

Building Better Bridges: An Asset Management Plan for Bridges & Structures



Bridges & Structures

INTRODUCTION

The City of Saskatoon's (City) bridges and structures inventory is composed of bridges, overpasses, pedestrian crossings, sound walls, retaining walls and chain-link fencing.

Preservation of the City's bridges and structures is funded from the Bridge Major Repair Reserve (BMRR). It was identified at its special meeting on December 4 and 5, 2012 through the 2012 – State of the Bridges Administrative report that the BMRR was underfunded. City Council resolved:

"That the bridges and structures preservation service level be established as Service Level "B", with a targeted annual investment level of \$5 million per year (2013 dollars), and additional one time contributions totalling approximately \$48 million (2013 dollars), over the next 10 years."

In 2016 dollars, the targeted contribution per the resolution of City Council in 2012 is \$5.33 million per year in base funding and \$52.3 million in one-time contributions.

The City has made significant progress in addressing this gap by increasing the annual base contribution to the BMRR from \$720,000 in 2012 to \$3.134 million in 2016 and has allocated a total of \$5.23 million in one-time funding from 2013-2016.

Although significant progress has been made to address the funding gap and resolution made by City Council in 2012, it has not been sufficient to meet ongoing long-term maintenance requirements.

CURRENT INVENTORY

The current inventory of the bridges and structures is \$948 million as detailed in Table 1 below.

Table 1: Bridges and Structures Inventory and Replacement Value

| Asset | Inventory | Replacement Cost |
|-------------------------|-----------|------------------|
| Bridges | 6 ea.* | \$485,000,000 |
| Overpasses | 49 ea. | \$371,000,000 |
| Pedestrian Crossing | 24 ea. | \$48,000,000 |
| Sound Attenuation Walls | 20 km | \$41,000,000 |
| Chain Link Fencing | 48 km | \$3,000,000 |
| Total | | \$948,000,000 |

*The six bridges include: Circle Drive North/42nd Street (considered two structures), University, Broadway, Idylwyld and Circle Drive South.

Bridges

For the purpose of this report, a bridge is a traffic crossing structure over a body of water.

Overpasses

An overpass is a traffic crossing structure over or under roadways and railways.

Pedestrian Crossing

A pedestrian crossing is a structure that allows pedestrians, cyclists and other walkway or trail users to cross over or under a major roadway, railway, body of water or other obstacle. Pedestrian crossings that are attached to a bridge or overpass adjacent to the road surfaces are not considered separately from the larger structure.

Sound Attenuation Walls

A sound attenuation wall is a barrier built alongside a railway, freeway or other high capacity roadway that reduces the impact of noise pollution to neighbouring properties.

Chain Link Fencing

Chain-link fencing included in this report is along road right-of-ways and prevent pedestrians from crossing onto the roadway. Chain-link fencing in parks and other areas are not considered in this report.

PHYSICAL CONDITION OF BRIDGES



Pedestrian Overpass from 23rd Street to 21st Street over 22nd Street



Campus Drive to Stadium



Circle Drive Cloverleaf

Condition ratings for bridges are on a five-point scale from "A" to "F", with a rating of "F" indicating a failed condition or severe deterioration and a rating of "A" signifying the structure is in Very Good condition or in a like new state. Table 2 outlines the structural condition rating which provides a general guide to the type of activities suggested by each rating. This particular rating system has been internally developed by the City.

Tables 2 and 3 outline the following two decisions to be made in order to proceed with an asset management plan.

1. What is the desired condition level?
2. How fast would City Council like to reach the desired condition level (expenditure level)?

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Table 2: Structural Condition Rating

| Rating | Physical Condition | Action |
|--------|--------------------|--|
| A | Very Good | No structural problems evident. Only monitoring and maintenance required. |
| B | Good | Minor deficiencies noted, monitoring and maintenance required. |
| C | Fair | Structures showing signs of deterioration. Corrosion is actively occurring in components of the structure. |
| D | Poor | Structure showing advanced deterioration. |
| F | Failed | Structure no longer capable of safely supporting design traffic loadings. |

It is difficult to illustrate the differences between very good, good and fair since not all structural defects are visible, as the overall conditions rating is based on the deck testing reports and the following testing: copper sulfate electrode equipotential survey, delamination testing, chloride testing (and reinforcing bar depth testing), and inspections.

