	5	6	6
0 - 49	1	3	6	6	6	6	6

2. The Regulation is amended by adding the following section:

Purpose

2.1 The purpose of this Regulation is to clarify the scope of the statutory defence available to a municipality under clause 44 (3) (c) of the Act by establishing maintenance standards which are non-prescriptive as to the methods or materials to be used in complying with the standards but instead describe a desired outcome.

3. (1) The heading before section 3 of the Regulation is amended by striking out "MINIMUM" and substituting "MAINTENANCE"

(2) Subsections 3 (1) and (2) of the Regulation are amended by striking out "minimum" wherever it appears.

(3) Subsection 3 (4) of the Regulation is amended by striking out "section 16.1" and substituting "section 16.1, 16.2, 16.3 or 16.4".

4. Subsections 3.1 (1) and (2) of the Regulation are amended by striking out "minimum" wherever it appears.

5. (1) Subsection 4 (1) of the Regulation is amended by striking out the portion before clause (a) and substituting the following:

Snow accumulation, roadways

(1) Subject to section 4.1, the standard for addressing snow accumulation on roadways is,

. . . . .

(2) Subsection 4 (3) of the Regulation is amended by adding "and, if applicable, lane width under clause (1) (b)," after "roadway" in the portion before paragraph 1.

(3) Subsection 4 (4) of the Regulation is amended by adding "and lane width" after "roadway" in the portion before clause (a).

(4) Subsections 4 (5) and (6) of the Regulation are revoked and the following substituted:

(5) For the purposes of this section, addressing snow accumulation on a roadway includes,

(a) plowing the roadway;

(b) salting the roadway;

(c) applying abrasive materials to the roadway;

(d) applying other chemical or organic agents to the roadway;

(e) any combination of the methods described in clauses (a) to (d);

(6) This section does not apply to that portion of the roadway,

(a) designated for parking;

(b) consisting of a bicycle lane or other bicycle facility; or

(d) used by a municipality for snow storage;

(5) The heading of the Table to section 4 of the Regulation is revoked and the following substituted:

SNOW ACCUMULATION - ROADWAYS

7. The Regulation is amended by adding the following sections:

Snow accumulation on roadways, significant weather event

4.1 (1) If a municipality declares a significant weather event relating to snow accumulation, the standard for addressing snow accumulation on roadways until the declaration of the end of the significant weather event is,

(a) to monitor the weather in accordance with section 3.1; and

(b) if deemed practicable by the municipality, to deploy resources to address snow accumulation on roadways, starting from the time that the municipality deems appropriate to do so.

(2) If the municipality complies with subsection (1), all roadways within the municipality are deemed to be in a state of repair with respect to snow accumulation until the applicable time in the Table to section 4 expires following the declaration of the end of the significant weather event by the municipality.

(3) Following the end of the weather hazard in respect of which a significant weather event was declared by a municipality under subsection (1), the municipality shall,

(a) declare the end of the significant weather event when the municipality determines it is appropriate to do so; and

(b) address snow accumulation on roadways in accordance with section 4.

Snow accumulation, bicycle lanes

4.2 (1) Subject to section 4.3, the standard for addressing snow accumulation on bicycle lanes is,

(a) after becoming aware of the fact that the snow accumulation on a bicycle lane is greater than the depth set out in the Table to this section, to deploy resources as soon as practicable to address the snow accumulation; and

(b) after the snow accumulation has ended, to address the snow accumulation so as to reduce the snow to a depth less than or equal to the depth set out in the Table to this section to provide a minimum bicycle lane width of the lesser of 1 metre or the actual bicycle lane width.

(2) If the depth of snow accumulation on a bicycle lane is less than or equal to the depth set out in the Table to this section, the bicycle lane is deemed to be in a state of repair in respect of snow accumulation.

(3) For the purposes of this section, the depth of snow accumulation on a bicycle lane and, if applicable, lane width under clause (1) (b), may be determined in the same manner as set out in subsection 4 (4) and by the persons mentioned in subsection 4 (3), with necessary modifications.

(4) For the purposes of this section, addressing snow accumulation on a bicycle lane includes,

(a) plowing the bicycle lane;

(b) salting the bicycle lane;

(c) applying abrasive materials to the bicycle lane;

(d) applying other chemical or organic agents to the bicycle lane;

(e) sweeping the bicycle lane; or

(f) any combination of the methods described in clauses (a) to (e).

TABLE

Snow Accumulation – Bicycle Lanes

Column 1 Class of Highway or Adjacent Highway	Column 2 Depth	Column 3 Time
1	2.5 cm	8 hours
2	5 cm	12 hours
3	8 cm	24 hours
4	8 cm	24 hours
5	10 cm	24 hours

Snow accumulation on bicycle lanes, significant weather event

4.3 (1) If a municipality declares a significant weather event relating to snow accumulation, the standard for addressing snow accumulation on bicycle lanes until the declaration of the end of the significant weather event is,

(a) to monitor the weather in accordance with section 3.1; and

(b) if deemed practicable by the municipality, to deploy resources to address snow accumulation on bicycle lanes, starting from the time that the municipality deems appropriate to do so.

(2) If the municipality complies with subsection (1), all bicycle lanes within the municipality are deemed to be in a state of repair with respect to snow accumulation until the applicable time in the Table to section 4.2 expires following the declaration of the end of the significant weather event by the municipality.

(3) Following the end of the weather hazard in respect of which a significant weather event was declared by a municipality under subsection (1), the municipality shall,

(a) declare the end of the significant weather event when the municipality determines it is appropriate to do so; and

(b) address snow accumulation on bicycle lanes in accordance with section 4.2.

8. Section 5 of the Regulation is revoked and the following substituted:

Ice formation on roadways and icy roadways

5. (1) The standard for the prevention of ice formation on roadways is doing the following in the 24-hour period preceding an alleged formation of ice on a roadway:

1. Monitor the weather in accordance with section 3.1.

2. Patrol in accordance with section 3.

3. If the municipality determines, as a result of its activities under paragraph 1 or 2, that there is a substantial probability of ice forming on a roadway, treat the roadway, if practicable, to prevent ice formation within the time set out in Table 1 to this section, starting from the time that the municipality determines is the appropriate time to deploy resources for that purpose.

(2) If the municipality meets the standard set out in subsection (1) and, despite such compliance, ice forms on a roadway, the roadway is deemed to be in a state of repair until the applicable time set out in Table 2 to this section expires after the municipality becomes aware of the fact that the roadway is icy.

(3) Subject to section 5.1, the standard for treating icy roadways is to treat the icy roadway within the time set out in Table 2 to this section, and an icy roadway is deemed to be in a state of repair until the applicable time set out in Table 2 to this section expires after the municipality becomes aware of the fact that a roadway is icy.

(4) For the purposes of this section, treating a roadway means applying material to the roadway, including but not limited to, salt, sand or any combination of salt and sand.

(5) For greater certainty, this section applies in respect of ice formation on bicycle lanes on a roadway, but does not apply to other types of bicycle facilities.

TABLE 1
ice formation prevention

Class of Highway	Time
1	6 hours
2	8 hours
3	16 hours
4	24 hours
5	24 hours

TABLE 2
Treatment of ICY ROADWAYS

Class of Highway	Time
1	3 hours
2	4 hours
3	8 hours
4	12 hours
5	16 hours

Icy roadways, significant weather event

5.1 (1) If a municipality declares a significant weather event relating to ice, the standard for treating icy roadways until the declaration of the end of the significant weather event is,

(a) to monitor the weather in accordance with section 3.1; and

(b) if deemed practicable by the municipality, to deploy resources to treat icy roadways, starting from the time that the municipality deems appropriate to do so.

(2) If the municipality complies with subsection (1), all roadways within the municipality are deemed to be in a state of repair with respect to any ice which forms or may be present until the applicable time in Table 2 to section 5 expires after the declaration of the end of the significant weather event by the municipality.

(3) Following the end of the weather hazard in respect of which a significant weather event was declared by a municipality under subsection (1), the municipality shall,

(a) declare the end of the significant weather event when the municipality determines it is appropriate to do so; and

(b) treat icy roadways in accordance with section 5.

8. (1) Subsection 6 (1) of the Regulation is amended by striking out "minimum".

(2) Section 6 of the Regulation is amended by adding the following subsections:

(1.1) For the purposes of this section, the surface area and depth of a pothole may be determined in accordance with subsections (1.2) and (1.3), as applicable, by a municipal employee, agent or contractor whose duties or responsibilities include one or more of the following:

1. Patrolling highways.

2. Performing highway maintenance activities.

3. Supervising staff who perform activities described in paragraph 1 or 2.

(1.2) The depth and surface area of a pothole may be determined by,

(a) performing an actual measurement; or

(b) performing a visual estimate.

(1.3) For the purposes of this section, the surface area of a pothole does not include any area that is merely depressed and not yet broken fully through the surface of the roadway.

9. (1) Subsections 7 (1) and (2) of the Regulation are revoked and the following substituted:

Shoulder drop-offs

(1) If a shoulder drop-off is deeper than 8 cm, for a continuous distance of 20 metres or more, the standard is to repair the shoulder drop-off within the time set out in the Table to this section after becoming aware of the fact.

(2) A shoulder drop-off is deemed to be in a state of repair if its depth is less than 8 cm.

(2) The Table to section 7 of the Regulation is revoked and the following substituted:

TABLE
SHOULDER DROP-OFFS

Class of Highway	Time
1	4 days
2	4 days
3	7 days
4	14 days
5	30 days

10. (1) Subsections 8 (1) and (2) of the Regulation are revoked and the following substituted:

Cracks

(1) If a crack on the paved surface of a roadway is greater than 5 cm wide and 5 cm deep for a continuous distance of three metres or more, the standard is to repair the crack within the time set out in the Table to this section after becoming aware of the fact.

(2) A crack is deemed to be in a state of repair if its width or depth is less than or equal to 5 cm.

(2) The Table to section 8 of the Regulation is revoked and the following substituted:

TABLE
CRACKS

Column 1 Class of Highway	Column 2 Time
1	30 days
2	30 days
3	60 days

4	180 days
5	180 days

11. Subsection 9 (1) of the Regulation is amended by striking out "minimum".

12. Subsections 10 (0.1), (1), (2), (3), (4), (5) and (6) of the Regulation are revoked and the following substituted:

Luminaires

(1) The standard for the frequency of inspecting all luminaires to check to see that they are functioning is once per calendar year, with each inspection taking place not more than 16 months from the previous inspection.

(2) For conventional illumination, if three or more consecutive luminaires on the same side of a highway are not functioning, the standard is to repair the luminaires within the time set out in the Table to this section after becoming aware of the fact.

(3) For conventional illumination and high mast illumination, if 30 per cent or more of the luminaires on any kilometre of highway are not functioning, the standard is to repair the luminaires within the time set out in the Table to this section after becoming aware of the fact.

(4) Despite subsection (2), for high mast illumination, if all of the luminaires on consecutive poles on the same side of a highway are not functioning, the standard is to deploy resources as soon as practicable after becoming aware of the fact to repair the luminaires.

(5) Despite subsections (1), (2) and (3), for conventional illumination and high mast illumination, if more than 50 per cent of the luminaires on any kilometre of a Class 1 highway with a speed limit of 90 kilometres per hour or more are not functioning, the standard is to deploy resources as soon as practicable after becoming aware of the fact to repair the luminaires.

(6) Luminaires are deemed to be in a state of repair,

(a) for the purpose of subsection (2), if the number of non-functioning consecutive luminaires on the same side of a highway does not exceed two;

(b) for the purpose of subsection (3), if more than 70 per cent of luminaires on any kilometre of highway are functioning;

(c) for the purpose of subsection (4), if one or more of the luminaires on consecutive poles on the same side of a highway are functioning;

(d) for the purpose of subsection (5), if more than 50 per cent of luminaires on any kilometre of highway are functioning.

13. The Regulation is amended by striking out "minimum" wherever it appears in the following provisions:

1. Sections 11 to 16.

2. Subsection 16.1 (1).

14. Subsections 16.1 (2), (2.1), (3) and (4) of the Regulation are revoked and the following substituted:

(2) If a surface discontinuity on or within a sidewalk exceeds two centimetres, the standard is to treat the surface discontinuity within 14 days after acquiring actual knowledge of the fact.

(3) A surface discontinuity on or within a sidewalk is deemed to be in a state of repair if it is less than or equal to two centimetres.

(4) For the purpose of subsection (2), treating a surface discontinuity on or within a sidewalk means taking reasonable measures to protect users of the sidewalk from the discontinuity, including making permanent or temporary repairs, alerting users' attention to the discontinuity or preventing access to the area of discontinuity.

(5) In this section,

"surface discontinuity" means a vertical discontinuity creating a step formation at any joint or crack in the surface of the sidewalk or any vertical height difference between a utility appurtenance found on or within the sidewalk and the surface of the sidewalk.

15. The Regulation is amended by adding the following sections.

Encroachments, area adjacent to sidewalk

16.2 (1) The standard for the frequency of inspecting an area adjacent to a sidewalk to check for encroachments is once per calendar year, with each inspection taking place not more than 16 months from the previous inspection.

(2) The area adjacent to a sidewalk that has been inspected in accordance with subsection (1) is deemed to be in a state of repair in respect of any encroachment present.

(3) For greater certainty, the area adjacent to a sidewalk begins at the outer edges of a sidewalk and ends at the lesser of the limit of the highway, the back edge of a curb if there is a curb and a maximum of 45 cm.

(4) The area adjacent to a sidewalk is deemed to be in a state of repair in respect of any encroachment present unless the encroachment is determined by a municipality to be highly unusual given its character and location or to constitute a significant hazard to pedestrians.

(5) If a municipality determines that an encroachment is highly unusual given its character and location or constitutes a significant hazard to pedestrians, the standard is to treat the encroachment within 28 days after making such a determination, and the encroachment is deemed in a state of repair for 28 days from the time of the determination by the municipality.

(6) For the purpose of subsection (4), treating an encroachment means taking reasonable measures to protect users, including making permanent or temporary repairs, alerting users' attention to the encroachment or preventing access to the area of the encroachment.

Snow accumulation on sidewalks

16.3 (1) Subject to section 16.4, the standard for addressing snow accumulation on a sidewalk after the snow accumulation has ended is,

a) to reduce the snow to a depth less than or equal to 8 centimetres within 48 hours; and

b) to provide a minimum sidewalk width of 1 metre.

(2) If the depth of snow accumulation on a sidewalk is less than or equal to 8 centimetres, the sidewalk is deemed to be in a state of repair in respect of snow accumulation.

(3) If the depth of snow accumulation on a sidewalk exceeds 8 centimetres while the snow continues to accumulate, the sidewalk is deemed to be in a state of repair with respect to snow accumulation, until 48 hours after the snow accumulation ends.

(4) For the purposes of this section, the depth of snow accumulation on a sidewalk may be determined in the same manner as set out in subsection 4 (4) and by the persons mentioned in subsection 4 (3) with necessary modifications.

(5) For the purposes of this section, addressing snow accumulation on a sidewalk includes,

(a) plowing the sidewalk;

(b) salting the sidewalk;

(c) applying abrasive materials to the sidewalk;

(d) applying other chemical or organic agents to the sidewalk; or

(e) any combination of the methods described in clauses (a) to (d).

Snow accumulation on sidewalks, significant weather event

16.4 (1) If a municipality declares a significant weather event relating to snow accumulation, the standard for addressing snow accumulation on sidewalks until the declaration of the end of the significant weather event is,

(a) to monitor the weather in accordance with section 3.1; and

(b) if deemed practicable by the municipality, to deploy resources to address snow accumulation on sidewalks starting from the time that the municipality deems appropriate to do so.

(2) If the municipality complies with subsection (1), all sidewalks within the municipality are deemed to be in a state of repair with respect to any snow present until 48 hours following the declaration of the end of the significant weather event by the municipality.

(3) Following the end of the weather hazard in respect of which a significant weather event was declared by a municipality under subsection (1), the municipality shall,

(a) declare the end of the significant weather event when the municipality determines it is appropriate to do so; and

(b) address snow accumulation on sidewalks in accordance with section 16.3.

Ice formation on sidewalks and icy sidewalks

16.5 (1) Subject to section 16.6, the standard for the prevention of ice formation on sidewalks is to,

(a) monitor the weather in accordance with section 3.1 in the 24-hour period preceding an alleged formation of ice on a sidewalk; and

(b) treat the sidewalk if practicable to prevent ice formation or improve traction within 48 hours if the municipality determines that there is a substantial probability of ice forming on a sidewalk, starting from the time that the municipality determines is the appropriate time to deploy resources for that purpose.

(2) If ice forms on a sidewalk even though the municipality meets the standard set out in subsection (1), the sidewalk is deemed to be in a state of repair in respect of ice until 48 hours after the municipality first becomes aware of the fact that the sidewalk is icy.

(3) The standard for treating icy sidewalks after the municipality becomes aware of the fact that a sidewalk is icy is to treat the icy sidewalk within 48 hours, and an icy sidewalk is deemed to be in a state of repair for 48 hours after it has been treated.

(4) For the purposes of this section, treating a sidewalk means applying materials including salt, sand or any combination of salt and sand to the sidewalk.

Icy sidewalks, significant weather event

16.6 (1) If a municipality declares a significant weather event relating to ice, the standard for addressing ice formation or ice on sidewalks until the declaration of the end of the significant weather event is,

(a) to monitor the weather in accordance with section 3.1; and

(b) if deemed practicable by the municipality, to deploy resources to treat the sidewalks to prevent ice formation or improve traction, or treat the icy sidewalks, starting from the time that the municipality deems appropriate to do so.

(2) If the municipality complies with subsection (1), all sidewalks within the municipality are deemed to be in a state of repair with respect to any ice which forms or is present until 48 hours after the declaration of the end of the significant weather event by the municipality.

(3) Following the end of the weather hazard in respect of which a significant weather event was declared by a municipality under subsection (1), the municipality shall,

(a) declare the end of the significant weather event when the municipality determines it is appropriate to do so; and

(b) address the prevention of ice formation on sidewalks or treat icy sidewalks in accordance with section 16.5.

Winter sidewalk patrol

16.7 (1) If it is determined by the municipality that the weather monitoring referred to in section 3.1 indicates that there is a substantial probability of snow accumulation on sidewalks in excess of 8 cm, ice

formation on sidewalks or icy sidewalks, the standard for patrolling sidewalks is to patrol sidewalks that the municipality selects as representative of its sidewalks at intervals deemed necessary by the municipality.

(2) Patrolling a sidewalk consists of visually observing the sidewalk, either by driving by the sidewalk on the adjacent roadway or by driving or walking on the sidewalk or by electronically monitoring the sidewalk, and may be performed by persons responsible for patrolling roadways or sidewalks or by persons responsible for or performing roadway or sidewalk maintenance activities.

Closure of a highway

16.8 (1) When a municipality closes a highway or part of a highway pursuant to its powers under the Act,the highway is deemed to be in a state of repair in respect of all conditions described in this Regulation from the time of the closure until the highway is re-opened by the municipality.

(2) For the purposes of subsection (1), a highway or part of a highway is closed on the earlier of,

(a) when a municipality passes a by-law to close the highway or part of the highway; and

(b) when a municipality has taken such steps as it determines necessary to temporarily close the highway or part of a highway.

Declaration of significant weather event

16.9. A municipality declaring the beginning of a significant weather event or declaring the end of a significant weather event under this Regulation shall do so in one or more of the following ways:

1. By posting a notice on the municipality's website.

2. By making an announcement on a social media platform, such as Facebook or Twitter.

3. By sending a press release or similar communication to internet, newspaper, radio or television media.

4. By notification through the municipality's police service.

5. By any other notification method required in a by-law of the municipality.

Commencement

16. This Regulation comes into force on the day it is filed.

Made by:

Kathryn McGarry

Minister of Transportation

Date made: May 2, 2018

Tags

- Laws

Rate

Rate this page

Share

Facebook Twitter Print

e-Laws

e-Laws provides access to official copies of Ontario's statutes and regulations.

Contact Us

Contact us

Topics

- Arts and culture
- Business and economy
- Driving and roads
- Education and training
- Environment and energy
- Government
- Health and wellness
- Home and community
- Jobs and employment
- Law and safety
- Laws
- Rural and north
- Taxes and benefits
- Travel and recreation

ABOUT ONTARIO

- privacy
- accessibility
- terms of use

b

Subject: Transportation Infrastructure Means Protection Update

Report to: Public Works Committee

Report date: Tuesday, April 16, 2019

Recommendations

1. That the recommendations contained in the *Transportation Infrastructure Means Protection* report, attached as Appendix 2 to Report PW 24-2019, **BE ENDORSED**;

2. That staff **BE DIRECTED** to proceed with the detailed design and tendering of the Transportation Infrastructure Means Protection project; and

3. That financing in the amount of $4,000,000 gross and net **BE INITIATED** from the approved 2019 capital budget for the Transportation Infrastructure Means Protection project and that the project **BE FUNDED** as follows:

    - Reserves – Capital Levy - $4,000,000

Key Facts

- The purpose of this report is to update Council on the status of the preliminary design report completed by Parsons Inc. (March 2019) and to seek direction on proceeding with the detailed design and tender package creation.

- In January 2019 Niagara Region's Medical Officer of Health and Commissioner (Acting), M. Mustafa Hirji, brought forward a report to Public Health and Social Services Committee entitled *PHD 03-2019 Preventing Deaths by Suicide on Public Infrastructure* (*PHD 03-2019*). *PHD 03-2019* is attached as Appendix 1.

- In consideration of *PHD 03-2019*, Committee approved a means prevention barrier at location StC-1, and directed staff to proceed with planning and to report back in the spring with a final recommendation and a detailed cost estimate.

- During 2019 Capital Budget deliberations, staff was directed to include $4,000,000 in the 2019 Capital Budget for the Transportation Infrastructure Means Protection project subject to Committee and Council approval of project initiation.

- Due to the extreme sensitivity of this project, and timeliness of erecting the means protection barriers being of significant importance (to address risk of additional deaths), staff are recommending that Parsons Inc. be directly retained to proceed

with the detailed deign and tender package creation in accordance with Niagara Region's Purchasing Bylaw.

- In January 2019, Region staff directly retained Parsons Inc. to complete a preliminary design report for Means Protection at StC-1, the direct award was attributed to the following:

    - The sensitive nature of the subject at hand
    - The need to expedite the composition of such report
    - Parsons familiarity with the structural design of the structure having been the original designer

- In late March 2019, staff received the final report completed by Parsons Inc. entitled *Transportation Infrastructure Means Protection* (TIMP) (Appendix 2).

- The TIMP report reviewed several areas of interest including the following:

    - Current state of the structure
    - A number of other structures throughout North America along with means protection design utilized on each structure
    - Options for outer wall barriers
    - Options for inner wall barriers
    - Construction materials
    - Capital cost associated with construction

- The estimated cost of construction for the means protection barrier would be in the order of $2,977,350 excluding taxes.

Financial Considerations

The full cost of implementing means protection barriers at StC-1 is estimated to be in the order of $3,508,023 (including 1.76% non-refundable HST). These costs include the following items:

- Detailed design of the barrier system
- Tendering
- Labor and material associated with the installation of the barrier system
- Contract administration and inspection of the barrier system
- Approval and coordination with MTO
- Miscellaneous contract costs

Should any deviation from these costs arise that cannot be accommodated within the $4,000,000 budget, staff will come back to Council in accordance with the budget control by-law.

Financial evaluation of the preferred barrier system should closely consider the lifecycle cost of the barrier system as it relates to suggested material types. Life cycle cost shall include the cost of expected future maintenance of various materials along with the initial capital cost of each material.

During 2019 Capital Budget deliberations, on the direction of Council through PHD 03-2019, staff submitted and Council approved an uninitiated business case entitled Transportation Infrastructure Means Protection - 20001038. Staff recommends initiating these approved funds in order to move forward with the detailed design, tender and construction of the means protection barriers.

In the six month period since October 2018, there have been six deaths by suicide at the location in question, as well as at least 1 additional serious attempt. With future deaths being a known probability as per updated assessment and recommendation by Dr. Hirji (Appendix 3), there is considerable risk with not installing the means protection barriers at this time.

Due to the extreme sensitivity of this project, and timeliness of erecting the means protection barriers being of significant importance (to address risk of additional deaths), staff are recommending that Parsons Inc. be directly retained to proceed with the detailed deign and tender package creation in accordance with Niagara Region's Purchasing Bylaw. Parsons Inc. has extensive background and knowledge of StC-1, which will allow Niagara Region to proceed with the installation of means protection barriers in an expeditiously manner. Staff have solicited a proposal from Parson Inc.to complete this phase of the project and have received a proposed cost of $141,626 (including 1.76% non-refundable HST). It is more than likely that Staff will retain Parsons Inc. to undertake contract administration and inspection services during the next phase of this work. Council should be aware that the award of contract administration and inspection services for the construction of StC-1 itself was also awarded to Parsons Inc. as a sole source procurement due to the criticality of the designer overseeing their design. The value of this previous work required and received Council approval.

Analysis

In January 2019 Niagara Region's Medical Officer of Health and Commissioner (Acting), M. Mustafa Hirji, brought forward a report to Public Health and Social Services Committee entitled *PHD 03-2019 Preventing Deaths by Suicide on Public Infrastructure* (PHD 03-2019D).

Council endorsement of recommendations in the above report directed staff to proceed with planning for means protection at StC-1.

In January 2019, staff retained Parsons Inc. to carry out a preliminary design report that would consider the feasibility of installing means protection on StC-1. The report would review similar structures that have means protection structures, and the various types of means protection that are feasible for the required application, the physical ability to retrofit means protection to the existing infrastructure, potential design parameters, materials options, along with their expected service life.

In late March 2019, staff received a completed TIMP report (Appendix 2). The highlights of the report are as follows:

- There are a number of examples throughout North America where various types of means protection have been installed and are performing as expected. A few locations are Burrard Street Bridge (Vancouver), Ironworkers Memorial Bridge (Surrey), Golden Gate Bridge (San Francisco), Prince Edward Viaduct (Toronto), High Level Bridge (Edmonton)
- Advantages and disadvantages of examples were provided
- Design options recommended for exterior barriers: *1. Inclined barrier with cantilever pipes, 2. Inclined barriers with supported pickets*
- Design options recommended for interior barriers: *1. Horizontal mesh at top of parapet, 2. Horizontal mesh at bottom of parapet*
- Materials options for means protection barrier construction
- Life cycle cost analysis of different construction materials

The TIMP report clearly concluded that retrofitting means protection to StC-1 was a feasible option.

