FINAL MIDTOWN CORRIDOR INDIVIDUAL BRIDGE SUMMARY AND MANAGEMENT PLAN

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June 2015
Executive Summary

The 18th Avenue Bridge (Bridge L8923) carries vehicular and pedestrian traffic over the Midtown Greenway in the city of Minneapolis. The bridge was constructed in 1916-1917 and is a contributing element in the Chicago, Milwaukee, and St. Paul Railroad Grade Separation Historic District.

Bridge L8923 is a three-span continuous concrete multi-beam bridge with arched fascia girders. The overall bridge length is approximately 95 feet and the bridge width from curb to curb is 32 feet with an 8 foot sidewalk on both sides of the bridge. The railings consist of original 36 inch tall concrete railings with an added steel pipe to provide an overall height of approximately 42 inches. It has two stub abutments, with the Midtown Greenway trail located beneath the center span of the bridge. The bridge’s historic integrity has been diminished by the addition of a large modern trail ramp at the northwest corner. The bridge is located in the most intact part of the corridor, which is the segment from 11th Avenue eastward.

Bridge L8923 is a lightly used bridge with average daily traffic (ADT) of 980 in 2011. It is in poor structural condition with the superstructure, substructure, and deck all having structural condition codes of 4. The bridge is structurally deficient and has an inventory rating of HS 21. (See page 15 for definition of structural condition codes, structural deficiency, and inventory rating.) Almost all of the beams are in poor condition and there are a few spalls on the underside of the deck. The substructure is cracked and spalled, and there are signs of settlement on the north abutment. A more immediate need at this bridge is to provide fill in front of both abutments. With proper maintenance, stabilization, and preservation activities it is believed Bridge L8923 could continue to serve its present purpose for 20 years or longer.

Any work on Bridge L8923 should proceed according to the Secretary of the Interior’s Standards for the Treatment of Historic Properties (36 CFR part 67) and the “Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior’s Standards” as adapted by the Virginia Transportation Research Council.
Bridge Location

Bridge L8923
18th Ave S

Location
Minneapolis
Hennepin County
T 29, R 24W, Sec 35
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I – Project Introduction

This individual bridge summary and management plan is an appendix to the Midtown Corridor General Bridge Management Plan (2015) which must be used in conjunction with this document. The overall plan describes the objectives, methods, and results of the Midtown Corridor Historic Bridge Study and provides further information on the recommended stabilization, preservation, and maintenance activities contained herein. This individual plan is based on visual observations; the overall plan discusses additional testing that should be completed before any preservation alternatives are pursued. The overall plan discusses the likely cause of the existing deterioration, intent of the preservation alternatives, and what statutes need to be considered when working on this historic bridge.

The purpose of the Midtown Corridor Bridge Study and this individual bridge summary is to determine the work required to preserve the bridge in accordance with the Secretary of the Interior’s Standards by assessing current conditions and proposing a set of treatment alternatives that address structural deficiencies, deteriorating historic fabric, and bridge longevity while at the same time protecting the historic character and integrity of the bridge and, in turn, that of the 2.8-mile Chicago, Milwaukee and St. Paul Railroad (CM&StP) Grade Separation Historic District.

The Midtown Corridor Bridge Study is part of a several-year cooperative effort, led by MnDOT, to promote the preservation of historic bridges across the state. “Historic” bridges are defined by federal law as bridges listed on, or eligible for, the National Register of Historic Places. The Midtown Corridor bridges are a subset of bridges addressed in the Minnesota Local Historic Bridge Study. Launched in 2012, two phases of the Minnesota Local Historic Bridge Study have been completed, with the most recent phase examining approximately 140 historic bridges across Minnesota owned by entities other than MnDOT. The Minnesota Local Historic Bridge Study is conducted through a partnership that includes MnDOT State Aid, the MnDOT Cultural Resources Unit (CRU), the Federal Highway Administration (FHWA), the State Historic Preservation Office (SHPO), the Army Corps of Engineers, local public works and county highway departments, county and township boards and city councils, the historic preservation community, and the general public.

The Minnesota Local Historic Bridge Study is designed to encourage the preservation of the state’s locally-owned historic bridges by compiling historic and engineering data on each bridge, analyzing bridge condition, and preparing a set of recommended treatment activities for each bridge. The recently completed statewide study also prepared National Register nominations for a select number of bridges, providing updates to MnDOT’s 2006 Management Plan for Historic Bridges in Minnesota, producing content for MnDOT’s Historic Bridges website, and exploring how other states are funding and managing historic bridge programs with an emphasis on locally-owned bridges.

An individual bridge report was prepared for each bridge in the Minnesota Local Historic Bridge Study. Each individual report suggests stabilization, preservation, and maintenance activities for each bridge. Stabilization activities are designed to maintain the bridge in its current state until a more substantial repair project is undertaken. These measures might be emergency repairs, or minor repairs intended to prevent emergency repairs in the near future. Preservation activities are designed to preserve the bridge and keep it in service for the next 20 to 30 years. Maintenance activities include items such as annual inspections and cleaning, vegetation removal, minor concrete repairs, and spot painting. This individual bridge report was created for the Midtown Corridor Bridge Study with the same purpose as the Minnesota Local Historic Bridge Study.