All structures in the City's inventory are safe for public use regardless of physical condition rating and the City works diligently to ensure all structures remain serviceable with the preservation program. Each structure in the City's inventory is inspected annually by civic staff to identify critical defects that may require investigation and to determine if there are any safety concerns.

The preservation program rates the condition of each structure. A "Poor" Condition rating can still have the structure rated as safe for users, however, it describes a structure that all inspection, testing and maintenance activities indicate that the structure has advanced deterioration and a rehabilitation is required, typically within 2-5 years.

An example of a "Poor" condition structure was Idylwyld Drive over Ruth Street Overpass illustrated in the pictures below. While monitored, the overpass was still safe to the general public, however, advanced deterioration was identified and to ensure the structure could remain in service a rehabilitation was required. Defects were discovered through deck testing and were not visible until rehabilitation occurs. The program allowed the City to plan and rehabilitate the structure in 2016 and ensured the overpass will remain safe and serviceable into the future.

An example of a "failed" condition structure was the Traffic Bridge, which was closed to traffic in August 2010 following determination of advanced structural deterioration resulting in inability to certify the bridge as safe to remain open.



Severe corrosion on the reinforcing steel.



Disintegrated concrete and delaminations that became apparent once asphalt was removed.

EXPENDITURE LEVELS

The Administration evaluates the condition of the City's assets in order to develop annual programs to maintain the assets at a minimum cost. Condition assessments or evaluations are conducted and used to establish condition levels as well as develop annual capital improvement plans.

The level of service for each type of asset is defined; however, as the level of service increases for the asset, so does the cost of maintaining the asset. In order to be able to compare the level of investment for all assets corporate-wide, five levels of expenditures are identified below. It should be noted that expenditure levels are not condition assessments but lead to a change in the asset condition over time. "A" represents the highest level of expenditure and "F" represents no expenditure.

Table 3: Expenditure Levels

| Expenditure Level | Asset Condition | Description |
|-------------------|--------------------------------------|---|
| A | Getting Better Quickly | Sufficient expenditures to keep asset in the condition specified by City Council and to increase asset condition/value quickly over time. |
| B | Getting Better | Sufficient expenditures to keep asset in the condition specified by City Council and to increase asset condition/value slowly over time. |
| C | Maintain Assets in Current Condition | Sufficient expenditures to keep asset in constant condition over time. |
| D | Getting Worse | Insufficient expenditures to maintain asset condition. Over time asset condition will deteriorate. |
| F | Getting Worse Quickly | No expenditures. Asset condition/value decreased rapidly. |

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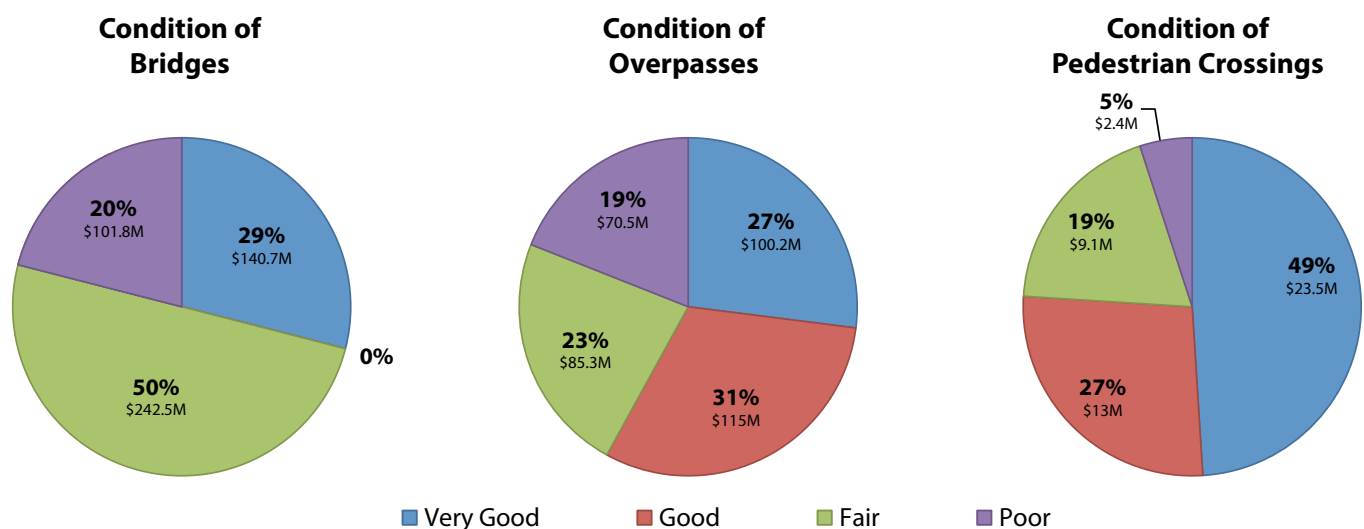
Table 4 aligns the desired condition and expenditure level. The table also shows the required 10 year funding to meet a Level “B” expenditure level and associated funding gap.