In mid-March, staff attended a steel fabrication plant to view a full scale model of the two exterior barrier options considered viable in the TIMP report. Staff reviewed the scale models along with our consultant Parsons Inc. Upon conclusion of this site visit, it was evident that of the two options considered, one option (inclined barrier with cantilever pipes) was far more robust and appeared to better serve the intended purpose.

The major benefit of the inclined barrier with cantilever pipes was the robust cross section. The stability of this robust cross section required less bracing and a reduced need for bracing resulting in a design that is less scalable by persons. The scalability of the design is an important consideration as a less scalable design is more likely to deter persons from attempting to climb the means protection.

The interior barrier considerations are very similar in nature; however, the *horizontal mesh at top of parapet* has benefits related to installation and maintenance. The top mounted option is also more visible and will act to further deter potential scaling of the interior parapet wall.

Materials evaluated for construction of the means protection barriers were galvanized steel and aluminum.

Galvanized steel and aluminum are estimated to have a very similar initial capital cost. However, the longevity of galvanized steel is dependant on the quality and durability of its galvanizing and its ability to resist corrosion. Galvanized steel would require a more frequent maintenance program to ensure the full life expectancy of the asset is realized. Aluminum is resistant to corrosion. Aluminum oxidizes naturally and is extremely durable in our climate. It is expected that an aluminum barrier would have significantly less ongoing maintenance to reach its expected asset life. Galvanized steel is a much heavier material making dampening of the steel to control vibration more predictable. Galvanized steel has been widely used for similar applications thus making its performance highly predictable. Although there have been no identified cantilevered pipe means protection barriers constructed of aluminum, staff are recommending further analysis be conducted during detailed design to determine the feasibility of this option.

Life cycle cost analysis is a method for evaluating the initial capital cost of an asset along with the maintenance required to assist the asset in reaching its expected asset life before requiring replacement. Some materials will require a lower initial capital investment and have a higher long term maintenance cost while others will have a higher initial capital investment and a lower long term maintenance cost. When making a determination of the most financially responsible materials to use it is important to consider the long term cost of an asset including any maintenance required over the life of the asset.

When reviewing all of the variables and the life cycle cost analysis is clear that galvanized steel has a higher life cycle cost than aluminum (see TIMP report Appendix 2). Staff along with our consultant feel that it would be prudent to take advantage of the lower life cycle cost of utilizing aluminum. However, further detailed design is required to ensure that dampening the barrier to prevent vibration is possible in this application. During the detailed design stage the cost associated with dampening the aluminum barrier will be reviewed and if found that dampening the aluminum would not be cost adverse, staff will proceed with the design utilizing aluminum. If found that in this application, dampening the aluminum barrier is not possible or cost prohibitive staff will proceed with a galvanized steel barrier. Staff will report back to Council via Council Memo once a final material has been established, in order for Council to be aware of the expected final product.

Alternatives Reviewed

Means protection is part of a holistic approach to suicide prevention as detailed in the Prevention Report, and as is being proposed in PHD 08-2019.

Staff have reviewed alternatives for several types of means protection including but not limited to the following:

- Vertical Steel Rod Fence (Burrard Street Bridge)
- Vertical Galvanized Cantilever Pipes (Ironworkers Memorial Bridge) **Preferred**
- Netting Systems (Golden Gate Bridge)
- Vertical Barrier with Rods (Price Edward Viaduct)
- Horizontal Steel Cable Barrier (High Level Bridge)

The advantages and disadvantages of each type of means protection in the locations listed is detailed in the TIMP report attached as (Appendix “2”).

Relationship to Council Strategic Priorities

This report does not relate specifically to any of Council’s strategic priorities. Nonetheless, it addresses a matter of current public interest, and is pursuant to an approval and direction by Council through PHD 03-2019.

Other Pertinent Reports

PHD 03-2019 Preventing Deaths by Suicide on Public Infrastructure

Prepared by:
Frank Tassone, C.E.T.
Associate Director Transportation Engineering
Public Works Department

Recommended by:
Catherine Habermebl
Acting Commissioner
Public Works Department

Submitted by:
Ron Tripp, P.Eng.
Acting Chief Administrative Officer

This report was prepared in consultation with M. Mustafa Hirji, Medical Officer of Health & Commissioner (Acting) (Public Health and Emergency Services), Sardar Nabi, Program Director Bridges (Parsons), Catherine Habermebl, Acting Commissioner (Public Works), Ron Tripp, Acting CAO, Dan Ane, Manager Program Financial Support

Appendices

Appendix 1	PHD 03-2019 Preventing Deaths by Suicide on Public Infrastructure	
Appendix 2	Transportation Infrastructure Means Protection	43 pages
Appendix 3	Update on Need for Means Protection on Infrastructure in St. Catharines (Memo to Pubic Works Committee by Dr. M. Mustafa Hirji, Medical Officer of Health & Commissioner (Acting))	

Subject: Preventing Deaths by Suicide on Public Infrastructure

Report to: Public Health & Social Services Committee

Report date: Tuesday, January 8, 2019

Recommendations

1. Regional Council as the Board of Health **RESOLVES** that current public discourse around suicide has caused contagion and **REQUESTS** local media and others with a public audience to adhere to the Canadian Psychiatry Association's 2017 "Media Guidelines for Suicide Reporting" to prevent further contagion of suicide
2. Regional Council as the Board of Health **ENDORSE** the proposed framework for preventing suicides on public infrastructure
3. Within this framework, Regional Council as the Board of Health **ENDORSE** the importance of considering a barrier at the location of multiple recent deaths by suicide and **DIRECT** staff to proceed with planning for such a barrier for installation in 2019, reporting back by spring 2019 with a final recommendation, detailed cost estimates, and budget options
4. To implement this framework, Regional Council as the Board of Health **DIRECT** staff to develop and report back in spring 2019 with detailed cost-estimates and budget options for:
    a. Suicide identification/intervention training
    b. Suicide risk assessment capacity-building
    c. Support for a Mental Health Hub/Clubhouse in St. Catharines
5. To implement this framework, Regional Council **DIRECT** staff to engage with the Ministry of Transportation on opportunities for provincial funding to support a possible infrastructure barrier as in recommendation #2
6. As part of this framework, Regional Council **DIRECT** staff to include consideration of barriers on any future major infrastructure projects, and to include details of their consideration in reports to Council for approval of such projects

Key Facts

- Deaths by suicides increase in the days and weeks after widespread discourse or coverage of the details of a death by suicide. This "contagion" is usually characterized by deaths from the same or similar means, and often in the same location. To prevent contagion, many specifics have been omitted from this report.

- Niagara-wide, there are approximately 44 deaths from suicide each year. Of these, an average of 3.8 deaths from suicide each year can be attributed to a fall from a height.
- Since October 2018, there have been three deaths by suicide from a single public infrastructure element in St. Catharines, as well as at least one death from an analogous infrastructure element elsewhere. The latter three deaths all occurred within days of significant public discourse of a prior death by the same means, and were likely due to contagion.
- Historically, the infrastructure implicated has not been associated with deaths from suicide, emphasizing that public discourse fueling contagion is likely responsible. It is unknown if this location may now become a “suicide magnet” longer term or not.
- Scientific research on suicide prevention in public places points to five areas of activities that should be taken in concert:
    - Restricting or deterring access to the means of suicide
    - Increasing opportunities for individuals to seek help
    - Increasing probability of human intervention
    - Redefining the public image of a place to no longer be attractive as a place to die by suicide
    - Improving integration and access of the mental health services
- Niagara Region staff and partners have escalated activity and plans in all five of these areas since October 2018 in order to reduce deaths by suicide Niagara-wide.
- Regarding the first area, barriers on infrastructure have relatively strong scientific evidence of preventing deaths by suicide from falls from a height, without a proportional increase in deaths elsewhere.
- The two infrastructure elements most strongly associated with deaths by suicide from a fall from a height are at locations other than where recent deaths have occurred, and where in discussion with the jurisdiction owner, barriers would not be feasible.
- Addition of a barrier to the infrastructure implicated recently in St. Catharines would cost upwards of $4 million and would take until late 2019 to be completed.

Financial Considerations

The proposed framework for suicide prevention on public infrastructure identifies several opportunities for enhanced work locally. The cost of such enhancements are included the table below.

Table 1. Framework to Prevent Suicides on Public Infrastructure and Possible Budget Implications

Area of Suicide Prevention	Activities	Local Enhancement	Estimated Capital Cost	Estimated Operating Cost
Restricting & Deterring Means	Barrier on public infrastructure	Barrier at location of recent suicides in St. Catharines	Approximately $4 million	
	Lighting	Review of lighting on infrastructure	$TBD	
Increasing Opportunities for Help Seeking	Signs & crisis phones	Signs		$TBD
	Staffed sanctuary	Implement HUB model or Clubhouse model in St. Catharines	$TBD	Contribution toward $700,000 cost
Increasing Probability of Intervention	Surveillance cameras	NRPS surveillance pilot	$TBD	
	Increased patrols	Increase in patrols		$TBD
	Suicide awareness & intervention training	ASIST & safeTALK training		$300,000 over 2 years (1.5 FTE)
Redefining the Public Image	Media Portrayal	Engagement with media Digital engagement campaign		$TBD
	Memorials	Relocation of memorials		$TBD
Mental Health System	Increasing suicide risk assessment	Public Health & CAMH-led capacity building		$67,500 over 2 years (0.5 FTE)
	Integration of mental health system	LHIN System Mapping		$500,000 implementation

Public Health could increase training for suicide awareness and intervention with 150 people who regularly interact with mental health clients as well as 500 members of the public. As well, Public Health has a plan to build capacity among health care providers for increased risk assessments. Together, this would require 2 FTEs of work over 2 years, production of supplies, reimbursement of the Niagara Distress Centre for services, and hosting a community forum at a total cost of $367,500.

Operating a mental health HUB or Clubhouse in St. Catharines would cost approximately $700,000. Niagara Region could support a portion of these operating

costs. Alternately, the Region could consider support through acquiring and donating a physical facility as a capital expenditure.

The LHIN is embarking on mapping the mental health system locally to identify gaps and opportunities for improvement. Niagara Region could contribute to implementation of improvements identified, particularly as they relate to current services. A possible future budget of $500,000 to implement these has been estimated. It is not recommended that any decisions be made to fund these until possible improvements have been identified.

None of the above estimates have been included in the 2019 operating or capital budgets, and/or previously approved budgets for Regional infrastructure. The Capital Variance Project provides funding for in-year capital project adjustments, and at this time $5.8 million in capital variance project funding is available to support priority projects, including the One District Police Facility, a number of transportation related projects and the low end estimate for the barrier on public infrastructure noted above.

Once the detailed cost estimates are determined, a report to Council with those estimates will be provided as well as recommended sources of funding. Council approval is a requirement of a Capital Variance Project draw greater than $1 million, and any further Capital Levy Reserve funding and/or an operating budget funding would required Council approval and a budget amendment.

Analysis

Contagion & Use of Language

Suicide “contagion” is the phenomenon where susceptible persons are influenced towards suicidal behaviour and certain suicide methods by learning of another’s suicide. This scientific finding has been validated many times: public discourse of a death, be it on social media, public fora, political debate, or traditional media can lead to an increase in deaths in the days and weeks after.[1] Additional suicides are most likely when there is/are

- greater volume or profile of discourse (e.g. front page coverage),
- descriptions that are specific and graphic (including the means of death and/or the location of death),
- descriptions of the victim in relatable terms,
- coverage of sympathy and concern towards the victim after the death, and
- ascribing simple or singular reasons for the death (e.g. was caused by bullying)

[1] Niederkrotenthaler T, Herberth A, Sonneck G. The "Werther-effect": legend or reality? *Neuropsychiatr*. 2007;21(4):284-90.

- language that implies action, control, or solution (e.g. “committed”, “successful” or “failed” attempt, “took their life”, prominent use of “suicide”)
- portrayal as achieving a result (e.g. relieving of pain/suffering; leading to peace or a “better place”; going to “heaven”; the act was quick, easy, and/or painless)

Research shows that when language and reporting avoids the above, contagion can be minimized (elimination of contagion requires there be no reporting).[2] As well, coverage that focuses on the opposite (e.g. other people who have overcome mental illness), it can lead to the opposite of contagion—a reduction in deaths by suicide in the days and weeks after.

In order to prevent this report, quotes taken therein, debate at Committee/Council, or subsequent coverage from contributing to contagion, language used in this report will sometimes be indirect and avoid specifics.

Statistics in Niagara

Statistics Canada’s Vital Statistics database is the established standard for examining causes of death. The most recent data release showed that in the 5 year period of 2008 to 2012, there were 222 deaths by suicide (average 44.4 deaths per year). Of these, on average,

- 18.2 deaths resulting from suspension from a cable,
- 9.8 deaths from a drug overdose,
- 3.8 deaths from a fall from a height,
- 3.2 deaths from chemical overdose,
- 3.0 deaths from firearms, and
- 1.8 deaths from sharp or blunt objects.

Examination of calls received by Emergency Medical Services data from 2016 to September of 2018 shows that call volumes related to suicide attempts and self-harm were stable from 2006 to 2015 (between 550 and 600 calls per year). There was an increase in calls thereafter with closer to 800 calls per year in 2016 to 2018. Part of this increase may be attributable to revised dispatch protocols during this time. It is unknown if more severe impacts from opioid use may be a contributor to this increase.

[2] Mark Sinyor, Ayal Schaffer, Yasunori Nishikawa, Donald A. Redelmeier, Thomas Niederkrotenthaler, Jitender Sareen, Anthony J. Levitt, Alex Kiss and Jane Pirkis. *CMAJ* July 30, 2018 190 (30) E900-E907; DOI: https://doi.org/10.1503/cmaj.170698

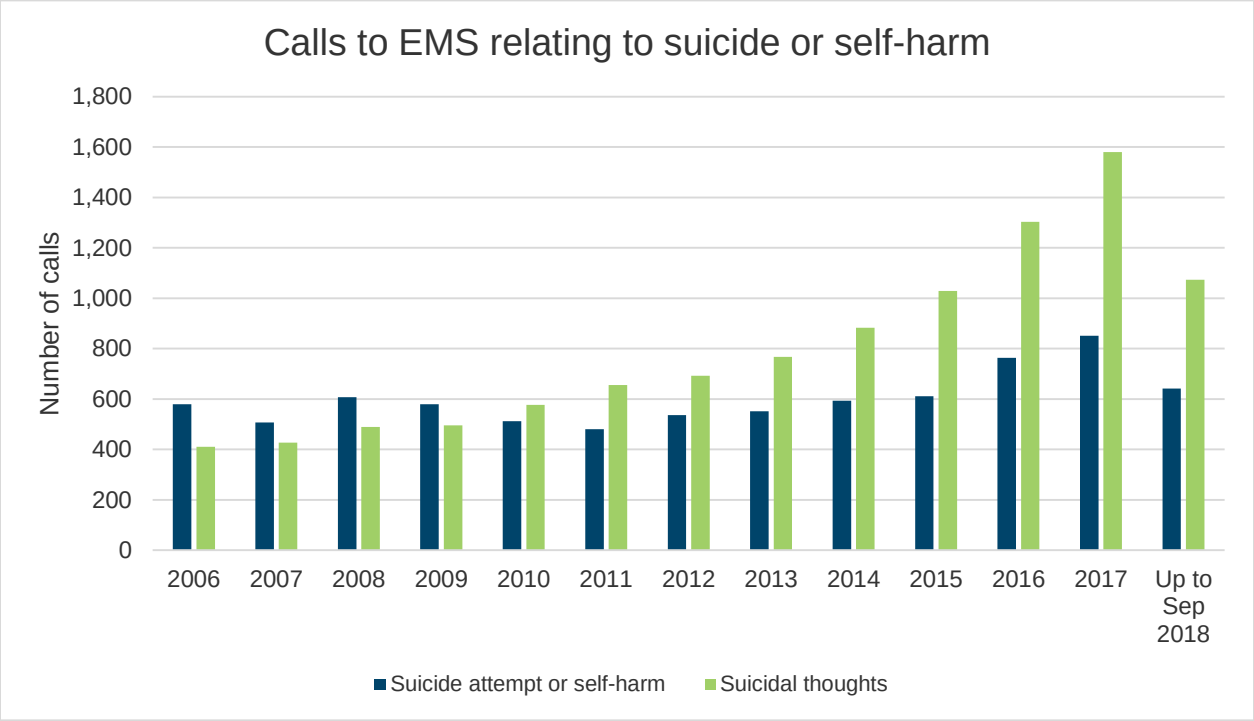


Figure 1 Calls to EMS relating to suicide or self-harm (2006 to September 2018)

Recent Events

In the three months since October 2018, there have been three deaths by suicide on an element of public infrastructure in St. Catharines, in addition to one reported attempt. As well, there has been at least 1 death at a similar infrastructure element elsewhere. Given the expected 3.8 deaths Niagara-wide per year from a fall from a height, 3 deaths in 3 months is unexpectedly high.

Under section 10 of the *Coroner's Act*, the Ontario Coroner's Office investigates every suspected death by suicide, and so has the most comprehensive and reliable data set. The coroner reported to us that they did not identify any deaths by suicide at this infrastructure between 2006 and 2017 (because the Coroner does not geocode investigations, their database query for deaths at this location was based on searching for place names, which is less accurate than geographical coordinates).

Data from Emergency Medical Services does not show any incident responses coded consistent with a death by or attempt of suicide at this infrastructure between 2010 and 2017 (EMS data is coded based on the 911 call, so if a response was not attributed to suicide or suicide attempt on the call, it would be missed by this database).

The lack of history of deaths by suicide at this location makes these recent deaths unusual. These deaths and the attempt all received significant discussion in the media, on-line, in political councils, and in public memorialization. This created significant risk of contagion. Indeed, all three of the later deaths occurred within 10 days of significant media coverage and public discourse of the earlier suicides, the highest risk period. The

reported attempt occurred within 18 days of such coverage. All of these are therefore likely attributable to a cycle of contagion, explaining the deviation from the historical norm.

In discussion with suicide experts, the three-month history is not enough to have confidence whether if this location will continue to have contagion-fuelled deaths by suicide, or if the cycle of contagion could end. However, there is certainly risk of the former.

Framework for Preventing Deaths by Suicide

Public Health England, the United Kingdom's scientific expert body on public health matters, published a guideline in November 2015 on preventing suicides in public places[3]. The guideline was based on a review of the scientific evidence, existing international guidelines, published and unpublished reports and policy documents, consultation with local governments worldwide, and interviews with survivors. The resulting guideline was pilot tested in local jurisdictions as well for revision prior to being published.

The guideline prioritizes action at the most frequently used places by individuals who die by suicide. A framework for prevention is outlined involving action in four areas of focus:

- Restricting and deterring individuals from the means of dying by suicide
- Increasing the opportunities for those in a public place who are contemplating dying by suicide to seek help
- Increasing the probability that persons can intervene with those intending to die by suicide in a public place
- Redefining the image of a public place where individuals die by suicide into one less attractive for this purpose

As suicide is complex, measures from multiple areas should be undertaken, ideally from all four, in order to be effective.

In addition, given the important role of the health care sector in diagnosing and treating mental illness before it progresses to suicidality, a fifth area of focus relating to this sector has been added to the framework

Below, the five areas are applied to publicly-accessible infrastructure in Niagara where deaths may occur from a fall from a height.

[3] Dr Christabel Owens, Rebecca Hardwick, Nigel Charles and Dr Graham Watkinson at the University of Exeter Medical School. *Preventing suicides in public places: A practice resource*. 2015.

Restricting/Deterring the Means

Restricting/deterring the means has been identified as one of the most scientifically-supported measures for suicide prevention[4]. When dealing with deaths on public infrastructure that occur from a fall from a height, the major means restriction is a barrier or netting. Additional deterrents would include lighting.

Research consistently shows that barriers (henceforth assumed to include netting) are effective at preventing deaths by suicide from falls on infrastructure, and that the majority of these deaths do not simply redistribute to other locations, but are completely prevented.[5][6]

The Ontario Coroner's Office was asked to identify the locations where deaths from suicide from a fall from a height are most common, and therefore where a barrier would be most impactful. The Coroner identified two locations (NF-1 and NF-2/NF-3 in Table 2). In addition, data was requested for the location of recent interest (StC-1). EMS responses for suicide and suicide attempts consistent with a fall from a height were also collected.

To supplement this, EMS data on responses to suicidal ideation by threatening to fall from a height was also reviewed. Data was limited to infrastructure widely used by the public (e.g. private residences, industrial buildings were excluded). Suicidal ideation rarely proceeds to death. Often it spurs individuals to treatment; other times it can be help-seeking for someone struggling to navigate the health care system. Nonetheless, suicidal ideation may highlight locations that are generally attractive for a suicide attempt.

A total of 44 locations had a suicide death, suicide attempt, or suicidal ideation associated with falling from a height from public infrastructure (Table 2).

As previously noted, location StC-1 has rarely seen deaths by suicide prior to 2018. Reviewing the EMS responses to suicidal ideation, however, StC-1 does seem to be the location with the most suicidal ideation, followed by NF-1 and NF-2.

It should be noted that after averaging less than 2 incidents per year at StC-1, in 2018 there have been 7 incidents up to December 14. This is likely due to contagion again.

With the history of the most deaths by suicides historically, NF-1 and NF-2/NF-3 are the best candidates for a barrier. Staff have informally engaged the jurisdiction owners for that infrastructure, however, barriers in those locations are deemed by them not to be feasible.

---

[4] Jane Pirkis, Matthew J Spittal, Georgina Cox, Jo Robinson, Yee Tak Derek Cheung, and David Studdert. The effectiveness of structural interventions at suicide hotspots: a meta-analysis. *International Journal of Epidemiology 2013;42:541–548. doi:10.1093/ije/dyt021*

[5] Pirkis *et al*. 2013.

[6] Sinyor M, Schaffer A, Redelmeier DA, et al. Did the suicide barrier work after all? Revisiting the Bloor Viaduct natural experiment and its impact on suicide rates in Toronto. *BMJ Open* 2017;7:e015299. doi:10.1136/bmjopen-2016-015299

StC-1 has the most frequent suicidal ideation implying some greater potential for deaths from suicide to occur here, though only a 3 month history of frequent deaths.

The Region retained the original designer of the structure in St. Catharines to develop a barrier design that would be structurally and esthetically compatible. This work is ongoing. The order of magnitude cost estimate for a barrier along all exposed edges of the structure is $4 million based on conceptual design and market intelligence. The design work continues, along with the refinement of the cost estimate and will be subject to a subsequent report to Council.

Given that, after consulting with suicide experts, there is uncertainty whether deaths from suicide due to ongoing contagion can be expected to continue at this location. There is therefore also uncertainty whether a barrier would be the best mental health intervention and the best use of taxpayer dollars, since there is a possibility that contagion will dissipate and deaths will stop occurring as was the case prior to 2018. However, if a barrier is not built but contagion does not dissipate, preventable deaths will continue.

To balance these imperatives, and given that a barrier cannot be erected until late 2019 at the earliest, it is recommended that planning for a barrier to be erected in late 2019 continue as a contingency. In the next several months, other suicide prevention efforts will continue. Based on the pattern of any further deaths over those months, a final recommendation on whether to build a barrier will be brought to Council in spring 2019.

The other means deterrent to suicide, lighting, does not appear to be a concern at StC-1 or NF-1 and NF-2/NF-3. Review of lighting in other locations can be pursued as part of the larger framework.

Table 2. Suicide deaths, attempts, and ideation associated with falls from a height from public infrastructure

	Deaths & Attempts (2010-2017)		**Deaths & Attempts (2018)**		**Suicidal Ideation (EMS Responses)**	
Infrastructure Element	Coroner (To Nov. 20)	EMS Calls	Coroner (To Nov. 20)	EMS Calls	2006–2017	2018 (To Dec.14)
NF-1	11	1	1		16	2
NF-2	10		0		7	
NF-3		1			2	
NF-4					3	1
NF-5				1	3	
NF-6		1			2	
NF-7					2	
NF-8					3	
NF-9						2
NF-10					1	
NF-11					1	
StC-1	**0**		**3***	**1**	**22**	**7**
StC-2					1	
StC-3		1			4	
StC-4				1		1
StC-5					1	1
StC-6		1				1
StC-7					1	
StC-8		1			2	
StC-9		1				
StC-10					1	
StC-11		1			3	1
StC-12		1			2	4
StC-13		1			5	1
StC-14		1			1	
StC-15					2	
StC-16		1				
StC-17					1	
StC-18						1
Thorold-1					1	
Thorold-2		1				
Thorold-3						1
Thorold-4					1	
Thorold-5					1	3
Welland-1					4	1
Welland-2					2	
Welland-3					1	
Welland-4					1	
Welland-5					1	
Grimsby-1					1	
Grimsby-2					1	
Fort Erie-1					2	
NOTL-1					1	
PC-1						1

Increasing Opportunity for Help Seeking

Encouragement to seek help, even subtle ones, are often enough to help suicidal persons break from their plan. Research has shown this to be effective, though less so than means restrictions.[7]

Installing signs of where to seek help is one significant measure. In response to the deaths by suicide in October, signs were immediately put up in the area with the number to call the Niagara Distress Centre.

Crisis phones and automated messages are additional measures that have been effective in other jurisdictions.

One other opportunity for help seeking exists when there is a staffed "sanctuary" nearby to which individuals experiencing a crisis can attend. In downtown Welland, the Oak Centre has been developed according to the internationally-recognized Clubhouse Model. This model is predicated on those with mental illness helping each other, and then supplementing that with professional services to help clients build mental health and social integration skills. The International Centre for Clubhouse Development has found that admission to hospital, and hospital stays for clients are significantly reduced if someone is a Clubhouse member. Given the success of the model in Welland, there is interest by many in St. Catharines to develop a Clubhouse in this city as well. The Oak Centre is largely funded through the local LHIN and has a total budget of around $700,000.