This bridge report’s activities follow the Secretary of the Interior’s Standards for the Treatment of Historic Properties and, in particular, the Standards for Rehabilitation and accompanying Guidelines. The Secretary of the Interior’s Standards are basic principles created to help preserve the distinct character of a historic property and its site, while allowing for reasonable changes to meet new engineering standards and codes. The Standards take a conservative approach to the preservation of historic fabric and recommend repairing rather than replacing deteriorated features whenever possible. The Standards apply to historic properties of all periods, styles, types, materials, and sizes and encompass the property's location and surrounding environment. Recommendations for the Midtown Corridor bridges are also
consistent with best practices outlined in the National Park Service's Preservation Brief 15 entitled *Preservation of Historic Concrete*, and with the "Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior's Standards," as adapted by the Virginia Transportation Research Council.

To compile this report, engineering and historical data were gathered from a variety of sources including multiple field visits, original construction plans, current MnDOT Structure Inventory Reports and MnDOT Bridge Inspection Reports, load ratings where available, historic photographs and documents, and the National Register nomination for the CM&StP Railroad Grade Separation Historic District.

Included in the appendices of this report are a glossary of historic preservation and engineering terms, the Virginia "Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior's Standards," and engineering and historical documents pertinent to this bridge such as the current MnDOT Structure Inventory and Bridge Inspection reports.

This individual bridge report is designed to provide the bridge owner and other interested parties with a comprehensive summary of engineering and historic data and recommendations that will enable historic bridge owners to make informed decisions when planning for and managing their historic properties. Again, this report should be used in conjunction with the overall Midtown Corridor General Bridge Management Plan which provides additional information and a multi-bridge perspective.

Below is an aerial view of Bridge L8923 to provide an understanding of the physical context of the bridge.
II – Historical Data

Contractor: Chicago, Milwaukee, and St. Paul (CM&StP) Railroad

Designer/Engineer: H. C. Lothholz, Engineer of Design, CM&StP Railroad
Charles Frederick Loweth, Chief Engineer, CM&StP Railroad

Description
Bridge L8923 carries 18th Avenue S. over the Chicago, Milwaukee, and St. Paul Railroad. Built in 1916-1917, it is a three-span, Neoclassical Revival style, continuous concrete deck girder bridge.

Geometrics. The bridge is about 122 feet long (measured end of rail to end of rail) and about 51 feet wide, the same as most of the CM&StP corridor bridges (which are 49 or 51 feet wide). The center span measures about 32 feet and the outer spans about 30 feet, which is typical of the corridor. The bridge is skewed 5 degrees (the only other historic bridge in the corridor that is skewed is Cedar Avenue one block to the east).

The street is about 32 feet wide between the curbs. Like most corridor bridges, it carries two lanes of traffic. The concrete deck has a bituminous overlay. (The decks were originally paved with 4-inch-thick wood blocks (“Track Depression Work” 1915).) The sidewalks retain their original width of approximately 8 feet but have received an overlay. (Original plans indicate the sidewalks were to be divided into 4-foot squares; historic photos suggest this occurred on at least some bridges.)

Structure. The substructure is comprised of concrete abutments and two piers or bents. Each pier has four square columns with a rounded-arched cross beam system that extends to the fascia to support cantilevered raised sidewalks. The bridge seat has simple Neoclassical coping.

The multi-beam continuous structural system uses non-prismatic reinforced concrete beams (roughly 13 inches wide, 4 feet deep, and 5 feet apart). The lower edge of the beams is angled to follow the lower curve of the fascia beams.

The fascias are haunched and ornamented with recessed panels that align with the pier columns. Smoke shields are missing from the fascias’ center spans.

Railings. The bridge has approximately 36-inch-tall solid concrete railings topped by a modern pipe rail at about 42 inches. The rail posts form squat, square columns with a base, shaft, and capital. The rail panels are similarly detailed. Both posts and panels have simple recessed panels in the shaft region. The capital level forms the handrail. The handrail has a peaked rather than flat top; only the 18th Avenue and Cedar Avenue bridges – the two easternmost bridges and the last two built – have handrails with this shape.

Near the ends of the bridge the railings move apart laterally, tracing the edge of the abutments, with the sidewalks widening correspondingly. The four ends of the railings were originally similar and symmetrical. In ca. 2004 approximately 15 feet was removed from the north end of the west rail to make room for a trail access ramp.

Concrete Surface. The bridge was originally unpainted (see Historic Integrity below). The surface of the abutments, piers, beams, underside of deck, and, to some extent, fascia, retains original board form lines. The fascia and railings have a fairly smooth finish. According to a 1915 article in Engineering News, the bridge railings built in 1913-1914 had a surface texture achieved by removing the forms after 24 hours and treating the concrete “with a stiff wire brush to expose the red granite screenings in the aggregate.” For the railings built in 1915-1917, “It was decided to discontinue this practice, as a smooth concrete face seems to give a more pleasing effect and to bring out more clearly the angles and planes of the design.” Instead, the forms remained in place at least 48 hours and the concrete was rubbed “with emery stone just enough to take out surface irregularities or brushed with cement grout to remove surface discolorations” (“Track Depression at Minneapolis” 1915).
The underside of the deck is blackened by locomotive smoke. Date blocks reading “1916” are cast into the abutments near the northeast and southwest corners.

**Other.** There is sloped gravel fill against both abutments. The south slope is retained by low timbers.

Attached or immediately adjacent to the northeast corner of the bridge is an approximately 25-foot-long mortared, coursed stone (mostly granite) rubble retaining wall aligned east-west near the top of the trench. At the base of the wall, the curving upper portion of the slope east of the abutment is paved with the same stone. The wall and paving appear to have been built to support the slope and adjacent private property and prevent erosion. The stonework probably dates from the early 20th century and may have been installed soon after the bridge was built. Also at the northeast corner, an early- to mid-20th century metal fence runs between the end of the railing and the adjacent building.