Table 4: Current Structural Condition and Desired Condition and Expenditure Level (in millions of \$)

| Asset | Physical Condition Actual | Physical Condition Desired | Desired Expenditure Level | Required 10 year funding (to meet Expenditure Level) | 10 year Budgeted Funding | 10 year Funding Gap (to meet Expenditure Level) |
|---------------------|---|----------------------------|---------------------------|--|--------------------------|---|
| Bridges | <i>Remaining:</i> <ul style="list-style-type: none"> • 29% Very Good • 50% Fair • 20% Poor | Good | Level B | 64.93 | 35.20 | 29.73 |
| Overpasses | <ul style="list-style-type: none"> • 27% Very Good • 31% Good • 23% Fair • 19% Poor | Good | Level B | 40.29 | 25.37 | 14.92 |
| Pedestrian Crossing | <ul style="list-style-type: none"> • 48% Very Good • 27% Good • 19% Fair • 5% Poor | Good | Level B | 0.35 | 0.00 | 0.35 |
| Total | | | | 105.57 | 60.57 | 45.00 |

In order to reach a physical condition of “Good” over the next 10 years, the BMRR would require an additional \$45 million.

The following charts show the current physical condition of the bridge and structure inventory by replacement value.



PRESERVATION PROGRAMS

The City works to ensure all bridges and structures remain safe and structurally sound. The program activities include:

- Washing and Sealing
- Safety Inspections
- Bridge Inspections & Deck Testing
- Minor Maintenance
- Major Rehabilitations
- Load Rating Program

The programs are funded through the Bridges Operating Budget and the BMRR. All bridges and structure programs have a critical part in maintaining the City's Bridges and Structures. The operating budget for annual maintenance is sufficiently funded.

Washing and Sealing

During the winter bridges are exposed to gravel, sand, and anti-icing chemicals that are spread on icy roads. The debris can cause wear on the surface of the bridge and salt can initiate chloride induced corrosion of the reinforcing steel in the bridge. The Bridge Washing and Sealing Program prolongs the life of the structures.

Safety Inspections

Each structure in the City's inventory is inspected annually by civic staff. The key goals of the safety inspections is to determine if there are any safety concerns with each structure, develop the minor maintenance programs, and identify critical defects that may require additional investigation.

Bridge Inspections & Deck Testing Program

The bridge inspection and deck testing program consists of completing industry standard inspections every 3 years and deck testing on a 6 year cycle for all bridges and overpasses that are over 10 years old in the City inventory. The deck testing covers the deck, barrier and curb components (if applicable), piers and abutments (if applicable), and expansion joints (if applicable) for each structure.

The deck testing information determines the approximate point at which each element is within its service life and produce corresponding remaining service life estimates. Once the remaining service life has been identified, rehabilitation strategies are developed and compared to help determine the optimal timing for rehabilitation.

Minor Maintenance

The minor maintenance program is completed on an annual basis under the Bridges Operating and Capital Budget. The program deals with repairs and maintenance for each structure as determined by the internal and external inspections. The minor repairs include items such as paving, route and crack sealing, concrete patching, repairing settling issues, erosion control at bridges, bridge drainage, impact damages, hand railing maintenance, and minor joint repairs.

Major Rehabilitations

The City uses deck testing data rehabilitation strategies to select rehabilitations and optimal timing for each structure.

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The rehabilitation strategies for each structure have a critical period of time for each strategy, based on the level of chlorides (salts) to induce corrosion in each structure. Once the critical period is missed, the repair strategy changes and the rehabilitation costs increase.