Another model that is being discussed locally are regional mental health HUBs. HUBs of this nature accept individuals in crisis, who would normally be taken to an emergency department. Instead, in a HUB, with no competing patients needing to see a caregiver, people with acute mental health or addictions issues can get immediate help, in a setting tailored with services they need, while simultaneously relieving pressure on overcrowded emergency departments. HUBs also engage with the community and other groups to raise awareness, build the community's skills to foster social inclusion and mental wellness, and facilitate community-led responses to mental health issues.

The Suicide Prevention Coalition has recommended a HUB for St. Catharines as a top priority.

Increasing Probability of Persons to Intervene

Human interaction is very effective at deterring a person from dying by suicide. Where a location is having frequent deaths by suicide, human interaction can be increased by having additional patrols by emergency workers, as well as surveillance (e.g. by cameras) to trigger an intervention. The Niagara Regional Police Service (NRPS) has a raised level of awareness by front line patrol officers with respect to persons in crisis or experiencing suicidal thoughts, and has increased patrols in affected areas. The NRPS is piloting the use of closed circuit television (CCTV) to enhance its ability to respond to

[7] Jane Pirkis, Lay San Too, Matthew J Spittal, Karolina Krysinska, Jo Robinson, Yee Tak Derek Cheung. Interventions to reduce suicides at suicide hotspots: a systematic review and meta-analysis. *Lancet Psychiatry* 2015; 2: 994–1001

calls for service, including suicidal persons and persons in crisis in parts of St. Catharines where there have been recent deaths.

Research shows that there is no significant difference to interaction by a member of the public versus an emergency worker. However, given their greater numbers, it is usually more likely someone contemplating suicide will interact with a member of the public, rather than an emergency worker. However, people often lack the confidence to intervene, or the skill to recognize suicidal behaviour. Applied Suicide Intervention Skills Training (ASIST) is an internationally-recognized program for helping people gain the skills to recognize someone at risk of suicide, and to know how to intervene to support a suicidal person. A condensed version of this training is known as safeTALK.

Currently Public Health has staff who provide safeTALK in certain settings. As well, through the Niagara Distress Centre, Public Health has access to ASIST trainers. Public Health proposes to increase ASIST (targeting 150 of those working with mental health clients) and safeTALK training (targeting 500 members of the general public).

The Suicide Prevention Coalition currently ranks suicide identification/intervention training as one of its two key areas of focus.

Redefining the Public Image

The most important measure to decrease deaths by suicide in a public place is to end discourse that associates that location with suicide. This sentiment is reflected in how this report is written. Recognizing the disproportionate role the media play in spreading information, a half-day session was held with all local media outlets on November 16, 2018 to discuss the current public discourse and ways to shift it to better align with the Canadian Psychiatry Association's 2017 "Media Guidelines for Suicide Reporting". Public Health Communications along with Strategic Communications and the media are continuing to work on measures resulting from that meeting. The Suicide Prevention Coalition currently ranks shaping media report as its second key area of focus.

Mental health experts highlight that memorials and floral tributes after a death can associate a location's public image with suicide. This can lead to others dying by suicide in the same location. Experts recommended that memorials be removed "as quickly and sensitively as possible to prevent them building up, within two to three days at the most".[8]

In recognition of this, the memorials at the location where several recent deaths by suicide have occurred were removed in early December 2018 to reduce the risk of additional deaths by suicide. This, unfortunately, occurred much later than the "two or three days" recommended by experts. Attempts were made to remove the memorial at earlier dates. However, given public outpouring and attention prior attempts were aborted when it became clear their removal would generate controversy and more discussion of the location in association with suicide, exactly what would cause additional contagion. Going forward, staff hope to be able to adhere to the 2–3 day

[8] PHE

expert recommendation if there are any additional unfortunate deaths. As well, a permanent memorial site is being made available by Public Health at the Glenridge Naturalization Area where another memorial already exists for mental health clients who have died by suicide.

One other means of redefining the public image of a location associated with suicide is to redecorate or landscape in order to change the location's feel to be more hopeful, and to less visible sections where one may die by suicide in relative privacy. Staff plan to be mindful of opportunities to undertake such changes, though it is not anticipated that this will be a significant activity.

Improving Supports in the Mental Health System

As the mental health sector has the greatest contact with those at risk of suicide, particularly those with the greatest risk and most severe illness, deaths from suicide may be preventable through better support for these patients.

Niagara Region Mental Health has developed a Suicide Risk Assessment Strategy to strengthen health service providers' abilities to identify those at risk of suicide so that they can receive needed care earlier in their course of illness. This strategy will be delivered over the next several years, though it could be accelerated with additional investment.

The LHIN is also considering engaging a consultant to map the mental health system to address difficulties in navigating the system, to identify gaps in service, and to enable its many parts to work as a more cohesive whole. As Niagara Region serves mental health clients, there may be opportunities to implement recommendations from this exercise here. However, given that our mental health program is generally not supported through municipal levy funding, it would be a variation from past practice to do so. Until concrete proposals for change are available, staff do not recommend investing in this.

Alternatives Reviewed

As suicide affects all of Niagara and many means beyond falls from a height, the report has examined suicide holistically and Niagara-wide, rather than focused only on the location of recent interest.

Staff recommend a comprehensive approach to suicide prevention, rather than focusing on a single measure, as multi-factorial action has been shown in research to be most effective.

Recommending a barrier on the recent location of interest could have been proposed, but this was deemed to be premature given the lack of certainty that contagion will continue. However, recommending against a barrier would be imprudent given the risk that deaths by suicide might continue. The recommendation to continue working towards a barrier but deferring a final decision preserves the same opportunity to prevent suicide deaths, while also being fiscally prudent.

Relationship to Council Strategic Priorities

This report does not relate specifically to any of Council's strategic priorities. Nonetheless, it addresses a matter of current public interest.

Other Pertinent Reports

N/A

_____

Prepared & Recommended by:
M. Mustafa Hirji, MD MPH FRCPC
Medical Officer of Health & Commissioners (Acting)
Public Health & Emergency Services

_____

Submitted by:
Ron Tripp, P.Eng
Acting Chief Administrative Officer

This report was prepared in consultation with Dr. Mark Sinyor, Assistant Professor of Psychiatry (University of Toronto) and Associate Scientist (Sunnybrook Research Institute); Stacy Terry, Chair (Niagara Suicide Prevention Coalition) and Director (Niagara Distress Centre); Dr. Karen C. Schiff, Regional Supervising Coroner; Ron Tripp, Acting CAO and Commissioner (Public Works); Rachel Skellet, Epidemiologist (Organizational & Foundational Standards); Renata Faber, Manager (Chronic Disease & Injury Prevention); Michael Franklin, Commander (Quality Management & Performance Standards, Emergency Medical Services), Heather Rilkoff, Health Research Specialist (Healthy Public Policy, Toronto Public Health), Sarah Sanford (Toronto Public Health), Jan Fordham (Healthy Public Policy, Toronto Public Health) and reviewed by Brett Flynn, Deputy Chief (Niagara Regional Police Service); Shelley Chenitz, CAO (City of St. Catharines); Linda Boich, Vice-President (Niagara Health); Karen Lutz, Commander (Quality Management & Performance Standards, Emergency Medical Services); Adrienne Jugley, Commissioner (Community Services); Sean O'Brady, Acting Director (Strategic Communications & Government Relations); Meredith Maxwell, Manager (Public Health Communications & Engagement).

Appendices

Canadian Psychiatric Association
Dedicated to quality care
Association des psychiatres du Canada
Dévouée aux soins de qualité

POLICY PAPER

Media Guidelines for Reporting on Suicide: 2017 Update of the Canadian Psychiatric Association Policy Paper

Mark Sinyor, MSc, MD, FRCPC[1]; Ayal Schaffer, MD, FRCPC[2]; Marnin J. Heisel, PhD, CPsych[3]; André Picard, BComm, BJourn, Hon LLD[4]; Gavin Adamson, MJ[5]; Christian P. Cheung, BSc Candidate[6]; Laurence Y. Katz, MD, FRCPC[7]; Rakesh Jetly, MD, FRCPC[8]; Jitender Sareen, MD, FRCPC[9]

This paper has been substantially revised by the Canadian Psychiatric Association's Research Committee and approved for republication by the CPA's Board of Directors on May 3, 2017. The original policy paper[1] was developed by the Scientific and Research Affairs Standing Committee and approved by the Board of Directors on November 10, 2008.

Summary

A substantial body of research suggests that media reports about people who have died by suicide, as well as the topic of suicide in general, can influence vulnerable people and is associated with higher subsequent rates of suicide. Emerging evidence also suggests that reports about people overcoming suicidal crises may lower suicide rates. The original 2009 Canadian Psychiatric Association (CPA) policy paper on media reporting of suicide[1] led to meaningful discussion between mental health professionals and journalists in Canada. This second iteration of the policy paper reviews the most up-to-date evidence relating to media reporting and suicide, and updates recommendations with more direct

[1] Assistant Professor, Department of Psychiatry, University of Toronto, Toronto, Ontario; Psychiatrist, Department of Psychiatry, Sunnybrook Health Sciences Centre, Toronto, Ontario
[2] Interim Psychiatrist-in-Chief and Head, Mood and Anxiety Disorders Program, Department of Psychiatry, Sunnybrook Health Sciences Centre, Toronto, Ontario; Associate Professor, Department of Psychiatry, University of Toronto, Toronto, Ontario; Vice-President, Education, International Society for Bipolar Disorders
[3] Associate Professor and Research Director (Psychiatry), Departments of Psychiatry and of Epidemiology and Biostatistics, Schulich School of Medicine and Dentistry, Western University, London, Ontario; Scientist, Lawson Health Research Institute, London, Ontario; Adjunct Faculty, University of Rochester Center for the Study and Prevention of Suicide, Rochester, New York
[4] Health Columnist, The Globe and Mail, Toronto, Ontario
[5] Associate Professor, School of Journalism, Ryerson University, Toronto, Ontario
[6] Research Student, Department of Psychiatry, Sunnybrook Health Sciences Centre, Toronto, Ontario.
[7] Professor, Department of Psychiatry, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba
[8] Head, Centre of Excellence, Directorate of Mental Health, Canadian Armed Forces Health Services, Ottawa, Ontario; Chair, Military Mental Health, Royal Ottawa Hospital, Ottawa, Ontario; Assistant Professor, Department of Psychiatry, Dalhousie University, Halifax, Nova Scotia
[9] Professor and Head, Department of Psychiatry, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba

engagement and input from the journalism community. Recommendations are meant as a guide for all relevant stakeholders, including journalists, editors, producers, journalism educators, researchers, policy makers, mental health professionals, and social media platforms. The paper suggests a framework for approaching suicide-related coverage and outlines potentially harmful and helpful aspects of reporting that should be avoided and included, respectively. Recommendations include using appropriate language, trying to reduce the stigma around mental disorders, and providing information about alternatives to suicide. Pertinent resources for people contemplating suicide, such as crisis services, should also be provided and can be directly linked to reports that appear online. Simplistic or glorified depictions of suicide should be avoided, and suicide should not be presented as a way of solving problems. Reports should avoid details of suicide methods, particularly if they are novel or unusual. Recommendations also include that, where possible, suicide should be covered by or with the input of health reporters who are best positioned to contextualize suicide within the broader topic of mental health. The paper also makes preliminary recommendations for social media and suggests collaboration with online platforms to help establish organizational standards concerning the dissemination of information about suicide.

Introduction

Scientific evidence from numerous natural experiments worldwide demonstrates that media reporting of suicide can sometimes result in contagion, with increased suicide rates across a population.[2-12] The association has satisfied the criteria of consistency, strength, temporality, specificity, and coherence required to conclude that there is a causal relationship.[13-14] The research evidence indicates that, in general, more suicide deaths occur following repetitive reporting of suicide.[5-6] This relationship is widely known as the Werther Effect, a reference to a 1774 novella published by Goethe describing the death by suicide of a young man who was rejected by the young woman he loved.[2] This suicide contagion effect is thought to be mediated by social learning, whereby a vulnerable person identifies with people depicted in the media and may be more apt to copy their suicidal behaviour and subsequently die by suicide.[5-7,15-16] The effect may be particularly pronounced for youth, a group that can be more susceptible to social learning,[17-22] and in cases where the media report relates to a celebrity, whose behaviour people may be more prone to emulate.[4,12,16,23-27] In contrast, the effect does not seem to occur if the person who died by suicide was a criminal.[16] Although the best evidence in this area comes from large, population-based, natural experiments, where it is challenging to prove exposure to media reports, findings from psychological autopsy studies, reviews of suicide notes, and interviews with people who have attempted suicide show that many have or were exposed to suicide-related media content, which influenced suicidal behaviour.[8,28-34] More recently, Niederkrotenthaler et al. postulated a corollary effect to the Werther Effect called the Papageno Effect, whereby media reporting emphasizing a positive outcome of a suicidal crisis may be associated with lower subsequent suicide rates.[5] This was based on a latent class analysis examining media and suicide reporting in Austria. The authors found that articles stressing "mastery of crisis," in which people contemplating suicide employed adaptive coping strategies rather than suicidal behaviour, were associated with a subsequent decrease in the rates of suicide.[5] The "active ingredients" of reporting that mediate contagion of suicide and adaptive behaviour are not fully understood; however, there is general consensus on putatively harmful and protective aspects of media reporting, and these form the basis for media guidelines.

Guidelines for responsible media reporting of suicide have been developed across numerous countries and jurisdictions worldwide.[35-38] Several guidelines have been produced in Canada, including those from the Canadian Psychiatric Association,[1] the Canadian Association for Suicide Prevention (CASP),[39] and the Mindset guidelines developed by journalists themselves.[40] Media guidelines have demonstrable impact on the quality of reporting on suicide[41-44] and, in some cases, have been associated with lower suicide rates.[42,45] It is estimated that guidelines can prevent more than 1% of suicide deaths; such a reduction in Canada would translate to the prevention of more than 40 deaths per year across the country.[46-47] Canadian studies examining media reporting—in general and per the guidelines above—are limited. A recent study examining adherence to Mindset's 14 specific recommendations in the aftermath of a celebrity suicide found that most recommendations were followed (range of adherence was 65% to 99% of articles), except for the recommendation to tell people considering suicide how they can get help (present in only 27% of articles).[48]

The original CPA position paper on media reporting and suicide[1] garnered controversy from some who expressed scepticism about the evidence base for suicide contagion,[49] and argued that perceived efforts to suppress suicide-related stories are counter-productive.[50] In the interim, there has been increased engagement

between mental health professionals and the media via informal dialogue surrounding specific reports, through symposia at the CPA annual meeting, and during and after Canada's first media forum for suicide prevention, held in Toronto in November, 2015.[49] In part due to a greater public desire for information about mental health, journalists are increasingly interested in covering issues related to mental health, including suicide, in a respectful and destigmatizing manner.[49] Most suicide deaths are not newsworthy and the media are sensitive to concerns about contagion; however, deciding when and how to cover suicide is a delicate balancing act.[49] Rather than telling journalists how to do their jobs, consensus is that the mental health community needs to work collaboratively with the media and provide them with the best available information to make those difficult decisions, and to provide context and help mitigate risks of contagion when the decision is to proceed with a report.[36,39,49]

One relatively new aspect to this discussion is the proliferation of social media and the implications for media guidelines on reporting suicide.[51-52] There are significant concerns about pro-suicide content, which accounts for a substantial proportion of suicide related-information online,[53-54] and that users may use social media to learn about suicide,[55-56] disseminate suicide methods,[57-58] normalize and desensitize people to self-injurious behaviour,[59] and publish suicide notes.[60-61] Social media sites also provide opportunities for prevention through learning about alternatives to suicide, resources for getting help, and for access to peers who have mastered suicidal crises.[52,62] Some platforms have developed built-in responses in which, for example, queries about suicide prompt the display of prevention resources or where users can report concerns about people who may be expressing suicidal ideation.[52,62-64] It has been suggested that, in the age of the internet, media guidelines may be impractical or irrelevant given the difficulty inherent in trying to constrain or regulate billions of comments and postings.[65] However, there is general agreement that social media sites should facilitate access to health information and resources for people contemplating suicide.[65-66] Furthermore, studies show that the traditional media commonly uses social networking sites like Facebook and Twitter to inform their coverage and, likewise, their coverage can influence social media.[51] This bidirectional relationship suggests that the approach of the traditional media to covering suicide is likely to have some impact on how it is depicted in social media.

The goals of this updated policy paper are 1) to increase engagement with the journalism community and to adjust previous recommendations collaboratively with journalists; 2) where possible, to achieve consistency between CPA recommendations and recent Canadian and international guidelines; and 3) to address the challenging issue of recommendations in the context of new online and social media. The recommendations below stem from a careful review of the available literature and of Canadian and international guidelines, as well as discussion with journalists and mental health professionals.

Recommendations for Traditional Media Coverage

Table 1 outlines in detail the recommended approach to developing a suicide-related report. Table 2 describes specific elements to be avoided and included, respectively, in media reports. We highlight 3 of these recommendations for special attention:

1. Health reporters, not crime reporters, are best positioned to cover suicides.

A key element of these recommendations is that, as much as possible, suicide be covered by health reporters rather than crime reporters or other journalists. The notion that suicide is a crime rather than the result of a mental disorder is archaic. Crime reporting often includes graphic details of the suicide to make reports more exciting and sensationalistic. Such detailed reporting for suicide coverage is inappropriate and may promote contagion. Health journalists have the greatest awareness of the complex issues surrounding suicide reporting and are therefore best positioned to cover the topic. We acknowledge that there may be situations where other journalists, such as sports, entertainment, or financial reporters, may want to cover suicide deaths in their areas; however, we recommend that they do so cautiously, paying attention to these guidelines, and we suggest they consult with their health reporter colleagues about suicide-related content.

2. Reports should generally avoid details of suicide methods, especially when unusual or novel methods are involved.

There is growing evidence that media reporting on novel methods of suicide has led to dramatic increases in suicide deaths by these methods and in overall suicide rates in various areas of the world.[67-70] Whereas media reports should generally avoid details of suicide methods, as these can lead to contagion effects, such an effect may be particularly pronounced when unusual

Table 1. Factors for Journalists and Editors/Producers to Consider Before Covering Suicide-Related Content

1. Weigh the story's newsworthiness and the public's need to be informed with potential harm related to contagion.
   - Be familiar with your organizational guidelines relating to reporting on suicide.
   - If the decision is to proceed with coverage, plan and/or discuss how harm might be minimized.
   - Seek advice from suicide prevention experts.
   - Be especially cautious when reporting on celebrity or youth suicide deaths, as these currently have the strongest evidence for contagion.
   - Consider how a vulnerable person may identify with the suicidal behaviour/people depicted, and consider steps that might minimize this.
2. Consider the impact of the report on:
   - those thinking of suicide or potentially at-risk for suicide,
   - those bereaved by suicide, including attention to respect for their privacy and grief,
   - the journalist who is reporting the story.
3. Consider the appropriate approach/format.
   - Suicide reporting should generally be done by health reporters rather than other journalists (e.g., crime reporters), as they are best positioned to contextualize the issue within the broader topic of mental health; if other journalists do report, they should at least consult with guidelines and/or health reporter colleagues.
   - Where possible, long-form reporting is recommended, as it allows journalists the opportunity for nuanced discussion and may avoid presenting the causes of suicide in an overly simplistic fashion.

Table 2. Recommendations for Potentially Harmful Elements of Media Reporting that Should Be Avoided and Potentially Helpful Elements to Include

Avoid	Include
1. Prominent coverage, including • front page/lead story coverage • prominent photos of the deceased or loved ones or people engaged in suicidal behaviour 2. Graphic or sensational depictions 3. Excessive detail, including • details or photos of the method and/or location; particularly avoid reporting novel or uncommon methods • glorifying or glamourizing either the person or the act of suicide in a way that might lead others to identify with them • the content of suicide notes 4. Repetitive or excessive coverage[a] 5. Inappropriate use of language, including • the word "suicide" in the headline • "commit" or "committed" suicide[b] • "successful/unsuccessful" or "failed" attempts 6. Simplistic or superficial reasons for the suicide (i.e., suicide as arising from a single cause or event, such as blaming social media for suicide) 7. Portraying suicide as achieving results and solving problems • do not describe suicidal behaviour as quick, easy, painless, certain to result in death, or relieving suffering/ leading to peace ("in a better place")	1. Appropriate language (e.g., "he died by suicide" or "her suicide death") 2. Reporting that reduces stigma about mental disorders/ seeking mental healthcare, and that challenges common myths about suicide • refer to research linking mental disorders with suicide • highlight that mental disorders are treatable and therefore that suicide is preventable • highlight the tragedy of suicide (i.e., describe it in terms of a lost opportunity for someone suffering to have received help) • seek advice from suicide prevention experts and consider including quotes on causes and treatments 3. Alternatives to suicide (i.e., treatment) • include community resource information, such as websites or hotlines, for those with suicidal thoughts • where possible, list or link to a list of options including reaching out to a trusted family or community member, speaking to a physician or health care provider, seeking counselling/talk therapy, calling a hotline/911, or going to a nearby emergency department • where possible, cite examples of a positive outcome of a suicidal crisis (i.e., calling a suicide hotline) • embed emergency resource links/banners (for online content) 4. Information for relatives and friends, such as • warning signs of suicidal behaviour • how to approach, support and protect a suicidal person

[a]We acknowledge that suicide death of prominent figures will invariably result in serial coverage but urge journalists to nevertheless weigh the need for additional stories.

[b]"Commit" evokes a crime, since suicide was historically criminalized; however, this terminology is not consistent with the modern understanding of suicide evolving from a treatable disorder.

or novel methods of suicide are involved. Therefore, publicizing these details should be avoided.

3. Emergency resource links should be included in all articles that deal with suicide.

Guidelines universally advise the media to provide resources, such as crisis lines, to people contemplating suicide. Online platforms afford an opportunity to go a step further. Reports themselves can be accompanied by embedded links to crisis services to facilitate access, thereby decreasing barriers to help-seeking.

Recommendations for Social Media

As described, this is largely uncharted territory in Canada and throughout the world. The recommendations below are meant to be a starting point, with the intention that future iterations of the CPA policy paper will refine and expand on them with input from social media organizations.

We recommend:

1. A novel collaboration between Canadian mental health professionals and social media organizations. Just as journalists are the experts in their area and must take a leadership role in responsible reporting of suicide, those best positioned to address suicide on social media are the designers of the social media sites themselves. In replicating efforts that have been successful with the traditional media, the CPA and mental health professionals should organize meetings, symposia, and forums to address the topic of suicide collaboratively with social media stakeholders.
2. Social media organizations consider the degree to which they might be used as a platform for suicide prevention. Specific efforts may include 1) providing information and resources to people who make suicide-related queries or posts, 2) including "panic buttons" that allow for rapid access to crisis services/hotlines, 3) providing mechanisms for users to report if they are concerned about someone with the possibility for rapid intervention, and 4) moderating forums that frequently include suicide-related postings and making sure to remove inappropriate posts.

Recommendations for Dissemination of Guidelines

Evidence from other countries suggests that media guidelines work best when there is ongoing collaboration between suicide prevention experts, journalists, journalism schools, and public health policy experts.[39]

We recommend:

1. Ongoing collaboration between journalists and mental health professionals, acknowledging scientific evidence and the autonomy of journalists.
2. All journalism schools include teaching of how to report responsibly and respectfully on the topic of suicide, including attention to issues related to ethics and social justice.
3. Media training for mental health professionals who are likely to be called on to comment on suicide in the press.
4. Education for policy-makers and other prominent figures who may be asked to comment publicly on the topic of suicide.

Conclusions & Future Directions

These recommendations mainly rely on data from large, natural experiments, which must be interpreted with a note of caution. Nevertheless, the weight of evidence suggests that certain types of media reporting, particularly those that glamourize suicide or a person who has died by suicide, can and do influence some people to die by suicide. Similarly, reporting that describes people overcoming suicidal crises and finding other solutions may encourage help seeking and more adaptive coping strategies. Further high-quality research is needed to identify which putatively harmful and protective elements of media reports mediate risk and confer benefit, respectively. More studies on the influence of media reporting in Canada and the impact of social media on suicide are also needed. The Canadian Psychiatric Association and mental health professionals across Canada are committed to helping the media make informed decisions about when and how to report on suicide. These efforts will ideally involve collaborative partnerships among all stakeholders, including mental health professionals, members of the media, individuals with lived experience, and all those touched by suicide. These ongoing collaborations, and future efforts that also include social media platforms, will provide the best opportunity to address this important issue.

References

1. Nepon J, Fotti S, Katz LY, et al. Canadian Psychiatric Association Policy Paper: Media guidelines for reporting suicide. Can J Psychiatry. 2009;5(Suppl):1–5.
2. Gould MS. Suicide and the media. Ann N Y Acad Sci. 2001;932:200–21.
3. Hawton K, Williams K. Influences of the media on suicide. BMJ. 2002;325(7377):1374–5.