There may be early walls or wall segments adjacent to or near the bridge.

Attached to the northwest corner of the bridge is a long, full height retaining wall and trail ramp built of large modular blocks. The wall and ramp was built ca. 2004 and is topped by a chainlink fence.

**Setting and Views.** The bridge is located within the Chicago, Milwaukee, and St. Paul Railroad Grade Separation Historic District. (See the Master map in the Midtown Corridor General Bridge Management Plan (2015) for the historic district boundaries.) The historic district’s identical bridges span the trench and are closely spaced – one block apart – giving the corridor strong visual continuity and a tunnel-like effect. The trench is about 110-120 feet wide at the top of the slope and 22 feet deep; near 18th Avenue the trench is curved and the sides slope at roughly 30 degrees. A recreational trail now replaces the railroad tracks. The floor of the trench beneath the bridge is at a single grade, as it was historically.

Vegetation on the trench slopes in most of the corridor consists largely of volunteer deciduous trees, shrubs, and herbaceous plants. There are recent out-of-character plantings on the trench floor near the bridge.

From both below and on top of the bridge, corridor views to the east are dominated by the curved trench, its wooded slopes, and the identical historic bridges. A retaining wall and trail ramp is a large modern element in the view to the west. (In part because the corridor curves at this location, the ramp also significantly blocks views of the 18th Avenue Bridge from the west.) Views from the top of the bridge also include surrounding city blocks.

When the bridge was built, the setting was comprised of a rail corridor, with about 20 trackside industries, aligned through a largely residential neighborhood. 29th Street intersects 18th Avenue near the south end of the bridge. The bridge’s setting today is a mix of residential and commercial. There is a commercial building northeast of the bridge and a house to the northwest (north of the trail ramp entrance). Across 29th Street a commercial building stands southwest of the bridge and a house and large new apartment building to the southeast. The bridge is located in Minneapolis’ East Phillips neighborhood.

**Historic Integrity**

Bridge L8923 generally retains historic integrity of location, design, setting, materials, workmanship, feeling, and association. However, integrity of design, setting, feeling, and association have been diminished somewhat by the large retaining wall and access ramp adjacent to the west side of the bridge. The bridge is located in the most intact part of the historic district, which is the segment from 11th Avenue eastward. Alterations to the bridge and its immediate setting include:

- Sidewalks received a concrete overlay ca. 1983.
- Simple pipe rails have been added to the concrete rails to increase railing height.
Both smoke shields have been removed.

Original plans indicate an iron picket right-of-way fence, built by the railroad as part of the project, was originally attached to the southwest and southeast corners of the bridge. It has been removed. (Examples of surviving segments of the fence include from Fremont to Dupont (two blocks) and Colfax to Lyndale (three blocks) on the south edge of the trench.)

Trains traveled the corridor until the summer of 2001. The last tracks were removed ca. 2002. (The original plans propose two main line tracks beneath the center span.)

A bituminous-paved recreational trail was installed under the center span, this segment opening in 2004. A square safety light was mounted on the north pier.

Unobtrusive modern shoebox streetlights have been added to the trail near the bridge.

The deck now has a bituminous overlay. (It was originally paved with 4-inch-thick wood blocks.)

Ca. 2004 a large retaining wall and trail ramp was built against the northwest abutment.

Ca. 2004 approximately 15 feet was removed from the north end of the west rail to make room for the trail access ramp.

The piers, the lower part of the abutments, fascia, and most of the roadway side of the railings have been painted grayish white. Painting of the piers and abutments occurred sometime after 1995.

Modern chainlink fencing is now attached to the southwest corner of the bridge.

See also changes described in Setting and Views above.

Attached to the northwest corner of the bridge is a long, full height retaining wall and trail ramp built of modular concrete block, topped by a chainlink fence.
Significance
Bridge L8923, built in 1916-1917 to carry 18th Avenue S. over the Chicago, Milwaukee, and St. Paul Railroad (CM&StP), is a good example of the Neoclassical Revival style, continuous reinforced concrete girder bridges that are a significant component of the CM&StP Grade Separation Historic District. The 2.8-mile-long historic district is comprised of a railroad corridor trench as well as 40 bridges. Thirty-eight bridges carry urban streets over the trench, one bridge carries I-35W over the trench, and one bridge at 29th Street east of Dupont Avenue does not span the trench but historically provided track-level access to it. Twenty-seven of the bridges are original; 26 of the 27 (all but the 29th Street Bridge) are nearly identical. The massive grade separation project, which coincided with an expansion of the CM&StP main line, involved more than a decade of planning and controversy. The tracks were not only depressed, but the set of bridges that crossed them was designed with an emphasis on aesthetics. The project played a significant role in the development of Minneapolis by advancing civic planning, facilitating transportation, increasing safety, protecting the quality of adjacent residential neighborhoods, and enhancing community aesthetics, all while maintaining important rail service and the viability of trackside industries. The bridges were designed by the CM&StP and built in 1912-1917 by railroad labor. The Minnesota historic bridge study found the CM&StP corridor bridges to be significant within the statewide historic context “Reinforced Concrete Highway Bridges in Minnesota, 1900-1945.” They are the work of designers identified in the context study as significant (J. H. Prior, H. C. Lothholz, and C. F. Loweth) and, as a collection, display unusual aesthetic qualities. According to the bridge study inventory form, “From an engineering perspective, the new crossings also were notable as early Minnesota examples of continuous, concrete, girder construction – a bridge type rarely used in the state for highway crossings” (Hess ca. 1997). The historic district was determined eligible for the National Register in 1997. It was officially listed on the National Register in 2005 under Criterion A (broad patterns of history) in the area of Community Planning and Development. The level of significance is listed as Local and the period of significance as 1912-1916. Bridge L8923 is contributing to the district.