The projects are typically selected for rehabilitation at the optimum date and confirmed through testing prior to rehabilitation. There is variability in the critical timeframe for rehabilitation, as it is unknown exactly when corrosion will be induced in the structure. However, typically once the protective membranes have failed and corrosion is occurring the deterioration rate substantially increases.

Load Rating Program

The City develops and maintains load rating analysis for several bridge/overpass structures located throughout Saskatoon. The City has had consultants prepare load capacity charts to confirm bridge capacity for truck traffic. The information is used within the City to develop the long haul vehicle routes, pickup and delivery maps and assist with the permitting process to ensure vehicle loads are within safe loading parameters for the bridges and structures.

Ten-Year Rehabilitation Plan

The projects are part of the major rehabilitation program and are selected on preservation strategies focused on reducing the cost of owning and maintaining the structures, as determined by the City's testing and assessment program.

The 10 year projects that have been selected have a critical time period for each strategy, based on the level of chlorides (salts) to induce corrosion in each structure. Once a critical time period is missed, the optimal strategy changes and the rehabilitation costs increase. There is variability in the critical timeframe for rehabilitation, as it is unknown exactly when corrosion will be induced in the structure, which is why a range is provided. Projects are typically selected for rehabilitation at the mid-date and confirmed through testing prior to rehabilitation.

POTENTIAL PLAN TO ADDRESS FUNDING GAP

Bridges, Overpasses and Pedestrian Crossings

As per the 2015 State of Bridges and Structures Report, the BMRR has been underfunded. There are currently a number of rehabilitation projects (\$105.6 million) anticipated to be required over the next 10 years. This outstanding bridge/overpass rehabilitation work includes three large projects totalling \$64.0 million: 2021 – University Bridge, 2024/2025 – Broadway Bridge, and 2024 – Idylwyld Ramp.

If all structures were in new condition, annual contribution to maintain bridges, overpasses and pedestrian crossings in good condition is estimated at \$5.33 million. However, since structures are not in new condition, more funding is required to address the backlog. The potential plan in Table 5 considers the following two sources of funding:

1. Increase the annual contribution to the reserve from \$3.18 million to \$4.22 million in 2018, \$5.26 million in 2019, \$6.30 million in 2020 and up to \$7.33 million in 2021 (0.51% mill rate impact each year).
2. Included in the Major Transportation Infrastructure Funding Plan are \$23.75 million of one time payments from 2016 to 2023.

If the potential plan were to be selected at budget deliberations, this would provide the BMRR with a total of \$87.28 million in funding over the next 10 years. Although short of the \$105.57 million gap identified in Table 4; this funding would be sufficient to make significant progress in reaching the expenditure goal of improving structure conditions slowly over time. As future maintenance schedules and timing can change, an annual update will be provided to make any adjustments as required.

Table 5: Funding Option to Improve Funding Gap: Bridge Major Repair Reserve – Increase Annual Contribution (In millions of \$)

| Funding | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---------------------|------|-------|-------|-------|-------|------|------|------|------|------|
| Annual Contribution | 3.18 | 4.22 | 5.26 | 6.30 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 | 7.33 |
| Mill Rate Impact | - | 0.51% | 0.51% | 0.51% | 0.51% | - | - | - | - | - |
| One Time Funding | 7.25 | - | - | - | 5.00 | 5.00 | 5.00 | - | - | - |

All figures presented in 2016 dollars.

Sound Attenuation Walls

Most of the sound attenuation walls have been constructed after 2003. The design life for a sound attenuation wall is 50 years; therefore, no major rehabilitation activities are anticipated to be required within the next 20 years. Starting in the 2017 budget cycle, \$100,000 has been allocated to cover ongoing minor maintenance requirements for this item.

Chain Link Fencing

There has not been a condition assessment completed for the chain link fencing but this assessment and a preservation program will be established over the next several years.

CLIMATE ADAPTATION STRATEGY

All of the City's bridges and structures are designed to resist the effects of weathering due to rain, ice, wind, and snow. Due to the nature of the construction materials used for these assets (i.e. concrete and steel), they are by nature resistance to many of the effects of climate change.

During periods of extreme weather such as a major rain event or high river levels due to flooding from other regions, Major Projects has established a protocol to complete underwater inspections of critical bridge elements for undermining to ensure structural components have not been compromised.





City of
Saskatoon