4. Niederkrotenthaler T, Fu KW, Yip PS, et al. Changes in suicide rates following media reports on celebrity suicide: A meta-analysis. J Epidemiol Community Health. 2012;66(11):1037–42.
5. Niederkrotenthaler T, Voracek M, Herberth A, et al. Role of media reports in completed and prevented suicide: Werther v. Papageno effects. Br J Psychiatry. 2010;197(3):234–43.
6. Pirkis JE, Burgess PM, Francis C, et al. The relationship between media reporting of suicide and actual suicide in Australia. Soc Sci Med. 2006;62(11):2874–86.
7. Pirkis J, Blood RW. Suicide and the media. Part I: Reportage in nonfictional media. Crisis. 2001;22(4):146–54.
8. Tousignant M, Mishara B, Caillaud A, et al. The impact of media coverage of the suicide of a well-known Quebec reporter: The case of Gaetan Girouard. Soc Sci Med. 2005;60:1919–26.
9. Etzersdorfer E, Voracek M, Sonneck G. A dose-response relationship between imitational suicides and newspaper distribution. Arch Suicide Res. 2004;8(2):137–45.
10. Stack S. Media Coverage as a risk factor in suicide. J Epidemiol Community Health. 2003;57:238–40.
11. Stack S. Suicide in the media: A quantitative review of studies based on nonfictional stories. Suicide Life Threat Behav. 2005;35(2):121–33.
12. Cheng A, Hawton K, Lee C, et al. The influence of media reporting of the suicide of a celebrity on suicide rates: A population-based study. Int J Epidemiol. 2007;36(6):1229–34.
13. Prikis J, Blood W, Beautrais A, et al. Media guidelines on the reporting of suicide. Crisis. 2006;27(2):82–7.
14. Pirkis J, Francis C, Blood R, et al. Reporting of suicide in the Australian media. Aust N Z J Psychiatry. 2002;36(2):190–7.
15. Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. Psychol Rev. 1977;84(2):191–215.
16. Niederkrotenthaler T, Till B, Kapusta ND, et al. Copycat effects after media reports on suicide: A population-based ecologic study. Soc Sci Med. 2009;69(7):1085–90.
17. Gould MS, Kleinman MH, Lake AM, et al. Newspaper coverage of suicide and initiation of suicide clusters in teenagers in the USA, 1988-96: A retrospective, population-based, case-control study. Lancet Psychiatry. 2014;1(1):34–43.
18. Gould M, Greenberg T, Velting D, et al. Youth suicide risk and preventive interventions: A review of the past 10 years. J Am Acad Child Adolesc Psychiatry. 2003;42(4):386–405.
19. Gould M, Jamieson P, Romer D. Media contagion and suicide among the young. Am Behav Scientist. 2003;46(9):1269–84.
20. Gould M, Kramer R. Youth suicide prevention. Suicide Life Threat Behav. 2001;31(Suppl):6–31.
21. Gould M, Wallenstein S, Kleinman M, et al. Suicide clusters: An examination of age-specific effects. Am J Public Health. 1990;80(2):211–2.
22. Shoval G, Zalsman G, Polakecitch J, et al. Effect of the broadcast of a television documentary about a teenager's suicide in Israel on suicidal behavior and methods. Crisis. 2005;26(1):20–4.
23. Fu KW, Chan CH. A study of the impact of thirteen celebrity suicides on subsequent suicide rates in South Korea from 2005 to 2009. PLoS One. 2013;8(1):e53870.
24. Suh S, Chang Y, Kim N. Quantitative exponential modelling of copycat suicides: Association with mass media effect in South Korea. Epidemiol Psychiatr Sci. 2015;24(2):150–7.
25. Schäfer M, Quiring O. The press coverage of celebrity suicide and the development of suicide frequencies in Germany. Health Commun. 2015;30(11):1149–58.
26. Kim JH, Park EC, Nam JM, et al. The Werther effect of two celebrity suicides: An entertainer and a politician. PLoS One. 2013;8(12):e84876.
27. Ueda M, Mori K, Matsubayashi T. The effects of media reports of suicides by well-known figures between 1989 and 2010 in Japan. Int J Epidemiol. 2014;43(2):623–9.
28. Yip PS, Fu KW, Yang KC, et al. The effects of a celebrity suicide on suicide rates in Hong Kong. J Affect Disord. 2006;93(1–3):245–52.
29. Marzuk PM, Tardiff K, Hirsch CS, et al. Increase in suicide by asphyxiation in New York City after the publication of Final Exit. N Engl J Med. 1993;329(20):1508–10.
30. Hawton K, Simkin S, Deeks JD, et al. Effects of a drug overdose in a television drama on presentations to hospital for self-poisoning: Time series and questionnaire study. BMJ. 1999;318:972–7.
31. Chen YY, Tsai PC, Chen PH, et al. Effect of media reporting of the suicide of a singer in Taiwan: The case of Ivy Li. Social Psychiatry Psychiatric Epidemiol. 2010;45:363–9.
32. Cheng ATA, Hawton K, Chen THH, et al. The influence of media coverage of a celebrity suicide on subsequent suicide attempts. J Clin Psychiatry. 2007;68(6):862–6.
33. Cheng ATA, Hawton K, Chen THH, et al. The influence of media reporting of a celebrity suicide on suicidal behaviour in patients with a history of depressive disorder. J Affect Disord. 2007;103(1–3):69–75.
34. Tsai CW, Gunnell D, Chou YH, et al. Why do people choose charcoal burning as a method of suicide? An interview based study of survivors in Taiwan. J Affect Disord. 2011;131:402–7.
35. Centers for Disease Control. Morbidity and moratality weekly report, suicide contagion and the reporting of suicide: Recommendations from a national workshop [Internet]. 1994. Available from: http://www.cdc.gov/mmwr/preview/mmwrhtml/00031539.htm.
36. World Health Organization (WHO). Preventing suicide: A resource for media professionals [Internet]. WHO Press, 2008. Available from: http://www.who.int/mental_health/prevention/suicide/resource_media.pdf.
37. American Foundation for Suicide Prevention. Recommendations for suicide reporting [Internet]. Available from: http://afsp.org/wp-content/uploads/2016/01/recommendations.pdf.
38. Mindframe. Reporting suicide and mental illness: A mindframe resource for media professionals [Internet]. Hunter Institute of Mental Health, 2014. Available from: http://www.mindframe-media.info/for-media/reporting-suicide?a=10217.
39. Canadian Association For Suicide Prevention (CASP). Media guidelines. Available from: http://suicideprevention.ca/understanding/for-media/. [Accessed November 11, 2016].
40. The Canadian journalism forum on violence and trauma. Mindset guidelines for reporting on mental health [Internet]. 2014. Available from: http://suicideprevention.ca/wp-content/uploads/2015/08/Mindset.compressed.pdf.
41. Etzersdorfer E, Sonneck G. Preventing suicide by influencing mass-media reporting: The Viennese experience, 1980–1996. Arch Suicide Res. 1998;4:67–74.
42. Niederkrotenthaler T, Sonneck G. Assessing the impact of media guidelines for reporting on suicides in Austria: Interrupted time series analysis. Aust N Z J Psychiatry. 2007;41(5):419–28.

43. Pirkis J, Dare A, Blood RW, et al. Changes in media reporting of suicide in Australia between 2000/01 and 2006/07. Crisis. 2009;30(1):25–33.

44. Fu KW, Yip PS. Changes in reporting of suicide news after the promotion of the WHO media recommendations. Suicide Life Threat Behav. 2008;38(5):631–6.

45. Bohanna I, Wang X. Media guidelines for the responsible reporting of suicide: A review of effectiveness. Crisis. 2012;33(4):190–8.

46. Krysinska K, Batterham PJ, Tye M, et al. Best strategies for reducing the suicide rate in Australia. Aust N Z J Psychiatry. 2016;50(2):115–8.

47. Christensen H, Cuijpers P, Reynolds CF 3rd. Changing the direction of suicide prevention research: A necessity for true population impact. JAMA Psychiatry. 2016;73(5):435–6.

48. Creed M, Whitley R. Assessing fidelity to suicide reporting guidelines in Canadian news media: The death of Robin Williams. Can J Psychiatry. 2017;62(5):313–317.

49. Sinyor M, Pirkis J, Picard A, et al. Towards a shared understanding: Perspectives from Toronto's first media forum for suicide prevention. Can J Public Health. 2016;107(3):e330–2.

50. Ladurantaye S. How the taboo against reporting on suicide met its end. The Globe and Mail. Dec. 10, 2011. Available from: http://www.theglobeandmail.com/life/health-and-fitness/health/conditions/how-the-taboo-against-reporting-on-suicide-met-its-end/article4181695/?page=all.

51. Campion-Smith B. Suicide, social media and newsroom taboos: How new media are changing the way suicides are reported. Ottawa (ON): Carleton University School of Journalism and Communication; 2015.

52. Luxton DD, June JD, Fairall JM. Social media and suicide: a public health perspective. Am J Public Health. 2012;102(Suppl 2):S195–200.

53. Biddle L, Derges J, Mars B, et al. Suicide and the internet: Changes in the accessibility of suicide-related information between 2007 and 2014. J Affect Disord. 2016;190:370–5.

54. Biddle L, Donovan J, Hawton K, et al. Suicide and the internet. BMJ. 2008;336(7648):800–2.

55. Dunlop SM, More E, Romer D. Where do youth learn about suicides on the internet, and what influence does this have on suicidal ideation? J Child Psychol Psychiatry. 2011;52(10):1073–80.

56. Robertson L, Skegg K, Poore M, et al. An adolescent suicide cluster and the possible role of electronic communication technology. Crisis. 2012;33(4):239–45.

57. Gunnell D, Derges J, Chang SS, et al. Searching for suicide methods: Accessibility of information about helium as a method of suicide on the internet. Crisis. 2015;36(5):325–31.

58. Morii D, Yasusuke M, Nakamae N, et al. Japanese experience of hydrogen sulfide: The suicide craze in 2008. J Occup Med Toxicol. 2011;5:28.

59. Lewis SP, Heath NL, St Denis JM, et al. The scope of nonsuicidal self-injury on YouTube. Pediatrics. 2011;127(3):e552–7.

60. Baume P, Cantor CH, Rolfe A. Cybersuicide: The role of interactive suicide notes on the Internet. Crisis. 1997;18(2):73–9.

61. Ruder TD, Hatch GM, Ampanozi G, et al. Suicide announcement on Facebook. Crisis. 2011;32(5):280–2.

62. Eggertson L. Social media embraces suicide prevention. CMAJ. 2015;187(11):E333.

63. Rice S, Robinson J, Bendall S, et al. Online and social media suicide prevention interventions for young people: A Focus on implementation and moderation. J Can Acad Child Adolesc Psychiatry. 2016;25(2):80–6.

64. Robinson J, Cox G, Bailey E, et al. Social media and suicide prevention: A systematic review. Early Interv Psychiatry. 2016;10(2):103–21.

65. Gunn Iii JF, Lester D. Media guidelines in the internet age. Crisis. 2012;33(4):187–9.

66. Maloney J, Pfuhlmann B, Arensman E, et al. How to adjust media recommendations on reporting suicidal behavior to new media developments. Arch Suicide Res. 2014;18(2):156–69.

67. Chen YY, Tsai CW, Biddle L, et al. Newspaper reporting and the emergence of charcoal burning suicide in Taiwan: A mixed methods approach. J Affect Disord. 2016;193:355–61.

68. Chen YY, Yip PS, Chan CH, et al. The impact of a celebrity's suicide on the introduction and establishment of a new method of suicide in South Korea. Arch Suicide Res. 2014;18(2):221–6.

69. Gunnell D, Coope C, Fearn V, et al. Suicide by gases in England and Wales 2001-2011: Evidence of the emergence of new methods of suicide. J Affect Disord. 2015;170:190–5.

70. Thomas K, Chang SS, Gunnell D. Suicide epidemics: The impact of newly emerging methods on overall suicide rates - a time trends study. BMC Public Health. 2011;11:314.

Transportation Infrastructure Means Protection

Concept Design Report

The Regional Municipality of Niagara
Public Works Department
1815 Sir Isaac Brock Way
Thorold, ON L2V 4T7
905-980-6000

625 Cochrane Drive, Suite 500
Markham, Ontario, Canada
L3R 9R9

March 2019

delivering a better world

HELP IS AVAILABLE

If you or someone you know is experiencing depression or showing signs of suicide risk, seek help as soon as possible. There is always support available. You are not alone.

Distress Centre Niagara
Free, Confidential, 24/7 Support

St. Catharines: (905) 688-3711

Port Colborne/Welland: (905) 734-1212

Beamsville/Grimsby: (905) 563-6674

Fort Erie: (905) 382-0689

If you are in crisis and require emergency assistance, please go to the nearest hospital or call 911.

PARSONS

Contents

PARSONS

Appendices

1.0 INTRODUCTION

1.1 EXISTING BRIDGE

The Burgoyne Bridge is located in the City of St. Catharines and carries Regional Road 81 (St. Paul Street West) over Twelve Mile Creek and Highway 406. The new 333-meter-long structure was completed in September 2017 and replaced the original Burgoyne Bridge which was constructed in 1915. The bridge serves as an important link between downtown St. Catharines and the western portion of the city and is oriented in the north-south direction. The span arrangement consists of seven spans of 30m, 42m, 42m, 44m, 125m, 30m, and 20m from south to north, with the 125m main span being supported by a centrally mounted steel tri-chord arch. The bridge is supported on reinforced concrete abutments and piers sitting on reinforced concrete caisson foundations. Figure 1.1 shows the general plan and elevation arrangement of the new Burgoyne Bridge. **Appendix A** includes the full general arrangement drawing for the Burgoyne Bridge.

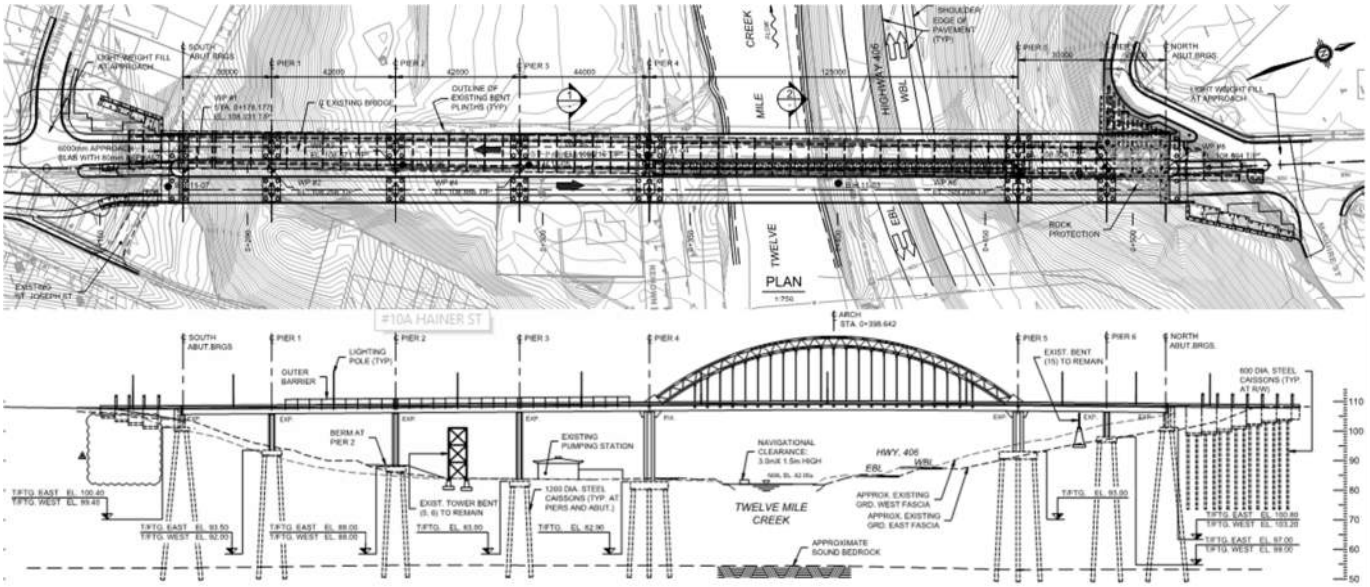


Figure 1.1 – Burgoyne Bridge Plan and Elevation

The cross section of the Burgoyne Bridge is in the form of a twin-deck structure making use of 2 parallel continuous composite trapezoidal box girders running the full length of the bridge. Each deck consists of 0.3m wide parapet walls, a 2.4m wide sidewalk, a 1.6m bike lane, a 3.5m traffic lane, and a 0.9m wide shoulder. The northbound and southbound decks are separated by a 5.5m gap over the entire bridge length. A series of floor beams and inclined hanger cables are utilized over the main span to transfer loads from the decks to the arch system. In addition, the main span has both lateral and longitudinal prestressed cables to increase the stiffness of the span and support the arch system. Figure 1.2 outlines a typical cross section for both the arch span and non-arch spans. **Appendix A** includes the full general arrangement drawing for the Burgoyne Bridge.

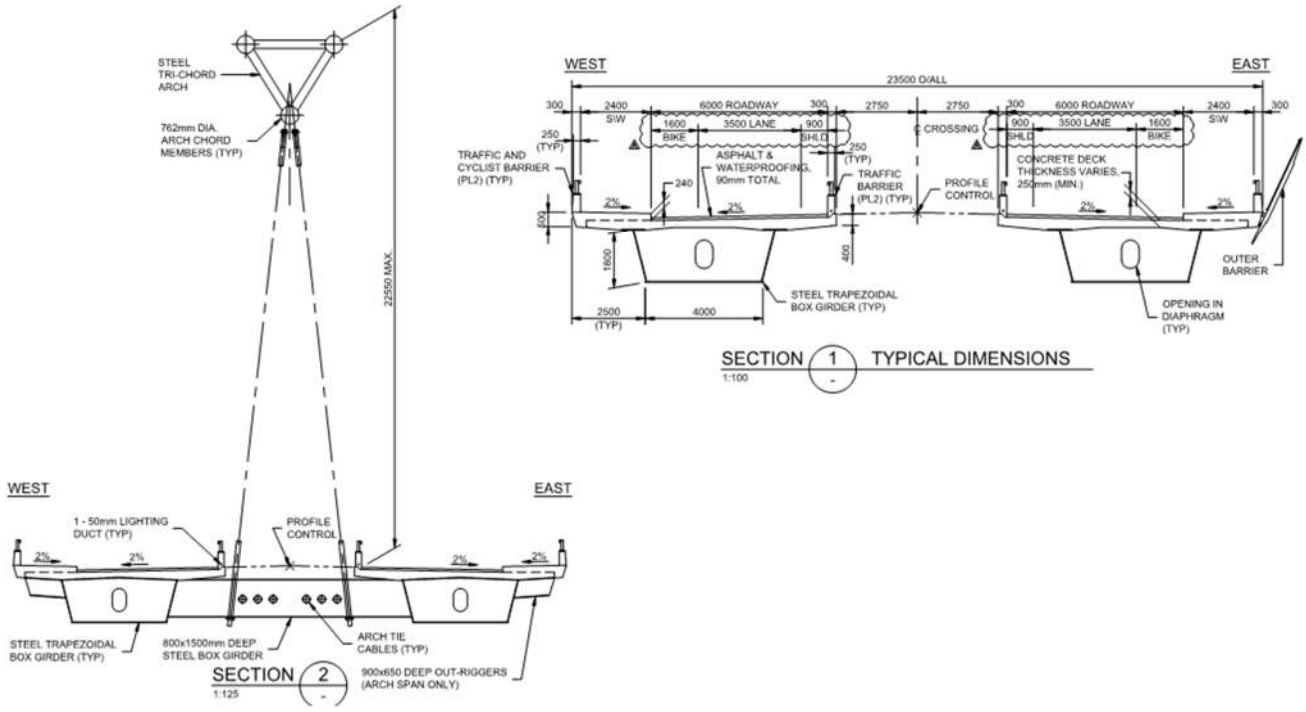


Figure 1.2 – Burgoyne Bridge Cross Sections

1.2 MEANS PREVENTION

Parsons has been contracted by the Regional Municipality of Niagara (the "Region") Public Works Department to investigate possible means prevention measures following several deaths by suicide and similar attempts from the Burgoyne Bridge. Means prevention refers to the action of preventing or blocking the ability of a person to die by suicide through various direct and indirect methods. Examples of means prevention include barriers, nets, and the complete removal of pedestrian access. Such measures vary between encouraging a person contemplating suicide to seek help, to physically removing the ability for such a person to die by suicide. Deaths by suicide from a bridge is a world-wide concern, with fatalities occurring at many landmark structures, which become known as suicide "magnets". This means that once a structure becomes known as a magnet, suicide contagion may result in an increasing number of deaths from the bridge. It is crucial that a system be put in place to prevent such notoriety and to remove the attraction of the bridge to persons contemplating suicide (Toronto Public Health, 2018).

Generally, physical barriers are considered the most effective means of preventing deaths by suicide as they restrict one's ability to make an attempt as well as provide a sense of imperviousness which may help to reduce the "ease" of dying by suicide (Draper, 2017). This report will focus on comparing different types of barrier solutions for the Burgoyne Bridge and make recommend an effective solution. It should also be noted that the Region may add supplementary measures to the bridge in the form of signage, help phones, or security cameras. These methods have only shown weak statistical evidence of effectiveness in reducing the rate of suicides, particularly if implemented on their own. However, they may be useful to supplement a barrier system as a means to encourage a suicidal person to seek help (Toronto Public Health, 2018).

When discussing deaths by suicide from bridges, it is important also to consider the concepts of displacement and substitution. Suicide displacement is the idea that a person contemplating suicide who is blocked from dying at a certain bridge may look for other, nearby structures instead. Suicide substitution is similar in concept, wherein a person may seek another method of dying by suicide. Adding means prevention barriers may reduce or eliminate the rate of deaths by suicide at a specific bridge, but that does not guarantee that the overall deaths from falling from a height (or any other means) will be reduced. Research has shown that at some locations there has been a partial counterbalancing at nearby bridges

immediately following a barrier installation in which the deaths by suicide increases at these bridges. This temporary displacement is then followed by a long-term stabilization and reduction in the overall death by suicide rate in the area. Comparatively, research has indicated that at other locations there have been no signs of displacement or substitution after a means prevention barrier was installed, therefore reducing the overall deaths by suicide (Draper, 2017). However, the most important takeaway is that there is no guarantee that all deaths by suicide from the Burgoyne Bridge, nearby bridges, or by any other means will be completely prevented after the implementation of a means prevention barrier.

1.3 BARRIERS ON THE BURGOYNE BRIDGE

It is understood the Region is proposing a barrier system on the Burgoyne Bridge as a means to prevent deaths by suicide from the structure. On the exterior sides of the bridge decks the Region has expressed an interest in a barrier that will match the profile and appearance of the existing debris fence located on the south east edge of the east bridge deck as pictured in Figure 1.3. Additionally, the inner gap between the two bridge decks will also need to be blocked. There are two possible methods to provide means prevention between the decks. Firstly, to provide a barrier which is similar to the exterior means prevention barrier, and secondly, through the addition of a horizontal steel mesh system on the interior edges of the bridge decks, spanning the existing gap between them, as shown in Figure 1.4.

Figure 1.3 – Existing Debris Barrier

Figure 1.4 – Existing Gap Between Bridge Decks

It is understood that the optimal solution will be one that minimizes the visual impacts to the structure while simultaneously simplifying construction through the incorporation of the existing bridge features. Due to the unique design and complexity of the existing traffic, pedestrian, and bicycle railing systems on the Burgoyne Bridge, it is preferable to minimize impact to their design and functionality wherever possible.

This report will investigate the advantages and disadvantages of similar systems installed at other bridge locations and will apply the knowledge gained from these case studies to develop alternatives for both the interior and exterior means prevention barriers on the Burgoyne Bridge. The primary goal is to identify feasible solutions which will help to reduce deaths by suicide from the bridge while also minimizing the aesthetic impacts and not impede the current ease of access for vehicles, pedestrians, and cyclists. It is very important to understand that there is no solution which will fully remove the risk of deaths by suicide from the Burgoyne Bridge. Even the most comprehensive and expensive systems installed at other bridges have had reported deaths since the implementation of a means prevention barrier. It is crucial that the Region and the Public are aware that there is still a chance of deaths by suicide from the Burgoyne Bridge, even after a barrier is installed.

2.0 STATE OF PRACTICE

In recent years, much focus has been put on researching and understanding mental health issues and the reasons why a person would choose to fall from a tall structure. Combined with a push in refurbishing existing structures with means prevention systems and also incorporating such measures into the design of new bridges, many different means prevention applications can be found. Specifically, means prevention in the form of barriers has been shown to be the preferred method of preventing deaths by suicide, both in Canada and throughout the world. Few examples of netting systems exist and are typically only implemented when there are large concerns from the Public regarding the aesthetic impacts of a traditional deck-mounted barrier. Many of these examples also have signs, security cameras, and help phones installed in addition to barriers. It is inconclusive whether or not these steps reduce the rate of suicide attempts at a site and are mostly regarded as optional, supplementary measures that may be considered. These items may be added to the structure with relative ease if the Region would find it beneficial, however an analysis of such measures is excluded from this report as they do not address the immediate issue of means restriction.

This section will discuss the different types of barriers installed at various bridges and the advantages and disadvantages with each unique system. The information gained from analyzing the barriers on other structures is critical in identifying what design aspects should and should not be included in the proposed Burgoyne Bridge means prevention barrier alternatives.

2.1 BURRARD STREET BRIDGE, VANCOUVER

Located in Vancouver, British Columbia, the Burrard Street Bridge is an 836m long steel truss bridge built in 1932. The area is known for having a high rate of deaths by suicides, with many deaths occurring from the bridge and others nearby. To address this issue, the City of Vancouver elected to retrofit the bridge with a means prevention barrier as shown in Figure 2.1. The barrier is a vertical steel rod fence mounted on top of the existing concrete parapet wall. The barrier was reported to cost $3.5 million and was constructed as part of a larger rehabilitation operation (Brown, 2016). A Public consultation was held to narrow down the options and find a solution that worked for both the City and the Public. Netting, glass, and mesh fencing were all considered, but were deemed to be too costly or too detrimental to the appearance of the bridge. The selected design was decided to be optimal for visibility, construction, and maintenance (Toronto, 2018).

Figure 2.1 – Burrard Street Bridge Barrier (City of Vancouver, 2017)

Advantages

The simple picket design minimizes view obstructions while mimicking the architectural features of the heritage structure. The design also incorporates concrete elements into the barrier system to enforce the image of consistency with the rest of the bridge. Horizontal members near the top of the fence provide an upper connection point for the pickets. This allows a thinner steel rod to be used, saving cost and weight while minimizing impacts to the view. Additionally, the staggered picket detail at the top has the dual purpose of matching the style of the existing bridge while also making it difficult for a person to climb over top of the fence. This design is easy to construct and minimizes construction and schedule costs by utilizing the existing bridge parapets.

Disadvantages

As a result of the decision to incorporate the existing parapet walls into the barrier design, a person has the ability to stand on top of the concrete parapets and light pole pedestals due to the fence being thinner than the concrete components it sits on. Additionally, gaps in the pickets at the concrete light pedestals may provide an opportunity to bypass the spike feature at the top of the pickets. Also, the horizontal member near the top of the fence may be too near to the top of the barrier to prevent someone from lifting themselves over the cantilevered bars. Similarly, the flat tops of the barrier support posts may provide a handhold to bypass the pickets. Combined with the ability to stand on top of the parapets, these hand holds may reduce the ability of the fence to stop climbers. Finally, due to the minimalist design and thinness of the vertical pickets, this barrier system does not give the same illusion of imperviousness that other options may provide.