Bridge L8923 was one of the last six bridges built in the corridor. The corridor’s bridges were generally built in sequence from west to east in 1912-1917. According to original plans, the 18th Avenue Bridge (CM&StP Bridge 0-1510) was largely built between late July and early December 1916 with the railing and smoke shield built in 1917. (See the sheets for construction details.)

The railroad trench and bridges were designed by J. H. Prior and H. C. Lothholz who successively served as Engineer of Design for the CM&StP. (Prior’s signature appears on plans for bridges west of about Stevens Avenue, and Lothholz signed plans for bridges from approximately Stevens Avenue eastward.) The railroad’s Chief Engineer for the design process was Charles F. Loweth. All three men are considered significant engineers within the statewide historic context “Reinforced Concrete Highway Bridges in Minnesota, 1900-1945” (Frame 1988).

The trench and bridges were constructed by crews of CM&StP workers supervised by W. R. Powrie, District Engineer for the railroad. Plan sheets for Bridge L8923 indicate Assistant Engineer was W. E. Duckett, Carpenter Foreman was G. Tornes, and Concrete Foreman was Ole Dahl. In July of 1915 there were 500 men on the corridor, more than half of whom were working on the bridges (Bainbridge 1915; “Track Depression Work” 1915).

Historic Context
Urban Centers, 1870-1940
Railroad Development in Minnesota, 1862-1956
Reinforced Concrete Highway Bridges in Minnesota, 1900-1945

National Register Status
Contributing to Listed Historic District

NRHP Historic District
Chicago, Milwaukee and St. Paul Railroad Grade Separation Historic District

Criterion A Significance
Community Planning and Development

Criterion C Significance
N/A
SHPO Inventory Number: HE-MPC-7305

Minneapolis HPC Status: Not individually designated, not in a district

Sources Used to Compile Section II – Historical Data


Hennepin County Regional Rail Authority (HCRRA). *Cultural Landscape Management Treatment Guidelines for the Chicago, Milwaukee, and St. Paul Railroad Grade Separation Historic District of the Midtown Corridor, Minneapolis, Minnesota*. 2006.

Hess, Jeffrey A. “Bridge L08923.” Minnesota Historic Bridge Inventory Form, ca. 1997.

Photographs, Historic Aerial, of Minneapolis. 1937 and 1938. Borchert Map Library, University of Minnesota, Minneapolis.

Photographs, Historic, of Midtown Greenway Bridges. City of Minneapolis Public Works Department.

Photographs, Historic, of Midtown Greenway Bridges. Hennepin County Library, Minneapolis.


“Photographs of Twenty-Four Early Minneapolis Businesses.” Circa 1917. Photograph album. Hennepin County Library, Minneapolis.

Site visits to the bridge by ONE, SRF, Gemini Research, Braun Intertec, MacDonald and Mack, and Wiss Janney Elstner, 2013-2014.


Character-Defining Features

Character-defining features are prominent or distinctive qualities or elements of an historic property that contribute significantly to its physical character, historic integrity, and significance. A list of character-defining features does not identify all important aspects of an historic property, however. Each historic property contains additional elements of location, design, setting, materials, workmanship, feeling, and association that together comprise its historic integrity or authenticity. Character-defining features of Bridge L8923 are listed below. (See the Midtown Corridor General Bridge Management Plan (2015) for character-defining features of the historic district.)

Feature 1: Reinforced concrete three-span bridge carrying a city street and raised sidewalks over a railroad trench 110-120 feet wide and 22 feet deep with moderately sloping sides. The trench curves at this location. Neoclassical Revival design shared by 26 bridges (originally 37). From both below and on top of the bridge, views of the trench and closely spaced identical bridges create visual continuity; the three spans create a tunnel-like effect.
Feature 2: Abutments with classical coping on bridge seats and date block imprints. Piers comprised of four square columns joined by rounded arches that extend to the fascia to support cantilevered sidewalks. Multiple beams integrated with the deck; beams are angled to follow the curve of the fascia beams. Fascias are haunched with recessed panel detailing over the piers. (A characteristic of the corridor bridges is smoke shields on the fascia beams at center span; they are currently missing from this bridge.)
Feature 3: 36-inch-tall concrete railings with both posts and panels divided into classical base, shaft, and capital. Simple recessed panels. Railings move apart laterally, tracing the edge of the abutments; sidewalks widen correspondingly.

Feature 4: Unpainted concrete surfaces with board form lines on abutments, piers, beams, and underside of the deck; smoother finish on fascia and railings.
III – Bridge Data

Date of Construction (remodel) 1916-1917
Common Name (if any)

Location
Feature Carried: 18th Avenue S. (MUN 164)
Feature Crossed: Midtown Greenway
County: Hennepin
Ownership (assumed not confirmed): Hennepin County Regional Rail Authority

MnDOT Structure Data
Data Current (as of): Oct 2014
Main Span Type: Continuous Concrete Girder, tee beam
Main Span detail:
Substructure Type - Foundation Type:
Abutment: Concrete – Timber Piles
Piers: Concrete – Spread Footing on Soil
Total Length: 95.0 ft
Main Span Length: 32.5 ft
Total Number of Span(s): 3
Skew (degrees): 5 Left
Structure Flared: No Flare
Roadway Function: Urban Local
Custodian/Maintenance Type: City of Minneapolis

Reported Owner Inspection Date 5/29/2014

Sufficiency Rating1 68.9
Operating Rating2 HS 34.2
Inventory Rating2 HS 21.0
Posted Load3 A - Open
Posting3 N/A
Design Load Unknown, designed before standard design trucks existed

Current Condition Code4 Deck: 4 Roadway Width: 32 ft curb to curb
Superstructure: 4 Vert. Clearance Over Rdwy: N/A
Substructure: 4 Vert. Clearance Under Rdwy: 18.5’ +/-
Channel and Protection: N/A North Span: 29.0 ft clear opening;
Culvert: N/A Center Span: 30.17 ft clear opening;
Deficiency Status6 Fracture Critical5 No level; location of trail
Deficiency Status6 Structurally Deficient South Span: 29.0 ft clear opening;

Deck Geometry: 5 Truck ADT Percentage: Not available
Underclearances: N/A Bypass Detour length: 1 mile
Waterway Adequacy: N/A Number of Lanes: 2
Approach Alignment: 6

1 - Sufficiency Rating is used to determine funding eligibility and priority for bridge replacement and rehabilitation. It is based on condition codes, inventory rating, appraisal ratings, ADT, and detour length.
2 - The bridges are load rated using an AASHTO defined 36 ton truck. An inventory rating of HS 12 implies the bridge may safely be able to carry a 21 ton truck indefinitely. An operating rating equal to HS 18 implies the maximum permissible live load that the bridge can carry is 32 tons.
3 - If the bridge is posted, the bridge cannot safely carry standard trucks used to design a new bridge. The posting values are determined by rating the bridge with model trucks determined by AASHTO. The trucks have specific distances between axles and axle loads. Typically, if the calculated operating rating is less than HS 27, calculations are completed to determine if posting is required. If the operating rating is greater than HS 27, it is assumed that posting is not required for the bridge.
4 - Bridges are provided structural condition codes based on inspection findings. The codes range between 9 and 0. A code of 9 is excellent condition; a code of 0 is failed – beyond corrective action. Code 4 is poor condition.
5 - A bridge is fracture critical if the failure of one member will likely cause a section or the entire bridge to collapse.
6 - Deficiency status is an additional check used to determine funding eligibility. If it is rated as structurally deficient or functionally obsolete, the bridge is eligible for funding. A bridge is structurally deficient if any of the deck, superstructure, or substructure condition codes are 4 or less, or if the structure evaluation appraisal rating is 2 or less. A bridge is functionally obsolete if any of the listed appraisal ratings are 3 or less.
7 - Bridges are rated on a scale of 0 to 9. Structural evaluation of 4 means meets minimum tolerable limits. Deck geometry rating of 5 means somewhat better than minimum adequacy. Approach alignment rating of 6 means very minor speed reduction required.
Non-MnDOT Data

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Location of Plans: City of Minneapolis

Previous Repairs, if any
Shotcrete repairs were completed above the trail in 2007. Shotcrete repairs to pier columns completed in 2009. Metal railing added to the top of the concrete rail to improve railing height. Shade of white paint applied to abutments and pier columns to cover graffiti.

Accident Data: Info not specific enough to report
IV – Existing Conditions/Activities

As described in the Project Introduction section, the bridge was visited multiple times. These visits were conducted to determine the existing condition of the bridge and vertical clearance.

General Bridge Description:
Bridge L8923 is a 3-span continuous concrete girder bridge which carries two lanes of traffic on 18th Avenue over the Midtown Greenway in the city of Minneapolis. There are 9 tee beams in each of the three spans. A concrete deck is topped with an approximately 4 ¼ inch thick bituminous overlay. The bridge has two stub abutments and two 4-column piers. The roadway width is 32 feet from curb to curb and there is an 8 foot sidewalk on either side of the bridge. The railings are made of concrete and stand 36 inches tall. A steel pipe rail was added on top to provide an additional 6 inches of height.

Serviceability Observations:
The bridge is structurally deficient due to its condition. All of the condition codes are a 4, which means the deck, superstructure and substructure are in poor condition. Bridges are provided structural condition codes based on inspection findings. The codes range between 9 and 0. A code of 9 is excellent condition; a code of 0 is failed – beyond corrective action. These codes are used to assist in determining the sufficiency rating of the bridge which is used to determine funding eligibility and priority for bridge replacement and rehabilitation.

The roadway and sidewalk geometrics on the bridge are consistent with the approaches on each end, but a minor speed reduction is required according to the appraisal rating.
Condition Observations:

Superstructure:

Scaling and spalls are found on most beams in the center span.

Not many deck spalls are present, although the deck is undergoing significant freeze/thaw demand and spalling will commence in the next few years. The total area of freeze/thaw damage is estimated to be 320 square feet.

Scaling and spalls are found on half of the beams in the south span.

The total beam spall repair area is estimated to be 408 square feet.

The north span is in the best shape with only 2 poor beams.
Substructure:

The north abutment, shown to the left, has a large spall and crack on both wing walls and the railing in the NE corner shows signs of settlement and overturning.

Both abutments show signs of seepage through the breastwall of the abutment.

On the two abutments combined, there are about 50 square feet of spalls where the unsound concrete is likely more than 4 inches deep and approximately 120 square feet of more shallow spalls.

The south abutment has minor cracks, but no real sign of movement.

On the two abutments combined, about 18 linear feet of cracks are less than ½ inch in width.

The piers are in fair condition. Some columns have been repaired with shotcrete. There is an additional crack and spall forming on the top of the same column which was repaired.

The total spall repair area on the columns is estimated to be 133 square feet.
Railings and Sidewalks:

The railings are in fair condition. The railing is badly pitted throughout. Some cracks are present in the top cap. Approximately 22 linear feet of the railing is in poor condition.