2.2 IRONWORKERS MEMORIAL BRIDGE, SURREY

Located near the Burrard Street Bridge in Vancouver, British Columbia, the Ironworkers Memorial Bridge is a 1292m long steel truss cantilever bridge built in 1957, which carries 6 lanes of traffic over the Burrard Inlet. Similar to the Burrard Bridge, a high number of deaths by suicide from the Ironworkers Bridge necessitated that a means prevention barrier be installed. The $10 million project (Saltman, 2017) consists of a vertical galvanized cantilevered pipe barrier acting as both a means prevention barrier and a pedestrian and cyclist guardrail. Refer to Figures 2.2 and 2.3 for details.

Figure 2.2 – Ironworkers Memorial Bridge Barrier (Saltman, 2017)

Figure 2.3 – Ironworkers Memorial Bridge Barrier (Ironworkers, 2018)

Advantages

The Ironworkers Memorial Bridge barrier primarily consists of vertical cantilevered steel pipes. By designing the vertical members to be cantilevered, no horizontal components are required near the top of the barrier which may otherwise provide a handhold for anyone attempting to climb it. The larger member size is also very resistant to any bending, and the size and height of the barrier gives a good sense of imperviousness to detract anyone from attempting to climb. The sidewalks were extended as part of a rehabilitation project, so there were no requirements to tie into the existing parapet walls. This reduces the number of footholds and allows the barrier to be continuous from top to bottom along the entire

bridge. Additionally, the tops of the cantilevered pipes are cut at an angle away from the deck to prevent them from becoming a handhold. No deaths have been reported since the barrier was constructed.

Disadvantages

The largest concern for the Ironworkers Memorial Bridge barrier is the larger view obstruction when compared to a picket style barrier. To allow for the cantilevered design, larger vertical components must be used which will further block the view, particularly at steep angles (refer to Figure 2.2 above). Consequently, no design considerations appear to have been put into the barrier to maintain the architectural style of the existing bridge. As such, the barrier is very obvious and intrusive when viewing the structure. Additionally, a cantilevered pipe design may prove to be heavier and potentially more expensive than a lighter picket design such as the one used on the Burrard Bridge. Finally, the pedestrian and cyclist railings mounted to the inside face of the barrier may allow a spot for a person to stand. However, it would be extremely difficult to lift oneself over top of the barrier from this position due to the lack of handholds and the pointed tops of the pipes.

2.3 GOLDEN GATE BRIDGE, SAN FRANCISCO

The Golden Gate Bridge in San Francisco is infamous for having the highest rate of deaths by suicide of any bridge in North America. The bridge has seen more than 1700 deaths since its opening in 1937. Discussions of installing a barrier have been occurring for decades but all attempts have been held back by preservation groups who were opposed to “tarnishing” the historic design. The Public also had many concerns that individuals contemplating suicide would seek another site nearby and that a barrier would not solve the underlying problem (Swan, 2018). It was finally decided that the best way to minimize the impact to the appearance and visibility from the structure was a netting system that is to be installed 20 feet below the edges of the deck, projecting 20 feet outwards. The net is currently being built and will reportedly cost approximately US$211 million by the time construction is complete in 2021 (Toronto, 2018). The net itself is made of a horizontal steel mesh supported by cantilevered steel brackets connected to the bridge superstructure. Figure 2.4 below shows a rendering of the proposed net system.

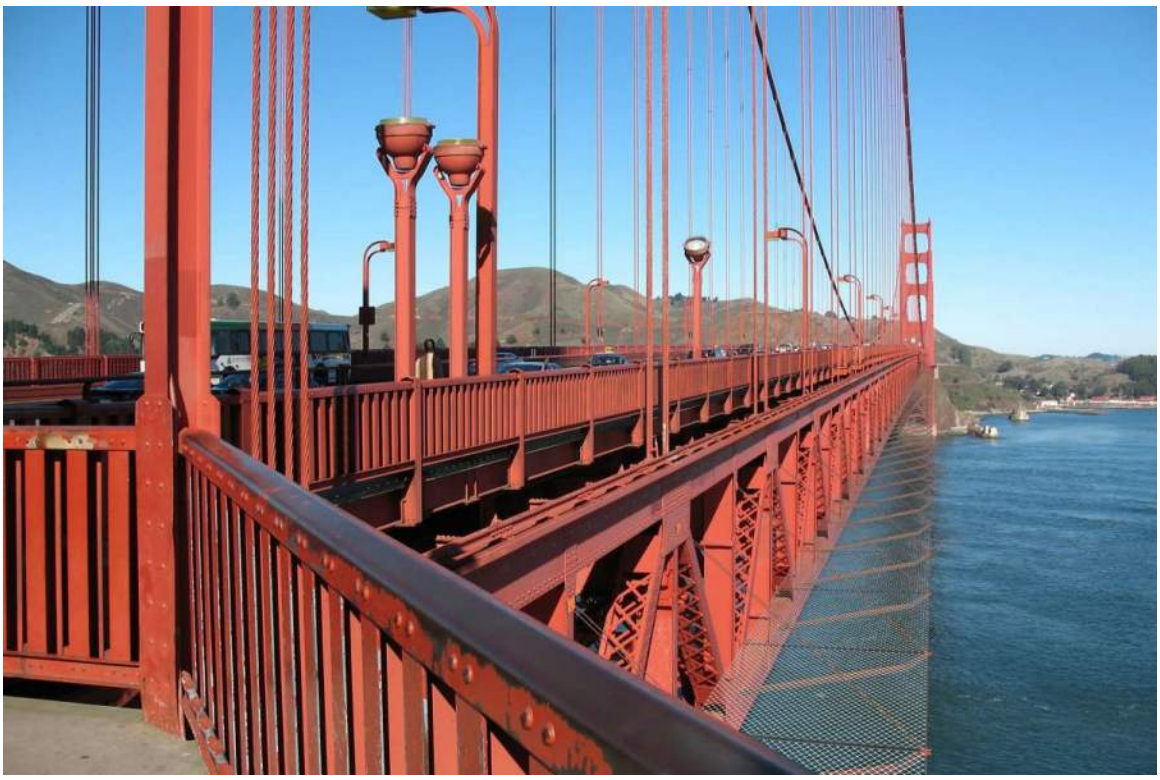


Figure 2.4 – Golden Gate Bridge Net - Render (Swan, 2018)

Advantages

The proposed Golden Gate Bridge netting system caters to the psychological concept that individuals contemplating suicide only wish to take their lives, so as such they may avoid situations that would cause harm but not death. A steel mesh 20 feet below the deck could cause substantial harm to a person who has jumped onto it, but it is not likely to result in death. This also ties into the concept of remorse after an attempt to die by suicide. Many survivors of an intentional fall from a height have stated they regret the decision immediately after the attempt. A net can provide this "second chance" that a desperate person may need (Draper, 2017). A netting solution is also optimal when it comes to minimizing visual impacts to the structure, particularly from the deck level. Such a system would have no influence on the view from the bridge deck and would partially blend in to the rest of the bridge superstructure when viewed from the sides. Consequently, a below-deck net is also optimal from an architectural preservation perspective, whereby the image of the bridge is not substantially altered.

Disadvantages

There are several consequences from a structural standpoint when adding such a heavy system onto a comparatively lightweight and slender bridge. In the case of the Golden Gate Bridge, motion dampers are being installed to counteract the additional wind load induced by the significant netting area (Toronto, 2018). Depending on the condition and design characteristics of a particular structure, such a system may require significant stiffening and additional brackets and support members to support such a net, if the bridge is even structurally capable of supporting it at all. As seen in the Golden Gate Bridge example, such a system and the associated structural improvements can be extremely expensive and take a significant amount of time to design and construct.

One could also make the argument that a net is not a true means prevention system in that it does not physically prevent a person contemplating suicide from attempting to fall from the bridge. A net will only provide the threat of injury or will catch individuals who do have an intentional fall and will then need to be rescued at the risk of first responders. A similar concern is that if an individual sees the net when contemplating death, they may decide to climb down to the net and then fall from this lower position.

2.4 PRINCE EDWARD VIADUCT, TORONTO

The Prince Edward Viaduct, also known as the Bloor Street Viaduct, had the 2nd highest rate of deaths by suicide of any bridge in North America, behind only the Golden Gate Bridge (Toronto, 2018). Located in Toronto, Ontario, the 494m length bridge experiences substantial pedestrian traffic and crosses over one of the busiest highways in the city. To address rising concerns over the high number of deaths from the bridge, the City of Toronto installed a complex vertical barrier system in 2003. The barrier uses a series of 5m tall vertical rods connected to an inclined structure supported off the side of the bridge. To maintain structural integrity, the barrier uses a system of cables to support the structure and reduce the impacts of additional wind loads. The barrier is considered to be architecturally significant and has been given the name 'Luminous Veil'. Refer to Figure 2.5 below for a deck view of the barrier.

Figure 2.5 – Prince Edward Viaduct Barrier (McQuigge, 2017)

Advantages

The Prince Edward Viaduct barrier showcases the most extensive version of a means prevention barrier. Reaching over 5m tall, it is regarded as one of the most effective systems of its kind. Since its construction in 2003, only a single death by suicide has occurred when there had previously been an average of 9 per year (McQuigge, 2017). One of the key design features of this barrier is the focus put on creating a system that was very effective, but also architectural pleasing. The design received approval from the local heritage groups who were previously opposed to a barrier (Toronto, 2018). The height and slenderness of the vertical rods prevent climbers from scaling the barrier while minimizing the impacts to the view from the bridge. Help phones and signage were also installed on the bridge as supplementary measures.

Disadvantages

While the Prince Edward Viaduct barrier is regarded as one of the most effective means prevention barriers, it is also one of the most complex. Significant architectural and structural design would have been required, and the tremendous size of the barrier would incur high material and construction costs. A barrier of this size also presents maintenance issues as specialized equipment would be needed to clear the barrier to access the outer portions of the bridge. Additionally, it was recorded that deaths by suicide on nearby structures increased immediately after the barrier was constructed, indicating that suicide displacement was occurring. However, the rate of deaths on these nearby bridges has since stabilized to the levels prior to the Luminous Veil's construction, meaning a long-term reduction in deaths by suicide from bridges has occurred (Toronto, 2018). This corresponds to research conducted at other high-profile suicide-magnet bridges around the world (McQuigge, 2017). It should be noted however that it is impossible to say that other factors, such as increased public awareness and new assistance programs, have not skewed these results positively in the long-term.

2.5 HIGH LEVEL BRIDGE, EDMONTON

To address rising concerns of deaths by suicide from the High Level Bridge in Edmonton, Alberta, a horizontal steel cable barrier was constructed on each side of the 777m long structure. The system makes use of a series of horizontal cables suspended between steel posts which are mounted directly to the sidewalk, as shown in Figure 2.6 below. The tops of the posts are inclined towards the sidewalks to deter individuals from climbing over the barrier. The system was reported to cost $3 million (Toronto, 2018).

Figure 2.6 – High Level Bridge Barrier (Suicide, 2017)

Advantages

Research indicates that the overall rate of deaths by suicide in the area has decreased since the barrier has been installed (McQuigge, 2017). The design was considered the most cost-effective solution for the long length of the bridge. The barriers were bolted directly to the sidewalks and required no other structural connections or modifications. The barrier was also installed in front of the existing bridge railing, simplifying construction accessibility and negating any interference with existing bridge components. Consequently, this system is fairly light weight, easy to construct, and uses a minimum amount of material. It is also preferable in that it minimizes the impacts to the view from the bridge. The design of the painted black steel components also fits in with the architecture of the existing bridge.

Disadvantages

The High Level Bridge barrier is an example of a non-optimal barrier design being installed due to cost concerns. Since the implementation of the barrier, there has only been a reported 50% reduction in deaths by suicide from the structure. Individuals are still able to climb over the barrier due to the horizontal cables acting as a ladder (Suicide, 2017). For comparison, the proposed optimal design was to use vertical stainless-steel bars, but this option was rejected due to a higher estimated cost of $7.5 million (Toronto, 2018). In addition to acting as a ladder, the horizontal cables have been susceptible to vandalism, with several examples reported of people cutting the cables. This allows a gap of any size to be created, essentially bypassing the barrier completely. Finally, cyclists and Pedestrians have made complaints regarding the tapered barrier impeding on the sidewalk headroom.

2.6 OTHER BARRIER EXAMPLES

In addition to the case studies described above, there exist many other examples of means prevention barriers installed on many different types of bridges throughout the world. Table 1 below summarizes several of these other bridges and indicates which barrier type is installed. Most of these examples follow similar designs to the examples previously outlined in this section. If further samples of bridge barriers are needed, several pictures and articles exist for each of the listed structures. Note that many of these bridges also have supplementary measures installed, such as help phones and signage, which may also be reviewed for information if needed.

Table 1 – Means Prevention Barrier Examples

Bridge Name	Location	Barrier Type
Golden Ears Bridge	Vancouver, British Columbia	Cantilevered steel pipe barrier (similar to Ironworkers Memorial Bridge).
Jacques Cartier Bridge	Montreal, Quebec	Picket fence barrier mounted to sidewalk with horizontal member near top. Tops of pickets are curved towards the sidewalk.
Angus L. MacDonald Bridge	Halifax, Nova Scotia	Cantilevered steel pipe barrier (similar to Ironworkers Memorial Bridge).
Aurora Bridge	Seattle, Washington	Picket fence barrier mounted to edge of deck with horizontal member near top. Barrier is outside of the existing parapet and mounted to deck overhang.
Bourne Bridge Sagamore Bridge	Bourne, Massachusetts	Picket fence barriers mounted to sidewalk with horizontal member near top. Tops of pickets are curved towards the sidewalk.
Ithaca Gorge Bridges	Ithaca, New York	Net system installed below deck (Similar to Golden Gate Bridge). Reports exist of suicides still occurring at the bridge. A temporary vertical barrier has since been installed at deck level.
All-America Bridge	Akron, Ohio	Vertical mesh fence barrier. Uses a fine steel mesh supported between adjacent vertical posts.
Memorial Bridge	Augusta, Maine	Vertical mesh fence barrier. Uses a standard steel mesh supported between adjacent vertical posts. Top of fence is inclined towards the sidewalks.
Duke Ellington Bridge	Washington, DC	Picket fence barrier mounted to edge of deck with horizontal member near top (similar to Burrard Street Bridge). Pickets curved towards sidewalk. Barrier is outside of existing parapet mounted to deck overhang.
Cold Spring Canyon Arch Bridge	Santa Barbara, California	Vertical mesh fence barrier. Uses a standard steel mesh supported between adjacent vertical posts. Fence is inclined towards the sidewalks.
Grafton Bridge	Auckland, New Zealand	Curved clear polycarbonate barrier mounted on top of parapets. Forms a canopy above the sidewalks.
Sydney Harbour Bridge	Sydney, Australia	Vertical mesh fence barrier. Top of fence is curved towards the sidewalks with barbed wire at the top. Fence is on both sides of both sidewalks, creating a “cage” that fully encloses the sidewalks.

3.0 BARRIER ALTERNATIVES

3.1 DESIGN CONSIDERATIONS

Using the recommendations and design traits of other successful means prevention barriers, Parsons is proposing the following criteria for the successful implementation of a barrier on the exterior edges of the Burgoyne Bridge. This list is also compiled based on the results from analyzing the case studies in Section 2 of this report.

1. A height greater than 2.5m above the sidewalk to prevent individuals from reaching up and easily pulling themselves over. The taller the barrier, the more effective it will be to prevent climbers.
2. Gaps between components should be 150mm or less to prevent an entire body from passing through any openings.
3. No foot or hand holds, particularly near the top of the barrier which would allow someone to lift or push themselves over. Likewise, any flat surfaces near the top of the barrier should be avoided.
4. The barrier should be composed of smooth vertical components that are hard to grab onto and provide no grip for a foot or hand to push against.
5. The components at the top of the barrier (pickets, posts, pipes, etc.) should be angled or pointed to prevent them from becoming a hand hold. If any horizontal members are located near the top of the barrier, the vertical components should be extended beyond to prevent someone from using the horizontal section to pull themselves up and over the barrier.
6. A barrier should provide the impression of imperviousness. The more difficult a barrier looks to overcome, the lower the chances that someone will attempt to climb it. This can be done by increasing the height of the barrier, using solid and stiff components, and minimizing any hand and foot holds.
7. Structural and aerodynamic stability: any barrier system should not compromise the structural capacity of the bridge and should be sound under all operating conditions. Special consideration should be put into the wind and snow/ice effects of the barrier and the impacts to the entire bridge.
8. Accessibility should not be impacted by the barrier for vehicles, cyclists, or pedestrians. This may be an issue on barriers which have a taper or incline towards the sidewalk or bike lane.

Similar considerations exist for the design of the horizontal net system that is proposed for the interior gap between the bridge decks. The net system must be structurally sound, free of any openings that would allow someone to pass through and should give the impression of imperviousness. In the case of the Burgoyne Bridge, the small number of netting examples and lack of any inclined barrier case studies will require barrier designs not seen on any other bridges. However, there are key concepts and design considerations that can be taken from the case studies outlined in Section 2 and applied to the special requirements of the Burgoyne Bridge. This section will describe and compare the alternatives proposed by Parsons for both the interior and exterior means prevention barriers.

3.2 EXTERIOR BARRIER

As previously discussed, it is understood that the Region is requesting an exterior barrier which will match the profile of the existing debris fence on the south east edge of the east bridge deck. Additionally, it has been noted that all barrier alternatives should minimize impacts to the existing bridge railing systems. As such, Parsons is recommending two alternatives for the exterior barrier. Both barrier options will have the same profile but will have different options for the design of the vertical members which will act as the primary means prevention components. It should be noted that a system identical to the exiting debris barrier (which uses a mesh fence) is not recommended for the purposes of a means prevention barrier as such a fence is easily scalable, regardless of height.

Additionally, per the Region's request, the proposed barrier alternatives will have the capacity to be constructed with either galvanized steel or aluminum materials. However, due to the structural differences with regards to material properties between the two metals, member sizes will be different between the two metal types to achieve the same deflection performance. The impacts of each metal type for the proposed barrier will be discussed in the following sections. It should

also be noted that stainless steel was omitted from consideration due to the much higher material costs as compared to galvanized steel and aluminum, with costs reaching upwards of 10-15 times more than these metals.

3.2.1 ALTERNATIVE 1: INCLINED BARRIER WITH CANTILEVERED PIPES

The first proposed alternative for the exterior means prevention barrier on the Burgoyne Bridge is an inclined cantilevered pipe barrier. Similar to the Ironworkers Memorial Bridge barrier outlined in Section 2.2, this barrier type utilizes larger diameter members to eliminate the need for any horizontal elements at the top of the barrier which could be used to climb over. Refer to Figure 3.1 below for a concept drawing for this barrier alternative. Refer to **Appendix B** for the full drawing. The pipes will in turn be mounted to a series of I-section posts. The posts will be connected to the bridge at every other existing railing post with a plate and bracket and will be anchored to the exterior face of the deck overhang. The tops of the pipes will be cut at an angle to prevent someone from using them to pull themselves over the top of the barrier. This option also has the capacity for an architectural shape at the top of the barrier, such as a scalloped or stepped top.

The estimated galvanized steel pipe outer dimeter for this option is 48mm, with aluminum being 60mm. This is due to the reduced stiffness of the aluminum creating deflection concerns if an individual were to attempt to force the members apart as compared to steel. In order to account for the decreased stiffness and reduce deflections to an acceptable limit, the aluminum components would need to be larger than their steel counterparts.

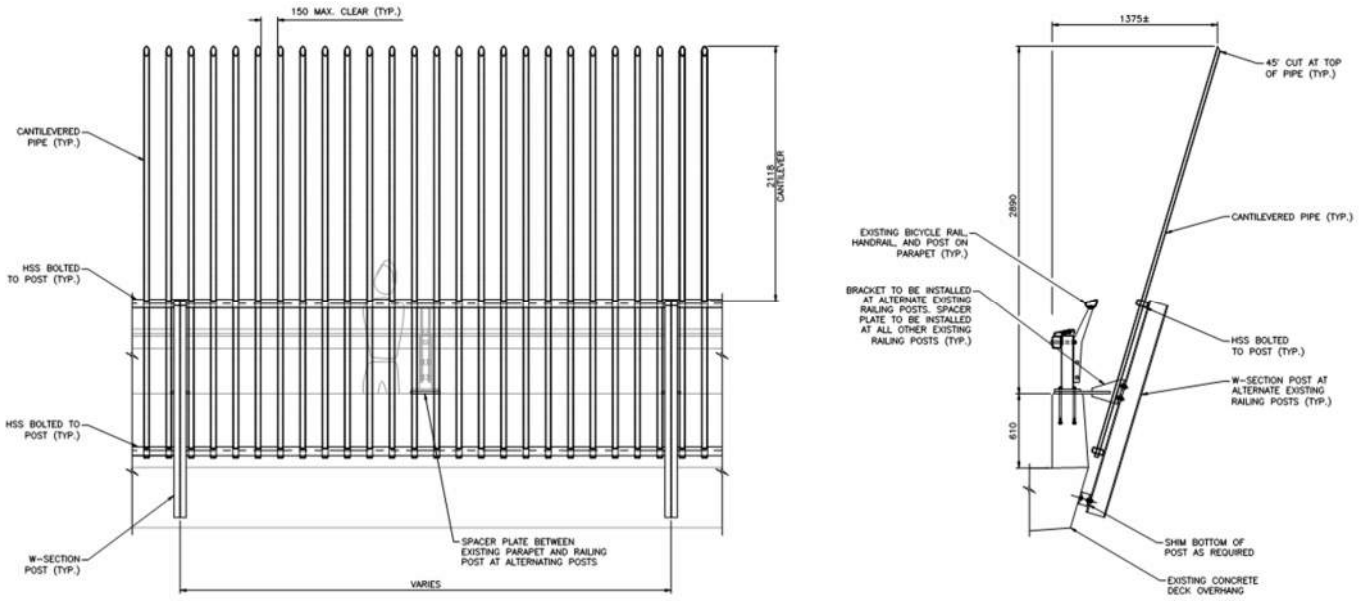


Figure 3.1 – Exterior Barrier Alternative 1

Advantages

This barrier type imposes a good sense of impassability and is the best option for means prevention effectiveness. The cantilevered pipe design limits the number of available handholds by not requiring an upper horizontal member for support. Likewise, the smooth surfaces of the pipes will prevent anyone from getting a solid grip and scaling the barrier. The angled cut at the top of the pipes would make it difficult for anyone to grab the top of the pipes and pull themselves up and over the barrier. Many existing barriers of the same design can be found on several landmark structures around North America, giving evidence of the effectiveness and efficiency of this type of barrier. Mock-ups have also shown that this barrier type gives a strong impression of imperviousness due to its height, member sizes, and lack of handholds. Finally, the ability to add architectural shaping to the top of the barrier will help to incorporate the system into the existing bridge design as much as possible.

Disadvantages

Alternative 1 may prove to be heavier than option 2 due to the increased member sizes required for the cantilever construction. However, this weight would be reduced if considering the aluminum option, even though the members will need to be larger. Additionally, the larger diameter pipes will reduce the view from the bridge and will be clearly visible when observing the bridge from the sides. This view obstruction is compounded when considering the larger diameter pipe required for the aluminum option. Consequently, increasing the diameter of the pipes for aluminum construction will result in an increased size for the HSS supports at the lower end of the barrier.

Damping of the cantilevered pipes will be required to reduce the effects of vibration for both the steel and aluminum options as a result of wind, rain, snow, and ice loading. More extensive damping will be required for the aluminum pipes due to the reduced stiffness when compared to steel. Aluminum is much more susceptible to induced vibrations than steel, with vibrations starting at lower applied loads and lasting for longer durations. This observed phenomenon can be easily explained from a material properties standpoint, with aluminum having a much lower stiffness than a comparable steel member, which results in a higher vibration frequency and time period before self-damping occurs. If the aluminum material option is selected for this barrier, special consideration will need to be given to the dynamic and fatigue design of the members to ensure there are no long-term performance concerns.

3.2.2 ALTERNATIVE 2: INCLINED BARRIER WITH SUPPORTED PICKETS

The second proposed alternative for the exterior means prevention barrier is an inclined supported picket barrier. Similar to the Burrard Street Bridge outlined in Section 2.1, this barrier type utilizes round steel pickets supported with horizontal members. The horizontal supports near the top of the barrier combined with full-height I-section posts will allow this alternative to use thinner, solid metal rods as the primary fencing system. Refer to Figure 3.2 below for a concept drawing for this barrier alternative. Refer to **Appendix B** for the full drawing. The remainder of the system will be identical to Alternative 1 due to the constraints of matching the profile to the existing debris barrier and minimizing impacts to the railing system.

The approximate diameter for the picket rods would be 21mm for galvanized steel and 25mm for aluminum. The upper HSS support alleviates many of the concerns found with using aluminum for Alternative 1 in that this system will be less susceptible to vibrations and induced deflections if a person attempts to pull the bars apart.