The roadway face of the railing is covered with paint.

This is a typical post condition.

The sidewalk is in satisfactory condition with a few minor cracks and spalls.
Approaches:

Bituminous pavement approaches are at each end of the bridge. One manhole is present on the south, but the watermain is abandoned. Cracks in the north approach panel show signs of settlement.

Non-Structural Condition:

A watermain was supported between the first two interior beams on the west side of the bridge.

The original plans show a 36 inch watermain going below the bridge. It is unknown if this watermain was installed and if it is still active.

Date of Site Visit: December 13, 2013 and May 22, 2014
Overall Considerations:
The 18th Avenue Bridge is currently open to vehicular traffic. The activities that follow assume the bridge will remain open to vehicular and pedestrian traffic.

The bridge was built in 1916-1917. Design standards for newly constructed bridges are different in 2014 than they were in 1916; among other requirements, vehicle loadings and railing crash level requirements are greater now. The activities presented below are intended to rehabilitate deteriorated portions of the bridge. The original load capacity of the bridge would be restored.

Once a project begins and the purpose and need are identified, the owner may desire or need additional vehicle load capacity, railing crash capacity, additional lanes or sidewalk widths, etc. Designers should consider the use of design exceptions and the use of non-typical details during project development. It may be possible for a deviation from current standards to be accepted by all parties. Creative solutions are encouraged to provide safe, durable, and functional designs that minimize the impact to the historic integrity of the bridge.

Stabilization Activities:
For the purposes of this report, stabilization is defined as measures performed to maintain the bridge in its current state until a more substantial repair project is undertaken. These measures could be minor repairs which are intended to prevent the need for emergency repairs in the near future, or could be emergency repairs.

It appears that most of the footing is visible on both abutments. Fill should be added in front of the abutments.

Preservation Activities:
For the purposes of this report, preservation is defined as actions taken to preserve the structural and historic integrity of the bridge for the next 20 to 30 years.

During the site visits completed in late 2013 and 2014, repair items were identified. These are summarized in the figures on the following page. Please note that all callouts on the figures are generic and not pointing to a specific repair location on the superstructure or substructure. A description of the repair items is provided following the figures. All repairs are intended to have minimum visual impact and minimal impact to historic fabric.
Precast Concrete Panels:
Precast concrete panels are suggested to strengthen the superstructure because over half of the beams are in poor condition and there are lower traffic counts on this bridge. By using precast panels, not all of the beams would need to be extensively repaired and more historic fabric can remain. The panels would be approximately 12 inches thick and would be placed between the beams, underneath the deck. The panels would span from substructure unit to substructure unit and are intended to carry all live load and all dead load which is not directly above an existing beam. The panels would need to be fixed to the substructure units and made to be integral with the deck through the addition of self-consolidating concrete above the panels. If corbels are used to fix the panels to the substructure units, the size should be minimized. While the original lower deck surface would be obscured and the original beam profile altered within the bays, historic fabric on the beams would be preserved.

Continuous Concrete Tee Beams:
A few of the beams would require spall repairs, both major (where approximately 4 inches of concrete is estimated to be replaced) and minor (where approximately 2 inches of concrete is estimated to be replaced). With the major repairs, the existing reinforcement should be cleaned and assessed for corrosion. Additional reinforcement may need to be added depending on the extent of the corrosion. All new concrete should be finished with a board form treatment to line up with the original board form lines and should match the texture and color of the adjacent historic concrete. Limit excess removals and excess new concrete to preserve the black residue that remains on the beams.

Concrete Deck:
The existing non-historic overlay and approximately 1 inch of the original concrete deck, which was not historically visible, would be removed. A new 2 inch concrete overlay would be added above the new 4 inch structural concrete deck (mentioned below) to provide significant protection against water infiltration. The alteration of the historic profile would be minimal.

A new 4 inch reinforced concrete deck would be placed on top of the existing concrete deck. The deck will strengthen the bridge and preserve historic fabric by preventing water from infiltrating the beams and substructure below.

Currently the underside of the deck is spalled at the longitudinal joint and at curb lines where water infiltration is the worst. The full depth of the deteriorated deck concrete beneath the existing overlay would be removed and new concrete would be poured with the structural deck. The upper side was historically not visible and will not be visible after the repair.

The existing concrete sidewalk (which has a modern concrete overlay) would be milled to the top mat of reinforcement. A new concrete overlay would be added of similar thickness. The alteration of the historic profile would be minimal.

Concrete Railing:
A small portion of the railing is suggested to be replaced in-kind due to severe spalls. The concrete should match the texture and color of the adjacent historic concrete.

During rehabilitation projects in 2013, the railings on 15th and 16th Avenues were strengthened with additional reinforcement such that the railings can withstand a 10 kip load. A design variance for these two bridges was obtained. One option is to provide the same additional strength for this railing and to reconstruct the entire cap of the railing in-kind with additional reinforcement. Additional reinforcement would also be needed in all pilasters to transfer the load to the deck. All concrete should match the texture and color of the adjacent historic concrete. For purposes of the preservation estimate an allowance for similar additional strengthening was included.

Currently the roadway face of the railing is coated with acrylic paint to cover graffiti. The roadway face of the railing should be repainted with an acrylic coating to protect it as much as possible from chlorides. The choice of coating should also be based on MnDOT’s most recent research on appropriate coatings for historic bridges.
Abutment and Piers:
The abutments and piers would require spall repairs, both major (where approximately 4 inches of concrete is estimated to be replaced) and minor (where approximately 2 inches of concrete is estimated to be replaced). With the major repairs, the existing reinforcement should be cleaned and assessed for corrosion. Additional reinforcement may need to be added depending on the extent of the corrosion. All new concrete should be finished with a board form treatment to line up with the original board form lines and should match the texture and color of the adjacent historic concrete. A few narrow cracks need to be filled with epoxy which is compatible with the adjacent historic concrete.

Helical anchors are suggested to prevent further settlement of the abutments. Helical anchors would be installed by drilling through the abutment footings and vertical faces. The new concrete which will replace the concrete removed to install the anchors would be finished similar to the spall repairs.

Concrete Approach Panels:
Concrete approach panels would be added to either end of the bridge to prevent water from collecting behind the abutments. This will alleviate pressure behind the abutments and in the deck. Structure excavation is required so that a concrete ledge can be built on the back side of the abutment wall to support the concrete approach panel. This ledge will not be visible as it will be buried beneath the new approach panel.

Cumulatively the recommended work is expected to meet the Secretary of the Interior’s Standards.

If funding is available, additional historic elements should be reconstructed to improve the overall historic integrity of the bridge. Concrete smoke shields were originally present over the center spans on the outside of both fascia girders. These smoke shields should be reconstructed. Details can be found in the original plans.

In addition, shotcrete repairs on the piers should be removed to create a concrete surface more compatible with the historic finish. The shotcrete would be removed until sound concrete is found. The concrete that will replace the shotcrete should be finished with a board form treatment to line up with the original board form lines. In addition, the repair concrete should match the texture and color of the adjacent original concrete.

Maintenance Activities:
Annual maintenance activities should be performed on this bridge. The maintenance activities should include an annual inspection, power washing of the deck each spring, clearing vegetation that interferes with the abutments and wing walls, spot painting the metal railing to repair chipped paint, and fixing spalls as required. The water pressure for the deck washing should be limited to 1750 psi. Care shall be taken when power washing adjacent to and on the concrete railing. The water pressure for cleaning historic concrete should be limited to 400 psi. A small area at the base of the railing should be tested prior to washing the railing to ensure that historic concrete will not be lost.
V – Projected Costs

It is important to recognize that the work scope and cost estimates presented herein are based on a limited level assessment of the existing structure. In moving forward with future project planning, it will be essential to undertake a detailed structure assessment addressing the proposed work for the structure. It is also important that any future preservation work follow applicable preservation standards with emphasis on rehabilitating and repairing in-place structure elements in lieu of replacement. This includes elements which are preliminarily estimated for replacement within the work scope of this report. Only through a thorough review of rehabilitation and repair options and comprehensive structural and historic assessment can a definitive conclusion for replacement of historic fabric be formed.

The opinions of probable construction costs provided below are presented in 2014 dollars. These costs were developed without benefit of a detailed, thorough bridge inspection, bridge survey or completion of preliminary design for the estimated improvements. The estimated costs represent an opinion based on background knowledge of historic unit prices and comparable work performed on other structures. The opinions of cost are intended to provide a programming level of estimated cost. These costs will require refinement and may require significant adjustments as further analysis is completed in determining the course of action for future structure improvements. A 25% contingency and 10% mobilization allowance has been included in the construction cost estimates. These values differ from the Minnesota Local Historic Bridge Study and are based off of previous estimates and bid tabs on work items performed in the Midtown Corridor.

Administrative and engineering costs are also presented below as 20% of the preservation activities. Engineering and administrative costs are also to be interpreted as programming level only. Costs can be highly variable and are dependent on the structure condition, intended work scope, project size, and level of investigative, testing, and documentation work necessary. Additional studies, evaluation, and historical consultation costs not exclusively called out may also be incurred on a case-by-case basis.

Maintenance, Stabilization and Preservation Costs (refer to the work item breakdown on the next page):

- Opinion of Annual Cost - Maintenance Activities: $ 7,500
- Opinion of Construction Cost - Stabilization Activities: $ 17,500
- Opinion of Construction Cost - Preservation Activities: $ 2.2 million

(Note the estimated maintenance costs assume the preservation activities are already completed).

Estimated Preliminary Design, Final Design, and Construction Administration Costs: $ 440,000
### MAINTENANCE, STABILIZATION, & PRESERVATION COST ESTIMATE (2014 DOLLARS)

**Bridge No. L8923 (18th Ave.)**

**December 31, 2014**

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**ESTIMATED MAINTENANCE COSTS** $7,500

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**ESTIMATED STABILIZATION COSTS** $17,500

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<tr>
<td>* To restore historic integrity</td>
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<td>25% CONTINGENCY</td>
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</table>

**ESTIMATED PRESERVATION COSTS** $2,123,000
Appendix A. Glossary

**Abutment** – Component of bridge substructure at either end of bridge that transfers load from superstructure to foundation and provides lateral support for the approach roadway embankment.

**Appraisal ratings** – Five National Bridge Inventory (NBI) appraisal ratings (structural evaluation, deck geometry, under-clearances, waterway adequacy, and approach alignment, as defined below), collectively called appraisal ratings, are used to evaluate a bridge’s overall structural condition and load-carrying capacity. The evaluated bridge is compared with a new bridge built to current design standards. Ratings range from a low of 0 (closed bridge) to a high of 9 (superior). Any appraisal item not applicable to a specific bridge is coded N.

**Approach alignment** – One of five NBI inspection ratings. This rating appraises a bridge’s functionality based on the alignment of its approaches. It incorporates a typical motorist’s speed reduction because of the horizontal or vertical alignment of the approach.