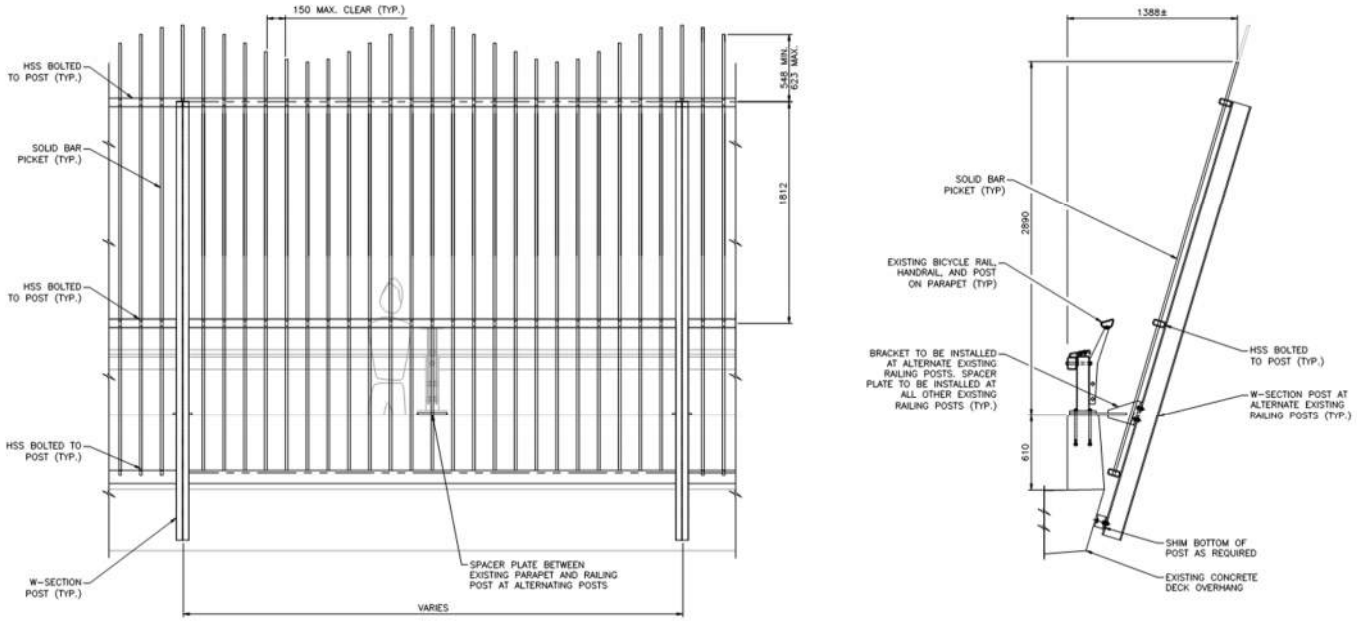


Figure 3.2 – Exterior Barrier Alternative 2

Advantages

Alternative 2 for the exterior barrier benefits from a lighter assembly due to the thinner pickets. By providing full-height posts and horizontal support members, the pickets do not need to be as large as they would be if they were cantilevered. The thinner vertical bars are also optimal from a viewing perspective as they will result in less obstruction to the view from the bridge. As with Alternative 1, this option allows for architectural features in the design. As shown in Figure 3.2 above, the proposed alternative 2 has a scalloped design, but other styles can easily be accommodated. The thin nature of the pickets also results in a built-in safety feature in that the small diameter tops would make it difficult for someone to pull themselves onto and over the barrier. As with Alternative 1, the top of the pickets can be clipped to deter them from being used as a handhold. As a result of the extra horizontal support, there will be less concerns over the barrier members vibrating when exposed to wind and snow loading. Finally, the steel and aluminum options will have generally the same construction, with the aluminum components only slightly larger than their steel counterparts to accommodate the lower stiffness of the aluminum.

Disadvantages

The primary drawback of the supported picket style barrier is the inclusion of the horizontal member near the top of the barrier which may present a handhold and potentially increase the risks of an individual being able to scale the barrier. However, by extending the pickets above this member, the ability for someone to use it as a handhold is reduced. Another drawback of this design is that the I-section posts would need to extend the full height of the barrier in order to support the upper picket connection member. This will add bulk to the barrier resulting in a discontinuous appearance to the overall system. Finally, Alternative 2 may not be as physically imposing as Alternative 1 due to thinner components comprising the majority of the barrier, which reduces the impression of impassability that is crucial to a successful means prevention barrier.

3.3 INTERIOR BARRIER

As previously discussed, it is understood that the Region is requesting an interior means prevention barrier system which will be in the form of a steel net spanning between the bridge decks over the full length of the Burgoyne Bridge. As with the exterior barrier, it has been noted that all barrier alternatives should minimize impacts to the existing bridge railing systems and other bridge components. An additional constraint on the arch span is that the net cannot impact the performance of the arch hanger system. As with the exterior barrier, Parsons is recommending two alternatives for the interior barrier. Both systems will be identical in design but will be positioned at different heights on the exterior side of the parapet walls. It is recommended that both alternatives use a very large mesh opening to discourage anyone from walking or climbing on top of the net. This will also reduce the visual and weight impacts of the system to the bridge. The proposed netting options on the Burgoyne Bridge also alleviates the major concerns with other netting systems (such as the Golden Gate Bridge) in that there will be no option to bypass the net as it will completely fill the gap between the bridges.

The proposed net system for both alternatives will be a stainless-steel cable net which will be supported by longitudinal cables adjacent to the parapet walls and transverse cables at intervals along the entire bridge length. The system will be supported by stainless steel connectors and brackets which will be either bolted to the parapet walls or utilize the existing railing anchorages. The net system will be highly durable, weather resistant, and customizable to be able to fit the complex geometry of the Burgoyne Bridge. Various options exist to allow for the replacement of the light poles on the bridge, as well as maintenance of the arch stay pipes and cables. Such a system has been used in various applications for pedestrian safety on buildings and bridges, particularly in Europe.

3.3.1 ALTERNATIVE A: HORIZONTAL MESH AT TOP OF PARAPETS

Interior barrier Alternative A consists of a horizontal steel mesh system spanning between the bridge decks which utilizes the existing railing anchorages for support brackets. The benefit of this arrangement is that there will be no drop onto the net if someone attempts to climb onto it. The net will act purely as a fence system to block anyone from falling from the bridge, as opposed to a method of catching someone during a fall. This option will be visible from the bridge deck to vehicles and pedestrians, which may have the unintended result of promoting people to climb on the net. There is also the potential of vandalism occurring to the net, an issue that will be compounded if the system is easily accessible from the deck level. However, construction and maintenance of the net system will be easier as the components will be accessible from deck level. Additionally, having the net located at the railings allows for the existing railing anchor bolts to be used, avoiding the need to anchor new brackets into the parapet walls. Coincidentally, mounting the net at the top of the parapets avoids interfering with the light pole pedestals and the access panels for the arch thrust blocks. Refer to Figure 3.3 for a concept sketch for Alternative A. The full drawing can be found in **Appendix B** as well as a separate drawing which includes the proposed provisions for protrusions in the net for the stay cables and light poles.

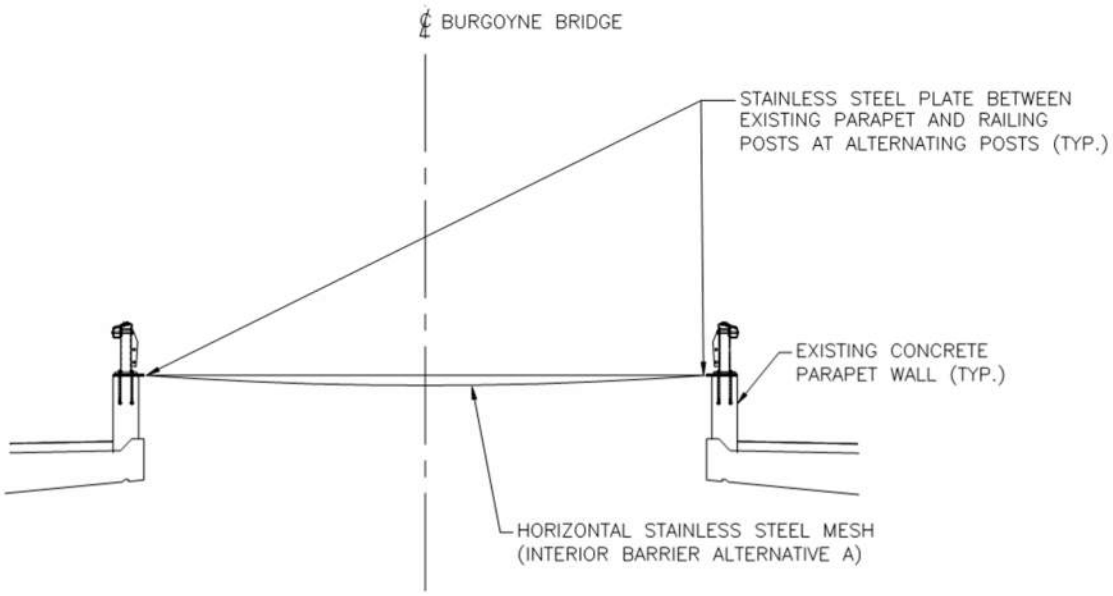


Figure 3.3 – Interior Barrier Alternative A

3.3.2 ALTERNATIVE B: HORIZONTAL MESH AT BOTTOM OF PARAPETS

Interior barrier Alternative B consists of a horizontal steel mesh system spanning between the bridge decks which is anchored to the deck overhang faces at the bottom of the parapet walls. This arrangement may allow someone to scale over the railing and parapet wall and climb on the net. Since the net is partially hidden by the parapet, it may be difficult to identify if a person is on the net and if they may need help. Similarly, a person would have the opportunity to jump onto the net from the top of the parapet wall due to the height difference, which may result in injury. Consequently, retrieving a person who is on the net may be more difficult for rescue personnel due to the restriction from the parapet and railing. Otherwise, having the net system below the level of the parapets will help to reduce the visual impact on the structure as it will be more difficult to see from the deck level. This option will also help to reduce the possibility of vandalism as the net will be more difficult to access from the deck. However, installation and maintenance of this system will also be reduced as the connections will be more difficult to access. Additionally, conflicts with the light pole pedestals and the arch thrust block access panels would require additional detailing of the net and may limit the required access during service. Finally, anchoring the support brackets to the existing concrete parapet walls may be difficult and time consuming due to the

possibility of striking reinforcement within the wall. Refer to Figure 3.4 below for a concept sketch for Alternative B. The full drawing can be found in **Appendix B**.

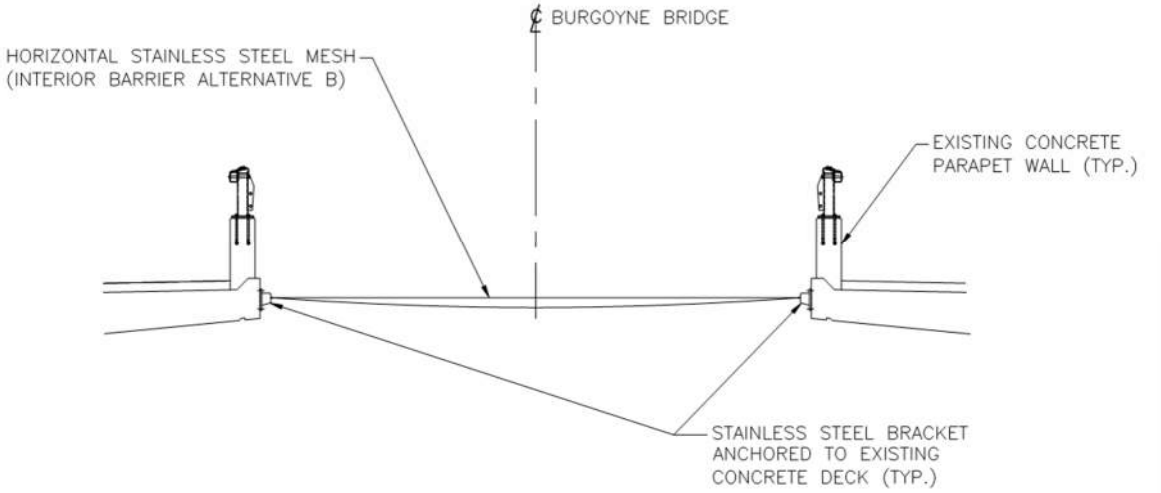


Figure 3.4 – Interior Barrier Alternative B

3.3 RECOMMENDED BARRIERS

Exterior Barrier

Parsons is recommending that Alternative 1 be selected for the exterior barrier. This inclined cantilevered pipe barrier was determined to be the best option with regards to means prevention. This barrier type provides a greater sense of impassibility and imperviousness, while the cantilevered design reduces the number of handholds, making it very difficult to scale the barrier. The smooth, larger diameter pipes would be challenging to hold on to or use as a foothold, and the angle cut into the top of the pipes further limits the ability for an individual to attempt to climb over the barrier. Most importantly, there are numerous successful precedents that can be observed on several bridges throughout the world where the same barrier type has been constructed.

Per the Region's request, Parsons has allowed for this barrier type to be constructed with either galvanized steel or aluminum components. As previously discussed, the lower stiffness of aluminum as compared to steel results in larger structural members for an aluminum option (60mm outer diameter) vs. the steel (48mm outer diameter) to limit the deflections of the pipe components. In an effort to understand the view differences between the two material options for the proposed exterior barrier system, Parsons has created a model comparing the two materials, as shown in Figure 3.5 below.

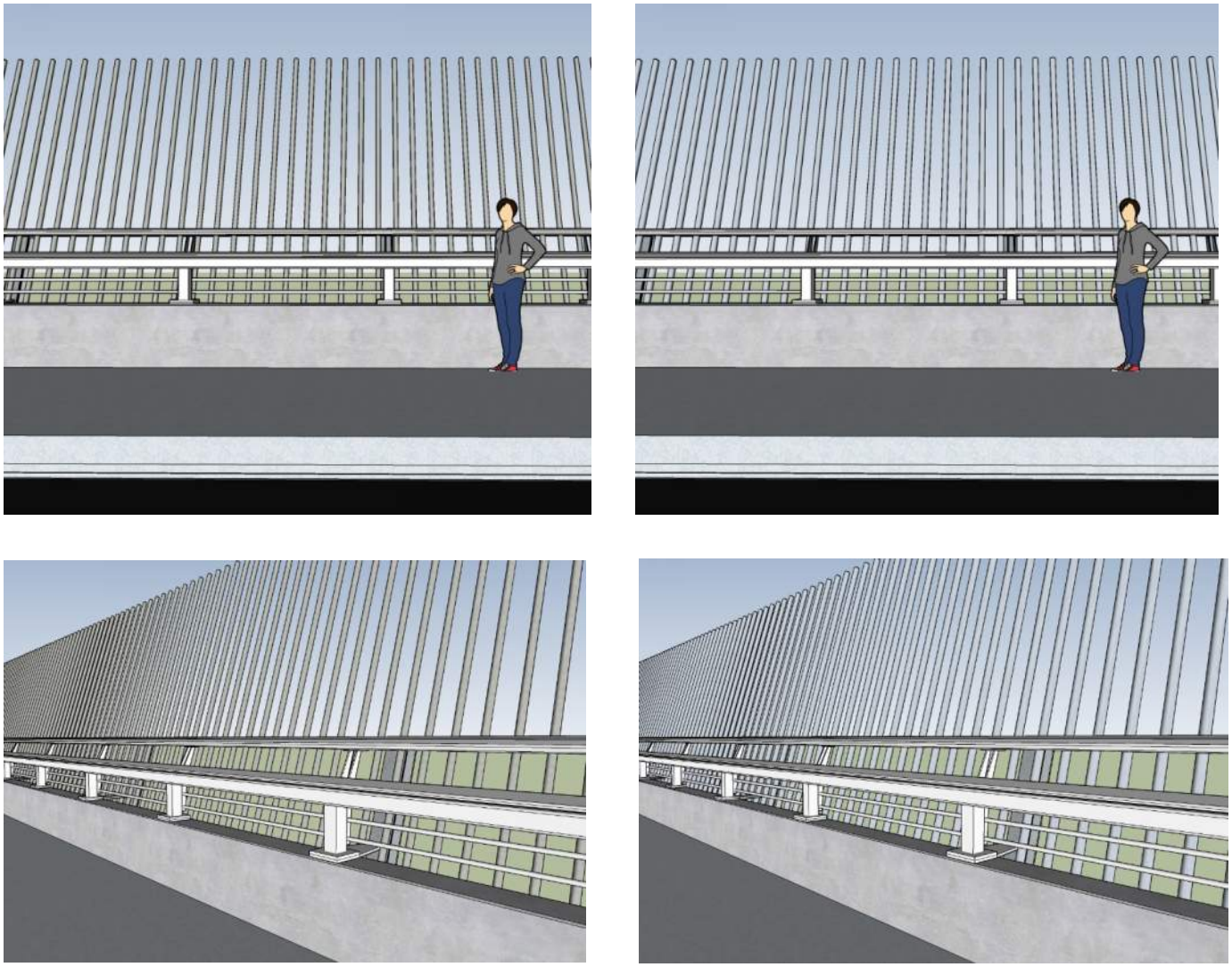


Figure 3.5 – Exterior Barrier Proposed Alternative – Galvanized Steel (Left) vs. Aluminum (Right)

The recommended interior and exterior barriers will be further discussed in the following sections and the preferred material type will be determined for the exterior barrier.

Interior Barrier

Parsons is recommending that Alternative A, a horizontal steel mesh mounted at the top of the parapet walls, be utilized for the interior barrier. This interior barrier configuration would allow for easier installation and maintenance of the net as compared to the other option due to the easier access from the bridge decks. By utilizing the existing railing anchor bolt assemblies for attaching the support brackets, construction of the net would minimize impacts to the bridge and avoid time consuming concrete anchoring. Additionally, no drop onto the net from the parapet wall and railing could potentially reduce the ability for a person to become trapped on the net and limits the efforts required for emergency personnel to rescue someone from the net if help is needed. Finally, by mounting the net at the top of the parapets, the light pole pedestals and arch thrust block access panels are avoided, thereby limiting complicated mounting techniques and impacts to the bridge and barrier during service.

4.0 DYNAMIC ANALYSIS

Parsons has retained RWDI to conduct dynamic analysis and wind tunnel testing of the proposed Burgoyne means prevention barriers. RWDI is in the process of building a sectional model of the bridge deck that replicates the bridge's main span geometry and mass distribution. The sectional model will be mounted on a spring suspension system and tested in the wind tunnel for the wind speed range that is expected at the project site. The model will be mounted in such a way that it can move both vertically and torsionally about the longitudinal axis. The deck will be tested with and without the means prevention barrier to assess the barrier's impact on the overall aerodynamic stability of the bridge deck. Tests will also be carried out to measure aerodynamic force and moment coefficients, with and without the barrier, that will be used for derivation of wind loads acting on the bridge. The sectional model tests are planned to take place in the coming weeks.

After completion of the tests, numerical methods will be used to combine the design wind speeds, turbulence levels at the site, static force and moment coefficients, and modes of vibration in order to determine wind loads acting on the bridge. Having recorded aerodynamic coefficients with and without the barrier allows for direct derivation and comparison of the wind loads between the two configurations evaluated. This information will be used during the detailed design phase of the barrier to ensure appropriate dynamic performance of the barrier.

In addition to determining the wind loads and confirming the dynamic performance of the bridge as a whole, dynamic analysis of the exterior barrier pipes will be required during the detailed design phase. It is likely that the pipes will require mass dampers to reduce vibrations caused by wind loading and potential vortex shedding around the exterior barrier pickets. Other successful precedents have been shown to use mass dampers within steel cantilevered pipes to limit vibrations under wind loading. These dampers have been shown to use minimal material and installation effort on similar barriers on other bridges. Without further analysis it is uncertain what extent of damping would be required for an aluminum barrier option. However, due to the reduced stiffness of aluminum as compared to steel, it could be argued that the level of damping will need to be more extensive than a steel option and may prove to be prohibitive from a cost or constructability standpoint or may simply be unfeasible for the member sizes and lengths proposed for this barrier. If aluminum is deemed to be the preferred material for the exterior barrier, more in-depth dynamic and material analysis will be required to confirm the extent of damping and that the final system will still conform to the mandatory means prevention requirements. Due to the lack of precedents on other bridges, the performance of an aluminum option is uncertain, and the level of damping poses a risk if this material is required.

5.0 CONSTRUCTION CONSIDERATIONS

Exterior Barrier

The exterior barrier will be designed in such a way that construction can be accommodated via lifting equipment situated on the bridge deck. The barrier brackets and posts will be installed as a single piece by locally lifting the existing railing and installing a plate onto the anchor bolts holding the railing to the parapet. The lower portion of the posts will be anchored to the concrete deck fascia with provisions to alter the anchor location if conflicts with reinforcement are encountered during anchor installation. Once the posts are installed, the vertical and horizontal barrier members will be installed in panels and bolted to the posts. This will allow for quicker construction, maintenance, and replacement. Depending on the size of lifting equipment selected, traffic can either be maintained on both bridge decks with traffic protection to delineate traffic from the workers and equipment (which would be located on the sidewalk side of the deck), or a closure of one of the decks during construction activities as with the interior barrier. If required, a bridge master unit can be used to scale over top of the outer barrier for construction of the barrier or maintenance and inspection during service. Several bridge master models from various suppliers are capable of passing over top of the proposed exterior barrier. As depicted in **Appendix C**, it is estimated that the installation of the exterior barrier will require approximately 33 working days. A more thorough staging plan can be developed during the detailed design of the barrier.

Interior Barrier

The interior mesh net can be primarily installed from the deck level. Brackets can be installed between the parapet walls and railing posts by utilizing the existing post anchor bolts by locally unbolting and lifting the railing. Once the brackets are installed the longitudinal and transverse support cables can be connected. The mesh net can then be attached to these support cables. An under-deck platform will be required spanning between the decks for a portion of the interior barrier where the transverse net cables are installed to allow for the net to be threaded onto these cables. It is expected the platform can be relocated at each applicable location as required. The installation of this barrier will also require a closure of one of the bridge decks when installing the barrier components as the net will need to be put into place from the deck level. Temporary traffic signals or flagging could be utilized to maintain two-way traffic during construction. As depicted in Appendix C, it is estimated that the installation of the interior barrier will require approximately 27 working days. A more thorough staging plan can be developed during the detailed design of the barrier.

6.0 COST ESTIMATES

6.1 CONSTRUCTION COST ESTIMATES

Estimated material, fabrication, delivery, and installation costs for the interior barrier and both galvanized steel and aluminum options for the exterior barrier are included in Appendix C. This cost estimate includes all expected works for the Burgoyne means prevention barriers. These cost estimates include a 40% contingency due to the custom fabrication and installation work which is difficult to quantify due to the lack of similar projects in Ontario for reference. Table 2 below includes a summary of the total material and fabrication costs, delivery costs, and installation costs for both barriers.

Table 2 – Construction Cost Estimates

Item	Material and Fabrication	Delivery	Installation	Contingency (40%)	Total Cost
Interior Barrier	$ 178,000	$ 4,000	$ 430,000	$ 245,000	$ 857,000
Exterior Barrier – Galvanized Steel	$ 694,000	$ 32,000	$ 511,000	$ 495,000	$ 1,732,000
Exterior Barrier - Aluminum	$ 657,000	$ 32,000	$ 511,000	$480,000	$1,680,000

As depicted in the table above, the aluminum exterior barrier is marginally less expensive than the steel exterior. This difference in estimated cost can largely be accounted for in the galvanizing process required for the steel components. If anodizing is selected for the aluminum option, it is expected the costs may become very similar for the two material options. As previously discussed, the extent of damping required for the aluminum option may also have unexpected costs associated with the analysis, design, fabrication, and installation of mass dampers.

6.2 LIFE CYCLE COST ANALYSIS

In order to evaluate and compare the life cycle cost performance of the steel and aluminum exterior barrier options, as well as the interior barrier, a life cycle cost analysis was performed, which can be found in Appendix D. The life cycle analysis considers a life cycle of 125 years to match the design life of the Burgoyne Bridge itself. Due to the life span differences between the galvanized steel, aluminum, and stainless steel, different material life spans and replacement years were selected based on an expected service life of the respective material. The cost analysis also considers periodic replacement

of a certain percentage of the barrier components to account for damage, vandalism, or localized excessive corrosion. Table 3 below summarizes the 125-year net present value costs associated with each barrier type.

Table 3 – Life Cycle Cost Analysis

Item	Life Cycle Cost: Net Present Value (NPV) at End of 125-year Life Cycle
Interior Barrier	$ 892,000
Exterior Barrier – Galvanized Steel	$ 2,465,000
Exterior Barrier - Aluminum	$ 1,984,000

Table 3 indicates that the aluminum exterior barrier option will have a lower 125-year NPV life cycle cost as compared to an equivalent steel barrier. This is largely due to the longer material life of aluminum which is expected to remain in service condition for a longer period than galvanized steel. Comparatively, the stainless-steel interior barrier has a much longer material life meaning that the increase in life cycle cost over the capital cost is negligible over the life cycle of the barrier.

7.0 SUMMARY AND RECOMMENDATIONS

Parsons has been contracted by the Regional Municipality of Niagara Public Works Department to investigate possible means prevention measures following several deaths by suicide and suicide attempts from the Burgoyne Bridge. Along with the Region's feedback, Parsons has selected two barrier types for use as means prevention on the Burgoyne Bridge based on case studies and feasibility analysis. It is understood that means prevention effectiveness is of utmost importance in the selection of appropriate barriers for use on the bridge.

Parsons is proposing two barriers for the bridge: an interior stainless-steel mesh net barrier which is mounted at the top of the parapet walls spanning horizontally between the two bridge decks, and an exterior cantilevered pipe barrier mounted on the exterior edges of the bridge. The interior barrier was selected as it completely removes the ability for a person to fall from the bridge, while minimizing impacts to the appearance and functionality of the structure. Stainless steel components ensure a long service life and utilizing the existing bridge railing anchor bolts minimizes the construction difficulty and schedule. The exterior barrier was selected primarily due to its effectiveness at providing means protection. By utilizing cantilevered vertical members, the ability of a person to use hand holds to scale the barrier is removed. This barrier option is optimal for providing a sense of imperviousness which will help deter individuals from attempting to climb the barrier.

Parsons also investigated the use of both galvanized steel and aluminum materials for the construction of the exterior barrier. While life cycle costs are higher than an equivalent aluminum barrier (with similar initial construction costs), many precedents of steel pipe barriers indicate that other designers and owners have determined galvanized steel to be the most effective and efficient material for constructing such a barrier. While aluminum has been used in bridge railing systems, there have been no identified cantilevered pipe means prevention barriers constructed with this material. If aluminum is determined to be the selected material for this barrier, additional effort will be required. While both materials are expected to be feasible for the proposed exterior barrier, further analysis will be required during detailed design.

Report Prepared by:

Brent I. Archibald, P.Eng.

Senior Structural Engineer, Bridges

Report Reviewed by:

Sardar A. Nabi, M.S., P.E., P.Eng.

Program Director, Bridges

REFERENCES

Brown, S. (2016, November 8). Suicide-prevention fence being installed on Burrard Bridge this week. Retrieved from https://vancouversun.com/news/local-news/suicide-prevention-fence-being-installed-on-burrard-bridge-this-week

City of Vancouver. (2017, February 17). *City of Vancouver completes west side upgrades to Burrard Bridge* [Photograph]. Retrieved from https://www.kitsilano.ca/2017/02/17/city-of-vancouver-completes-west-side-upgrades-to-burrard-bridge/

Draper, J. (2017, January). *Suicide prevention on bridges: The national suicide prevention lifeline position*. National Suicide Prevention Lifeline.

Ironworkers Memorial Bridge [Map]. (2018, August). Retrieved from https://www.google.com/maps/@49.2967686,-123.0262912,3a,37.6y,131.32h,86.87t/data=!3m6!1e1!3m4!1sPbwevzgvo_xwSIZX0g0Cyw!2e0!7i16384!8i8192

McQuigge, M. (2017, June 20). Barrier at Bloor Street Viaduct significantly reduced suicides, study suggests. Retrieved from https://www.thestar.com/news/gta/2017/06/20/barrier-at-bloor-street-viaduct-significantly-reduced-suicides-study-suggests.html

Saltman, J. (2017, June 8). Metro Vancouver police chiefs call for suicide-prevention barriers on bridges. Retrieved from https://vancouversun.com/news/local-news/metro-vancouver-police-chiefs-call-for-suicide-prevention-barriers-on-bridges

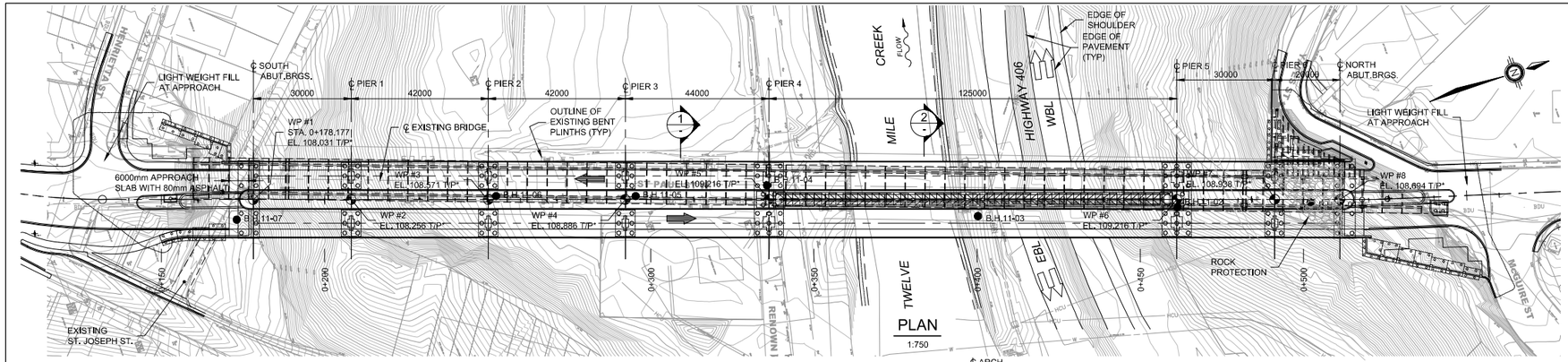
Suicide attempts on High Level Bridge down since barriers installed, city says. (2017, June 13). Retrieved from https://www.cbc.ca/news/canada/edmonton/suicide-attempts-on-high-level-bridge-down-since-barriers-installed-city-says-1.4158308

Swan, R. (2018, August 4). Golden Gate Bridge suicide barrier construction begins. Retrieved from https://www.sfchronicle.com/bayarea/article/Golden-Gate-Bridge-suicide-barrier-construction-13131352.php

Toronto Public Health. (2018, May). Interventions to prevent suicide from bridges: An evidence review and jurisdictional scan.

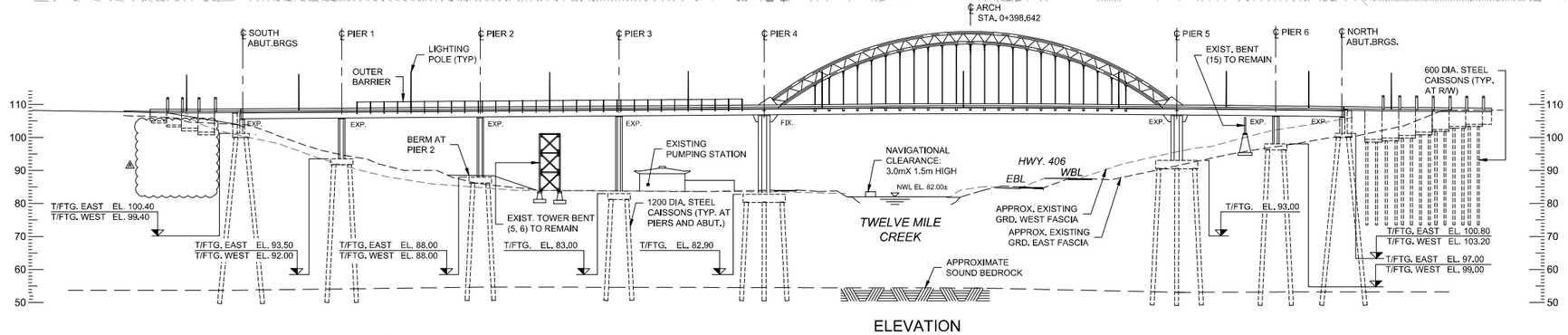
APPENDIX A

BURGOYNE BRIDGE GENERAL ARRANGEMENT



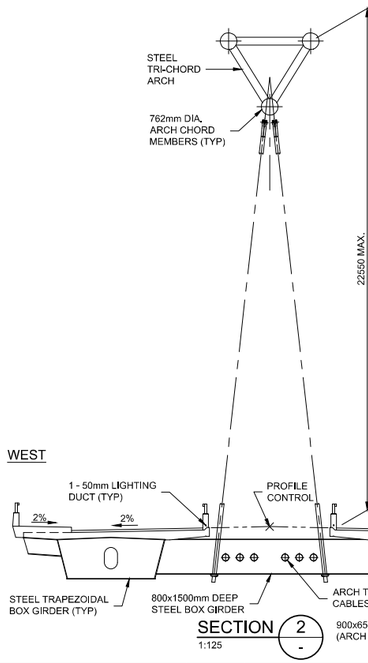
PLAN

1:750

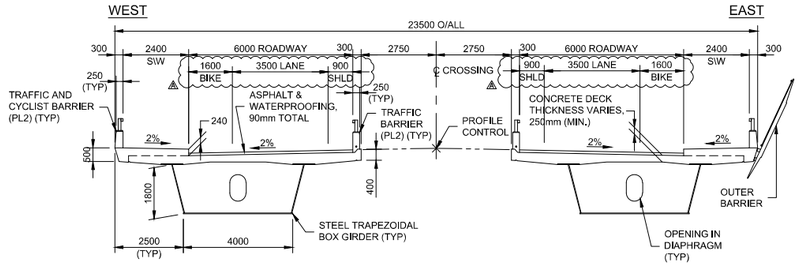


ELEVATION

1:750

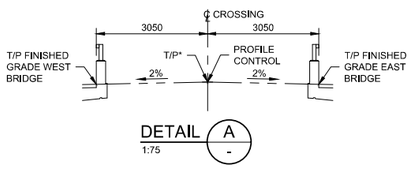


SECTION 2 - 1:125

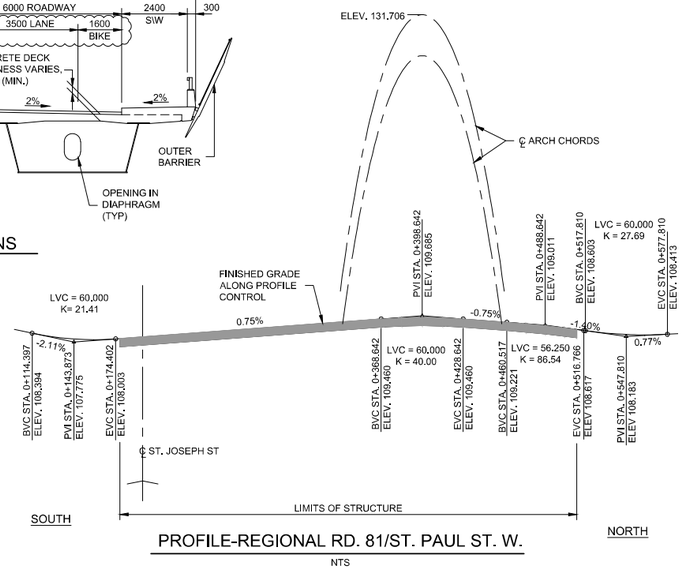


SECTION 1 - TYPICAL DIMENSIONS

1:100



DETAIL A - 1:75



PROFILE-REGIONAL RD. 81/ST. PAUL ST. W.

NTS

GENERAL NOTES:

DESIGN LOADS

BRIDGE:

- CL-625-ONT TRUCK LOAD, CL-625-ONT LANE LOAD.

SIDEWALK:

- PEDESTRIAN LOADS AND MAINTENANCE VEHICLE OF CHBDC S6-06.

CLASS OF CONCRETE

THRUST BLOCKS ..... 40 MPa
FOOTINGS, CAISSONS AND TOPPING SLABS ..... 30 MPa
REMAINDER (UNLESS OTHERWISE NOTED) ..... 35 MPa

- THE MAXIMUM NOMINAL SIZE OF AGGREGATE IN SIDEWALK SHALL NOT EXCEED 13.0mm.

CLEAR COVER TO REINFORCING STEEL

FOOTINGS & CAISSONS ..... 100 ± 20mm
DECK & SIDEWALK:
TOP & SIDES (STAINLESS STEEL REINFORCING) ..... 60 ± 10mm
BOTTOM (BLACK STEEL REINFORCING) ..... 50 ± 10mm
REMAINDER ..... 70 ± 20mm
UNLESS OTHERWISE SPECIFIED

REINFORCING STEEL

1. REINFORCING SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
2. STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500MPa, UNLESS OTHERWISE SPECIFIED
3. BARS MARKED WITH PREFIX "S" DENOTE STAINLESS STEEL BARS.
4. UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES SHALL BE CLASS B.
5. BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STRRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE MTO STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.

CONSTRUCTION NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE. CHAINAGES AND ELEVATIONS ARE IN METRES,
2. MAINTAIN FULL NAVIGATIONAL CLEARANCE THROUGHOUT CONSTRUCTION.
3. THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.

LEGEND:

WP	DENOTES WORKING POINT
T/P*	DENOTES THEORETICAL TOP OF PAVEMENT AT PROFILE CONTROL (SEE DETAIL "A")
U/S	DENOTES UNDERSIDE
S/W	DENOTES SIDEWALK
R/W	DENOTES RETAINING WALL
T/FTG	DENOTES TOP OF FOOTING

REFERENCE DRAWINGS

DRAWINGS OF THE EXISTING BRIDGE MAY BE VIEWED FOR INFORMATION PURPOSES AT THE OFFICES OF THE CITY OF ST. CATHERINES. ALL DIMENSIONS SHOWN ON REFERENCE DRAWINGS SHALL BE CONSIDERED APPROXIMATE.

THE PREFIX RR81-ST SHALL BE APPLIED TO ALL DRAWING NUMBER REFERENCES.

BENCHMARK

ELEVATION: 111.886
STATION: 00163U3519
N:4,778,711.270 E:642,154.302

APPLICABLE STANDARD DRAWINGS:

OPSD-3329.100	DECK, REINFORCEMENT SUPPORTS FOR REINFORCING STEEL FOR SLABS DEPTHS 300mm OR LESS
OPSD-3349.100	DECK, DRAINS DRAINAGE OF NEW DECK BELOW ASPHALT WEARING SURFACE
OPSD-3941.200	FIGURES IN CONCRETE, SITE NUMBER AND DATE LAYOUT
OPSD-3950.100	JOINTS, CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE

NO.	REVISION	DATE	INIT.
A	AS-BUILT	2018-08-31	BIA

NOTES/LEGEND

1 THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

2 PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.

3 DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN. ELEVATIONS AND STATIONS ARE IN METRES.

DRAFTING	KRS
DESIGN	SS
CHECKED BY	BIA
APPROVED BY	

Niagara Region PUBLIC WORKS

PARSONS

RN-13-04
BURGOYNE BRIDGE REPLACEMENT
CITY OF ST. CATHARINES

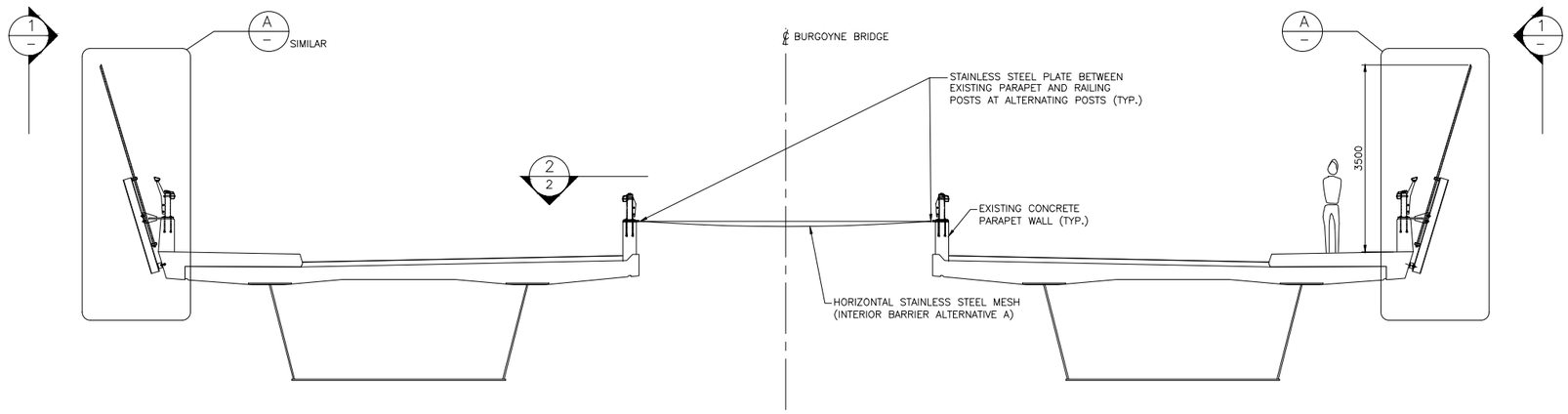
GENERAL ARRANGEMENT

CONSULTANT FILE No.	BT3316
DATE	2013-08-27
SCALE	AS SHOWN
REF. No.	
DWG No.	RR81-ST01
REV.	A

DRAWING FILE: J:\TOR\BT3331\BT\Docs\As-Built Drawings\Structural\RR81-ST01 - General Arrangement.dwg PLOTTED: Aug 09, 2018 - 8:57am PLOTTED BY: p001624D

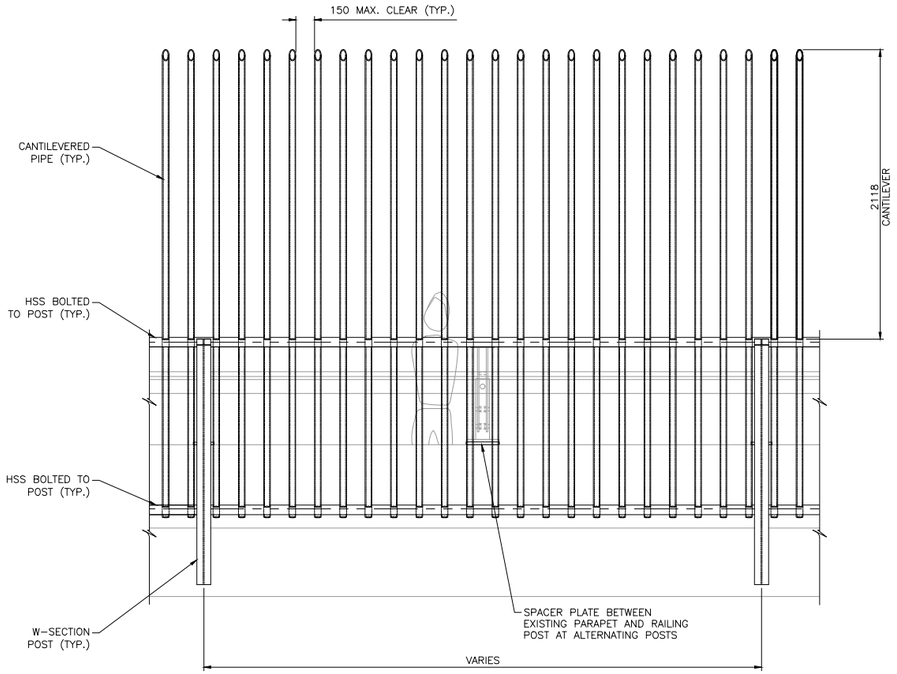
APPENDIX B

BARRIER ALTERNATIVES – DRAWINGS

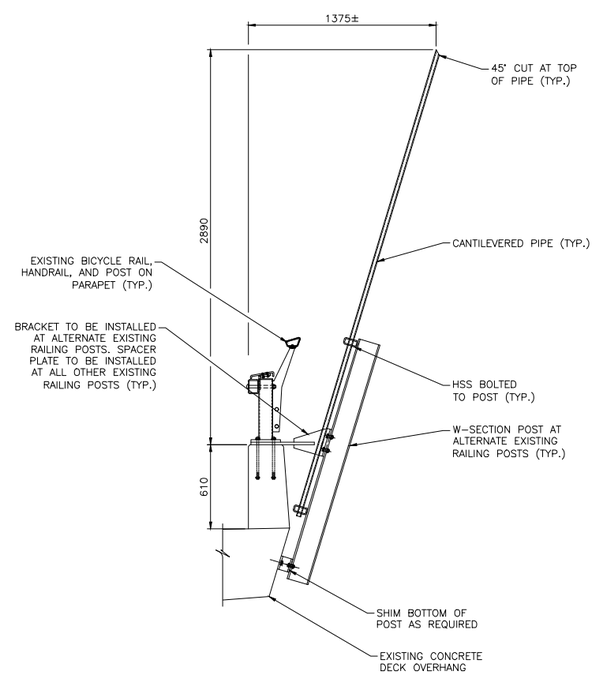


SECTION – EXTERIOR BARRIER ALTERNATIVE 1, INTERIOR BARRIER ALTERNATIVE A

1:50



SECTION 1 / – 1:20



DETAIL A / – 1:20

NOT FOR CONSTRUCTION

NO.	REVISION	DATE	INIT.
---	---	---	---

NOTES:
1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN. ELEVATIONS ARE IN METRES.

DRAFTING	R.S.
DESIGN	B.I.A.
CHECKED BY	– –
APPROVED BY	

Niagara Region PUBLIC WORKS

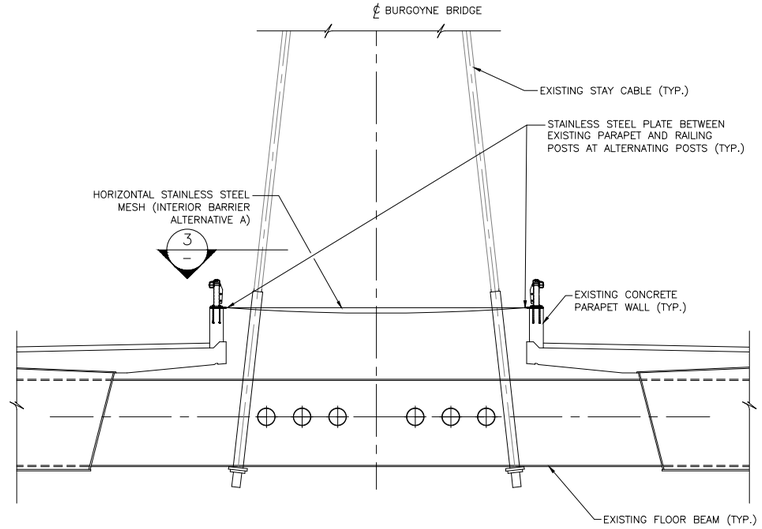
PARSONS

2013-T-104 (RN-13-04)
BURGOYNE BRIDGE REPLACEMENT
CITY OF ST. CATHARINES

MEANS PREVENTION BARRIER ALTERNATIVE 1

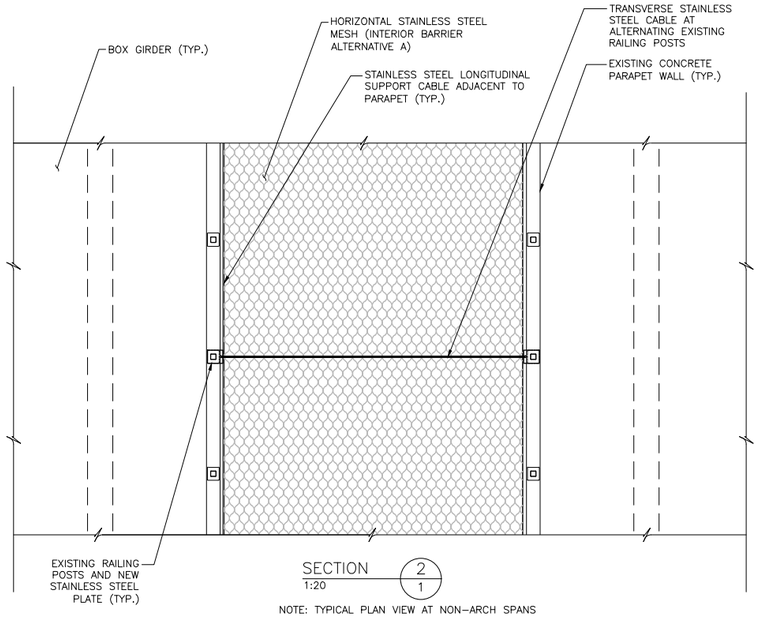
CONSULTANT FILE No.	-----
DATE	YYYY–MM–DD
SCALE	AS SHOWN
REF. No.	
DWG No.	1
REV.	A

DRAWING FILE: J:\TOR\477029 Burgoyne Prevention Barrier\BT\Drawings\Burgoyne Bridge Means Prevention Barrier.dwg PLOTTED: Mar 26, 2019 – 2:06pm PLOTTED BY: p009244C

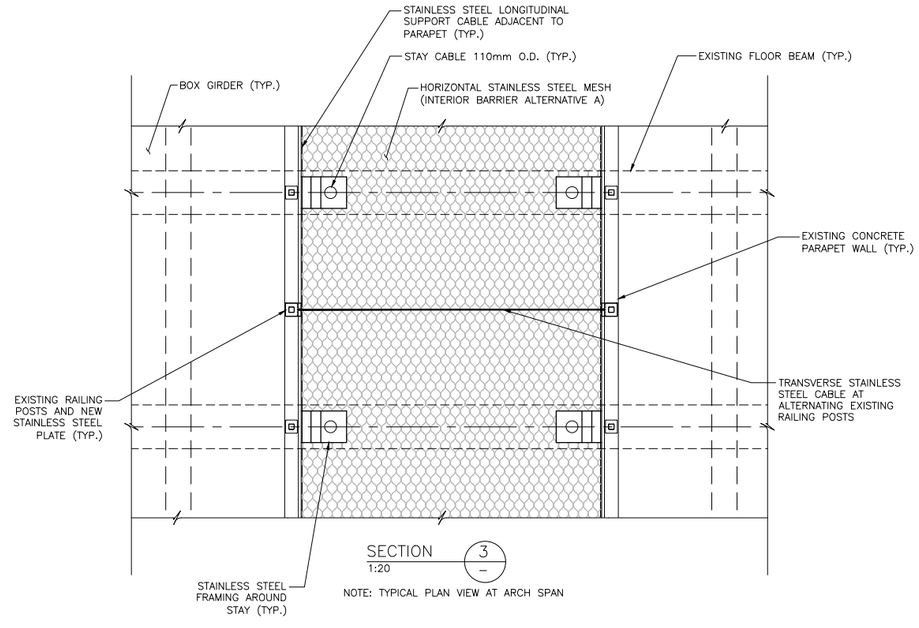


SECTION AT MAIN SPAN – EXTERIOR BARRIER ALTERNATIVE 1, INTERIOR BARRIER ALTERNATIVE A

1:50



NOTE: TYPICAL PLAN VIEW AT NON–ARCH SPANS



NOTE: TYPICAL PLAN VIEW AT ARCH SPAN

NOT FOR CONSTRUCTION

NO.	REVISION	DATE	INIT.
---	---	---	---

NOTES:
1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN. ELEVATIONS ARE IN METRES.

DRAFTING	R.S.
DESIGN	B.I.A.
CHECKED BY	– –
APPROVED BY	

Niagara Region PUBLIC WORKS

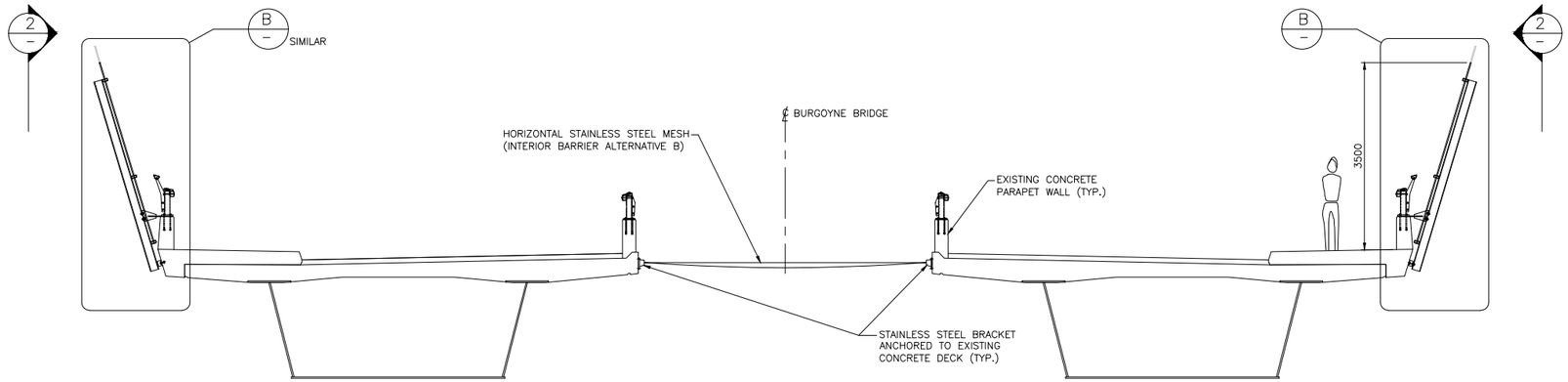
PARSONS

2013-T-104 (RN-13-04)
BURGOYNE BRIDGE REPLACEMENT
CITY OF ST. CATHARINES

MEANS PREVENTION BARRIER ALTERNATIVE 1

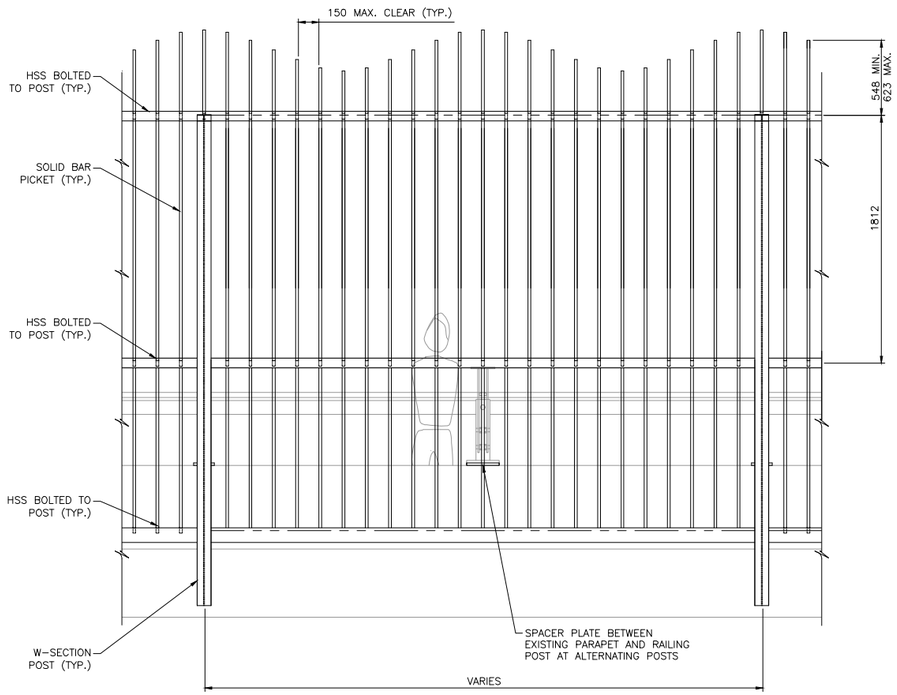
CONSULTANT FILE No.	-----
DATE	YYYY–MM–DD
SCALE	AS SHOWN
REF. No.	
DWG No.	2
REV.	A

DRAWING FILE: J:\TOR\477029 Burgoyne Prevention Barrier\BT\Drawings\Burgoyne Bridge Means Prevention Barrier.dwg PLOTTED: Mar 26, 2019 – 5:25pm PLOTTED BY: p009244C

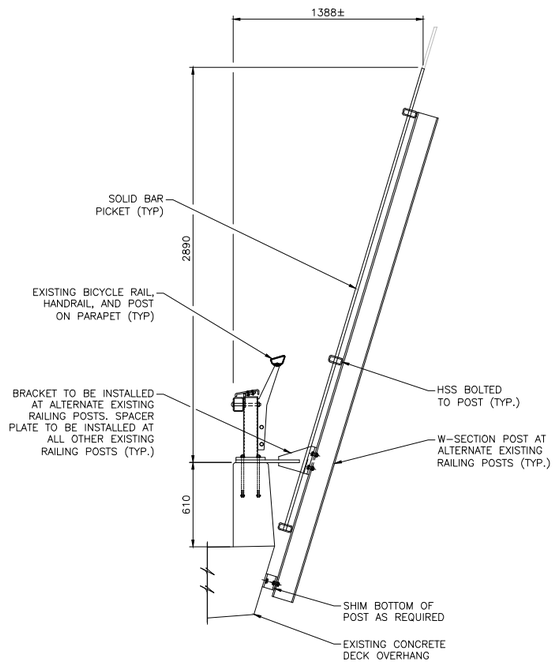


SECTION – EXTERIOR BARRIER ALTERNATIVE 2, INTERIOR BARRIER ALTERNATIVE B

1:50



SECTION 2 / 1:20



DETAIL B / 1:20

NOT FOR CONSTRUCTION

NO.	REVISION	DATE	INIT.
---	---	---	---

NOTES:
1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN. ELEVATIONS ARE IN METRES.

DRAFTING A.F.N
DESIGN --
CHECKED BY --
APPROVED BY --

Niagara Region PUBLIC WORKS

PARSONS

2013-T-104 (RN-13-04)
BURGOYNE BRIDGE REPLACEMENT
CITY OF ST. CATHARINES

MEANS PREVENTION BARRIER ALTERNATIVE 2

CONSULTANT FILE No. -----
DATE YYYY–MM–DD
SCALE AS SHOWN
REF. No.
DWG No. 3
REV. A

DRAWING FILE: J:\TOR\477029 Burgoyne Prevention Barrier\BT\Drawings\Burgoyne Bridge Means Prevention Barrier.dwg PLOTTED: Mar 26, 2019 – 12:38pm PLOTTED BY: p009244C

APPENDIX C

COST ESTIMATES

Galvanized Exterior Barrier Total Cost

Total barrier length	666	m	Fabrication rate	16	hrs/pcs
Panel size (average)	4.1	m/panel	Installation rate	5	pcs/day
Total number of panels	162	pcs	Metal tonnage	51598	kg

Cost items		Quantity		Unit rate		Amount
Fabrication and shop work		2592	hrs	$ 75.00	/hr	$ 194,000.00
Galvanizing		51598	kg	$ 2.00	/kg	$ 103,000.00
Delivery cost		162	pcs	$ 200.00	/pcs	$ 32,000.00
Site erection costs	in hours:	264	hrs	$ 800.00	/hr	$ 211,000.00
	in days:	33	working days			
Equipment rental		1	sum	$ 300,000.00		$ 300,000.00
				Construction subtotal		$ 840,000.00
				Material subtotal		$ 397,000.00
				Exterior barrier subtotal		$ 1,237,000.00
				40% Contigency		$ 495,000.00
				Exterior barrier total		$ 1,732,000.00
				Cost/m		$ 5,200.00

Interior Barrier Total Cost

Total span length	333	m			
Panel size (average)	20	m/panel	Anchorage installation	10	days
Total number of panels	17	pcs	Metal tonnage	1407	kg
Border and intermediate cab	760	m	Installation rate	1	pcs/day

Cost items		Quantity		Unit rate		Amount
Freight		1	sum	$ 4,000.00		$ 4,000.00
Site erection costs	in hours:	216	hrs	$ 600.00	/hr	$ 130,000.00
	in days:	27	working days			
Equipment rental		1	sum	$ 300,000.00		$ 300,000.00
				Construction subtotal		$ 434,000.00
				Material subtotal		$ 178,000.00
				Interior barrier subtotal		$ 612,000.00
				40% Contigency		$ 245,000.00
				Interior barrier total		$ 857,000.00
				Cost/m		$ 2,600.00

Total cost

Exterior and Interior subtotal	$	1,849,000.00
40% Contigency	$	740,000.00
Total	$	2,589,000.00
Total cost/m	$	7,800.00

Aluminum Exterior Barrier Total Cost

Total barrier length	666	m	Fabrication rate	16	hrs/pcs
Panel size (average)	4.1	m/panel	Installation rate	5	pcs/day
Total number of panels	162	pcs	Metal tonnage	35783	kg

Cost items		Quantity		Unit rate		Amount
Fabrication and shop work		2592	hrs	$ 90.00	/hr	$ 233,000.00
Delivery cost		162	pcs	$ 200.00	/pcs	$ 32,000.00
Site erection costs	in hours:	264	hrs	$ 800.00	/hr	$ 211,000.00
	in days:	33	working days			
Equipment rental		1	sum	$ 300,000.00		$ 300,000.00
					Construction subtotal	$ 776,000.00
					Material subtotal	$ 424,000.00
					Exterior barrier subtotal	$ 1,200,000.00
					40% Contigency	$ 480,000.00
					Exterior barrier total	$ 1,680,000.00
					Cost/m	$ 5,000.00

Interior Barrier Total Cost

Total span length	333	m			
Panel size (average)	20	m/panel	Anchorage installation	10	days
Total number of panels	17	pcs	Metal tonnage	1407	kg
Border and intermediate cab	760	m	Installation rate	1	pcs/day

Cost items		Quantity		Unit rate		Amount
Freight		1	sum	$ 4,000.00		$ 4,000.00
Site erection costs	in hours:	216	hrs	$ 600.00	/hr	$ 130,000.00
	in days:	27	working days			
Equipment rental		1	sum	$ 300,000.00		$ 300,000.00
					Construction subtotal	$ 434,000.00
					Material subtotal	$ 178,000.00
					Interior barrier subtotal	$ 612,000.00
					40% Contigency	$ 245,000.00
					Interior barrier total	$ 857,000.00
					Cost/m	$ 2,600.00

Total cost

Exterior and Interior subtotal	$ 1,812,000.00
40% Contigency	$ 725,000.00
Total	$ 2,537,000.00
Total cost/m	$ 7,600.00

Cost Estimate - Exterior Barrier - Material Cost

Galvanized Steel						
Alternative 1: Cantilevered Pipes						
Item	**Unit**	**Unit Cost**	**Quantity**	**Total Cost**	**Linear Cost ($/m)**	**Comments**
Pipe	m	$ 11.10	12622	$ 140,000.00	$ 420.00	48mm OD, 190mm C/C spacing
Horizontal HSS	kg	$ 5.00	26640	$ 133,000.00	$ 400.00	2 HSS per barrier
W-Section Post	kg	$ 5.00	10490	$ 52,000.00	$ 160.00	Installed at every other existing pedestrian railing post. Half-height post.
Filler Plate	kg	$ 5.00	1987	$ 10,000.00	$ 30.00	At all existing pedestrian posts without new bracket
Upper Bracket	kg	$ 5.00	6600	$ 33,000.00	$ 100.00	Installed at every new barrier post
Lower Bracket	kg	$ 5.00	5882	$ 29,000.00	$ 90.00	Installed at every new barrier post
			Material subtotal	$ 397,000.00	$ 1,200.00	

Aluminum						
Alternative 1: Cantilevered Pipes						
Item	**Unit**	**Unit Cost**	**Quantity**	**Total Cost**	**Linear Cost ($/m)**	**Comments**
Pipe	m	$ 13.62	11419	$ 156,000.00	$ 470.00	60mm OD, 210mm C/C spacing
Horizontal HSS	kg	$ 7.50	19980	$ 150,000.00	$ 450.00	2 HSS per barrier
W-Section Post	kg	$ 7.50	8991	$ 67,000.00	$ 200.00	Installed at every other existing pedestrian railing post. Half-height post.
Filler Plate	kg	$ 7.50	936	$ 7,000.00	$ 20.00	At all existing pedestrian posts without new bracket
Upper Bracket	kg	$ 7.50	3108	$ 23,000.00	$ 70.00	Installed at every new barrier post
Lower Bracket	kg	$ 7.50	2769	$ 21,000.00	$ 60.00	Installed at every new barrier post
			Material subtotal	$ 424,000.00	$ 1,270.00	

Cost Estimate - Interior Barrier - Material Cost

Alternative 1: Steel Mesh Net						
Component	**Unit**	**Unit Cost**	**Quantity**	**Total Cost**	**Linear Cost ($/m)**	**Comments**
Steel mesh net	m^2	$ 75.00	1900	$ 143,000.00	$ 430.00	AISI 316 stainless steel, mesh size 180 mm
End bracket	pcs	$ 200.00	34	$ 7,000.00	$ 20.00	Custom, stainless steel, every 10m at cable termination
Intermediate bracket	pcs	$ 150.00	134	$ 20,000.00	$ 60.00	Custom, stainless steel, every 5m between cable attachments
Border cable	m	$ 7.00	760	$ 5,000.00	$ 20.00	DIA 8, AISI 316 stainless steel, Fu = 52.8 kN
Turnbuckle	pcs	$ 30.00	49	$ 1,000.00	$ 3.00	AISI 316 stainless steel
Cable end attachment	pcs	$ 25.00	98	$ 2,000.00	$ 10.00	For DIA 8 cable, AISI 316
			Material subtotal	$ 178,000.00	$ 543.00	

APPENDIX D

LIFE CYCLE COST ANALYSIS

Life Cycle Cost Analysis - Burgoyne Means Prevention Barrier

Site:	Burgoyne Bridge
Exterior barriers (total length)	666 m

Alternative 1: Galvanized		
Year	**Activity**	
0	New construction	
15	Picket repair: replacement and/or miscellaneous repair	10% of total length
30	Full replacement	
45	Picket repair: replacement and/or miscellaneous repair	10% of total length
60	Full replacement	
75	Picket repair: replacement and/or miscellaneous repair	10% of total length
90	Full replacement	
105	Picket repair: replacement and/or miscellaneous repair	10% of total length
120	Full replacement	
125	End of service life	

Alternative 2: Aluminum		
Year	**Activity**	
0	New construction	
20	Picket repair: replacement and/or miscellaneous repair	15% of total length
40	Full replacement	
60	Picket repair: replacement and/or miscellaneous repair	15% of total length
80	Full replacement	
100	Picket repair: replacement and/or miscellaneous repair	15% of total length
120	Full replacement	
125	End of service life	

Activity Cost Estimates

Alternative 1: Galvanized

Activity	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
New Construction	-	-	-	$ 1,732,000.00
Picket Repair	67	m	$ 5,200.00	$ 346,320.00
Full Replacement	-	-	-	$ 1,732,000.00

Alternative 2: Aluminum

Activity	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
New Construction	-	-	-	$ 1,680,000.00
Picket Repair	100	m	$ 5,000.00	$ 499,500.00
Full Replacement	-	-	-	$ 1,680,000.00

Discount Rate =	5.00%

Residual Value Analysis

Alternative	Replacement Year	Replacement Cost	Residual Year	Value at End of Life Cycle	Residual Value at End of Cycle	Residual Value at Year Zero
1	120	$ 1,732,000.00	25	$ 511,464.40	$ (1,220,535.60)	$ (3,498.12)
2	120	$ 1,680,000.00	35	$ 304,567.68	$ (1,375,432.32)	$ (3,942.06)

Present Value Analysis (Level 3)

Year	Alternative 1: Galvanized		Alternative 2: Aluminum	
	Cost	Present Value (PV)	Cost	Present Value (PV)
0	$ 1,732,000.00	$ 1,732,000.00	$ 1,680,000.00	$ 1,680,000.00
15	$ 346,320.00	$ 166,585.84	$ -	$ -
20	$ -	$ -	$ 499,500.00	
30	$ 1,732,000.00	$ 400,745.74	$ -	$ -
40	$ -	$ -	$ 1,680,000.00	$ 238,636.75
45	$ 346,320.00	$ 38,544.21		
60	$ 1,732,000.00	$ 92,723.53	$ 499,500.00	$ 26,740.99
75	$ 346,320.00	$ 8,918.26	$ -	$ -
80	$ -	$ -	$ 1,680,000.00	$ 33,897.32
90	$ 1,732,000.00	$ 21,454.13	$ -	$ -
100	$ -	$ -	$ 499,500.00	$ 3,798.44
105	$ 346,320.00	$ 2,063.48	$ -	$ -
120	$ 1,732,000.00	$ 4,964.00	$ 1,680,000.00	$ 4,814.97
125	$ -	$ -	$ -	$ -
	Total Present Value (TPV) =	$ 2,467,999.20		$ 1,987,888.47
	Residual Value (RV) =	$ (3,498.12)		$ (3,942.06)
	Net Present Value (NPV) =	**$ 2,465,000.00**		**$ 1,984,000.00**

Life Cycle Cost Analysis - Burgoyne Means Prevention Barrier

Site:	Burgoyne Bridge	
Interior barrier (total length)	333	m

Steel Mesh Net		
Year	**Activity**	
0	New construction	
38	Partial repair & maintenance: replacement and/or miscellaneous repair	10% of total length
75	Full replacement	
113	Partial repair & maintenance: replacement and/or miscellaneous repair	10% of total length
125	End of service life	

Activity Cost Estimates

Steel Mesh Net

Activity	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
New Construction	-	-	-	$ 857,000.00
Repair	33	m	$ 2,600.00	$ 86,580.00
Full Replacement	-	-	-	$ 857,000.00

Discount Rate =	5.00%

Residual Value Analysis

System	Replacement Year	Replacement Cost	Residual Year	Value at End of Life Cycle	Residual Value at End of Cycle	Residual Value at Year Zero
Steel mesh net	120	$ 857,000.00	25	$ 253,074.48	$ (603,925.52)	$ (1,730.88)

Present Value Analysis (Level 3)

Year	Steel Mesh Net	
	Cost	Present Value (PV)
0	$ 857,000.00	$ 857,000.00
37.5	$ 86,580.00	$ 13,893.73
75	$ 857,000.00	$ 22,069.04
113	$ 86,580.00	$ 357.78
125	$ -	$ -
Total Present Value (TPV) =		$ 893,320.55
Residual Value (RV) =		$ (1,730.88)
Net Present Value (NPV) =		**$ 892,000.00**

Niagara Region

Public Health & Emergency Services
1815 Sir Isaac Brock Way, Thorold, ON L2V 4T7
905-980-6000 Toll-free: 1-800-263-7215

MEMORANDUM

Appendix 3: PW 24-2019

Subject: Update on Need for Means Protection on Infrastructure in St. Catharines

Date: April 1, 2019

To: Public Works Committee

From: M. Mustafa Hirji, Medical Officer of Health & Commissioner (Acting)

Pursuant to Regional Council's request during approval of the Capital Budget at their meeting of Feb. 28, 2019, this memo provides an update as well as my current recommendation on the need for means protection at the element of infrastructure in St. Catharines where there have been several deaths by suicide.

Background and Current Situation

From October 2018 to December 2018, there were three deaths by suicide and at least one significant attempt from the infrastructure element in St. Catharines. In response to this, at PHSSC on Jan. 8, 2019, PHD 03-2019 recommended proceeding with planning to build a barrier to prevent deaths by suicide, while reserving a final decision until later in the year.

Councillors identified that the risk of deaths by suicide and urgency for a barrier was too great to defer the final decision. Committee therefore approved building of the barrier, which was subsequently endorsed by Council on Jan. 17, 2019. Council also amended the proposed Capital Budget to include a project budget to build this barrier, with that budget approved by Council on Feb. 28, 2019.

Since the Jan. 8, 2019 meeting, there have been three additional deaths by suicide in less than three months.

The rate of deaths by suicide at this location has therefore continued these past three months at the rate from the previous three months.

This rate, slightly greater than one death per month, would be the second highest in North America were it to become the new norm.

Scientific Evidence for Barriers

Recent scientific research finds that barriers are the most effective strategy to prevent deaths by suicide from falling from infrastructure:

- One 2015 review of all published research on suicide prevention identified means protection measures (barriers being the means protection barrier when falling

from infrastructure) to be the most effective strategy for suicide prevention, at least five time more effective than any other strategy[1].
- One 2014 review conducted by the McMaster Health Forum (Hamilton, Ontario) similarly found means protection to be in the set of most effective strategies for suicide prevention.[2]

As well, scientific evidence consistently shows that barriers do not just lead to people dying by suicide at alternate locations:
- A 2016 and a 2013 review combining the results of all previously published studies showed that while a barrier may cause some individuals to attempt to die by suicide by another means or at another location, many persons are prevented entirely from dying by suicide.[3,4]
- A 2017 study showed that a barrier erected to prevent suicide from a location in Toronto led to effective elimination of deaths at that location, with no increase in deaths by other causes or at other locations—i.e these deaths were completely prevented.[5]

Cost Effectiveness of Barriers

Members of Council have debated the cost effectiveness of a barrier as compared to other potential strategies.

It should be emphasized that the barrier is a capital expenditure, and most other measures Council might fund would be operating expenditures. Money budgeted for the barrier cannot be reallocated to funding different operating measures. A complementary process is underway to examine possible operating expenditures through report *PHD 08-2019*.

Nonetheless, for Council's information, I am sharing some scientific evidence cost effectiveness here.

[1] Jane Pirkis, Lay San Too, Matthew J Spittal, Karolina Krysinska, Jo Robinson, Yee Tak Derek Cheung. "Interventions to reduce suicides at suicide hotspots: a systematic review and meta-analysis". *Lancet Psychiatry*. 2015; 2: 994–1001. doi:10.1016/S2215-0366(15)00266-7
[2] Hirji MM, Wilson MG, Yacoub K, Bhuiya A. Rapid Synthesis: Identifying Suicide-prevention Interventions. Hamilton, Canada: McMaster Health Forum, 30 June 2014.
[3] Gil Zalsman *et al*. *Suicide prevention strategies revisited: 10-year systematic review*. *Lancet Psychiatry* 2016; 3: 646–59 Published Online June 8, 2016 http://dx.doi.org/10.1016/ S2215-0366(16)30030-X
[4] Jane Pirkis, Matthew J Spittal, Georgina Cox, Jo Robinson, Yee Tak Derek Cheung, and David Studdert. The effectiveness of structural interventions at suicide hotspots: a meta-analysis. *International Journal of Epidemiology 2013;42:541–548. doi:10.1093/ije/dyt021*
[5] Sinyor M, Schaffer A, Redelmeier DA, et al. Did the suicide barrier work after all? Revisiting the Bloor Viaduct natural experiment and its impact on suicide rates in Toronto. *BMJ Open* 2017;7:e015299. doi:10.1136/bmjopen-2016-015299

A rigorous and precise comparison of costs is not possible here given that evidence of cost-effectiveness comes from different jurisdictions and different local contexts. Direct comparison of these costs is not precise. Nonetheless, in the table below are some rough approximations of cost-effectiveness that give a sense of the scale of cost of various measures.

Suicide Prevention Measure	**Proportion of Deaths Prevented**	**Cost per Life Saved**
Media Reporting Guidelines	1%[6]	$1,000[7]
Means Prevention Barriers	86%[8]	$50,000[9]
Patrolling Attendant Intervening	No Evidence Found	$135,000[10]
Primary Care Mental Health Intervention	2.5%[11]	$244,000[12]
School-based Suicide Prevention	1%[13]	$1,750,000[14]

As noted, the cost-effectiveness depends greatly on the local conditions. E.g. the media reporting guidelines cost is assuming there is no cycle of contagion fueled in part by media reporting. Were that to exist, significantly more than 1% of deaths might be prevented, and the cost per life saved would fall much lower.

Similarly, the $50,000 per life saved for a barrier is assuming a rate of one death every two years over an assumed 80 year lifespan for the $4 million infrastructure. That is significantly less often than the rate of 12 per year that has been observed the past six months, in which case cost-effectiveness would be closer to $2,000 per life saved.

[6] Mark Sinyor *et al*. *Media Guidelines for Reporting on Suicide: 2017 Update of the Canadian Psychiatric Association Policy Paper*. 2017.
[7] World Health Organization. *Preventing suicide: a global imperative*. 2014. Assumed minimum 25 life years saved from prevented death by suicide.
[8] Zalsman *et al*.
[9] Assumption of 1 attempted death every 2 years, over 80 years, for a cost of $4 million.
[10] Cost of minimum wage employees ($14 per hour) to cover 24 hours a day for an entire year. Assumed 10% payroll-related costs.
[11] Ingrid Zechmeister, Reinhold Kilian, David McDaid and the MHEEN. “Is it worth investing in mental health promotion and prevention of mental illness? A systematic review of the evidence from economic evaluations group”. *BMC Public Health* 2008, 8:20 doi:10.1186/1471-2458-8-20
[12] Zechmeister *et al*. $183,000 US converted to $244,000 Canadian.
[13] S. Ahern *et al*. “A cost-effectiveness analysis of school-based suicide prevention Programmes. *European Child & Adolescent Psychiatry*. 2018. https://doi.org/10.1007/s00787-018-1120-5
[14] Ahern *et al*. 47,017 Euros converted to $70,000 per attempt prevented. Factored in that only 1% of attempts are prevented, and attempts result in death 4% to 25% of the time.

Nonetheless, even with a very modest rate of death at the infrastructure in question, a barrier would be significantly more cost effective than most other strategies.

Recommendation

In considering my recommendation, I have again consulted with Dr. Mark Sinyor, Psychiatrist (Sunnybrook Hospital) and Assistant Professor of Psychiatry (University of Toronto) who is an international expert in both suicide contagion and suicide prevention.

Deaths by suicide at the location in St. Catharines have continued at a very frequent rate (effectively the second highest rate in North America) over the past three months. There is now a continuous six month trend.

There is no science to predict whether a location is likely to remain a suicide magnet or not. However, the longer the trend of frequent deaths, the more likely that a location will become a suicide magnet. Given the high profile and significant discourse associated with deaths over the past six months, it is very likely that the location in St. Catharines is now associated with suicide with much of the population. Therefore, it can be expected that some deaths will continue even if measures to prevent further contagion are taken. Even a 10-fold decline in the rate of deaths would leave this infrastructure as a significant suicide magnet.

Barriers are highly effective at preventing deaths by suicide, and they are also highly cost-effective, and much more so than other measures.

My recommendation, therefore, is that construction of a barrier should proceed. It will make a significant reduction to deaths by suicide, is the most cost-effective way to address the recent cycle of deaths by suicide, and demonstrate to the Niagara community Council's and Niagara Region's resolve to address mental illness.

Respectfully submitted and signed by

_____
M. Mustafa Hirji, MD MPH FRCPC
Medical Officer of Health & Commissioner (Acting)