**Character-defining features** – Prominent or distinctive aspects, qualities, or characteristics of a historic property that contribute significantly to its physical character. Features may include structural or decorative details and materials.

**Condition, fair** – A bridge or bridge component of which all primary structural elements are sound, but may have minor deterioration, section loss, cracking, spalling, or scour.

**Condition, good** – A bridge or bridge component which may have some minor deficiencies, but all primary structural elements are sound.

**Condition, poor** – A bridge or bridge component that displays advanced section loss, deterioration, cracking, spalling, or scour.

**Condition rating** – Level of deterioration of bridge components and elements expressed on a numerical scale according to the NBI system. Components include the substructure, superstructure, deck, channel, and culvert. Elements are subsets of components, e.g., piers and abutments are elements of the component substructure. The evaluated bridge is compared with a new bridge built to current design standards. Component ratings range from 0 (failure) to 9 (new) or N for (not applicable); elements are rated on a scale of 1-3, 1-4 or 1-5 (depending on the element type and material). In all cases condition state 1 is the best condition with condition state 3, 4 or 5 being the worst condition. In rating a bridge’s condition, MnDOT pairs the NBI system with the newer and more sophisticated Pontis element inspection information, which quantifies bridge elements in different condition states and is the basis for subsequent economic analysis.

**Corrosion** – The general disentegration of metal through oxidation.

**Cutwater** – The wedge-shaped end of a bridge pier, designed to divide the current and break up ice.
**Decay** – Deterioration of wood as a result of fungi feeding on its cell walls.

**Delamination** – Surface separation of concrete, steel, glue laminated timber plies etc. into layers.

**Deck geometry** – One of five NBI appraisal ratings. This rating appraises the functionality of a bridge’s roadway width and vertical clearance, taking into account the type of roadway, number of lanes, and ADT.

**Deficiency** – The inadequacy of a bridge in terms of structure, serviceability, and/or function. Structural deficiency is determined through periodic inspections and is reflected in the ratings that are assigned to a bridge. Service deficiency is determined by comparing the facilities a bridge provides for vehicular, bicycle, and pedestrian traffic with those that are desired. Functional deficiency is another term for functionally obsolete (see below). Remedial activities may be needed to address any or all of these deficiencies.

**Deficiency rating** – A nonnumeric code indicating a bridge’s status as structurally deficient (SD) or functionally obsolete (FO). See below for the definitions of SD and FO. The deficiency rating status may be used as a basis for establishing a bridge’s eligibility and priority for replacement or rehabilitation.

**Design exception** – A deviation from federal design and geometric standards that takes into account environmental, scenic, aesthetic, historic, and community factors that may have bearing upon a transportation project. A design exception is used for federally funded projects where federal standards are not met. Approval requires appropriate justification and documentation that concerns for safety, durability, and economy of maintenance have been met.

**Design load** – The usable live-load capacity that a bridge was designed to carry, expressed in tons according to the AASHTO allowable stress, load factor, or load resistance factor rating methods. An additional code was recently added to assess design load by a rating factor instead of tons. This code is used to determine if a bridge has sufficient strength to accommodate traffic load demands. A bridge that is posted for load restrictions is not adequate to accommodate present or expected legal truck traffic.

**Deterioration** – Decline in condition of surfaces or structure over a period of time due to chemical or physical degradation.

**Efflorescence** – A deposit on concrete or brick caused by crystallization of carbonates brought to the surface by moisture in the masonry or concrete.

**Extant** – Currently or actually existing.

**Extrados** – The upper or outer surfaces of the voussoirs which compose the arch ring. Often contrasted with intrados.
**Footing** – The enlarged, lower portion of a substructure which distributes the structure load either to the earth or to supporting piles.

**Fracture Critical Members** – Tension members or tension components of bending members (including those subject to reversal of stress) whose failure would be expected to result in collapse of the bridge.

**Functionally obsolete** – The Federal Highway Administration (FHWA) classification of a bridge that does not meet current or projected traffic needs because of inadequate horizontal or vertical clearance, inadequate load-carrying capacity, and/or insufficient opening to accommodate water flow under the bridge. An appraisal rating of 3 or less for deck geometry, underclearance, approach alignment, structural evaluation or waterway adequacy will designate a bridge as functionally obsolete.

**Gusset plate** – A plate that connects the horizontal and vertical members of a truss structure and holds them in correct position at a joint.

**Helicoidal** – Arranged in or having the approximate shape of a flattened coil or spiral.

**Historic fabric** – The material in a bridge that was part of original construction or a subsequent alteration within the historic period of the bridge (i.e., more than 50 years old). Historic fabric is an important part of the character of the historic bridge and the removal, concealment, or alteration of any historic material or distinctive engineering or architectural feature should be avoided if possible. Often, the character-defining features include important historic fabric. However, historic fabric can also be found on other elements of a bridge that have not been noted as character-defining.

**Historic bridge** – A bridge that is listed in, or eligible for listing in, the National Register of Historic Places.

**Historic integrity** – The authenticity of a bridge’s historic identity, evidenced by the survival and/or restoration of physical characteristics that existed during the bridge’s historic period. A bridge may have integrity of location, design, setting, materials, workmanship, feeling, and association.

**Inspections** – Periodic field assessments and subsequent consideration of the fitness of a structure and the associated approaches and amenities to continue to function safely.

**Intrados** – The inner or lower surface of an arch. Often contrasted with extrados.

**Inventory rating** – The load level a bridge can safely carry for an indefinite amount of time expressed in tons or by the rating factor described in design load (see above). Inventory rating values typically correspond to the original design load for a bridge without deterioration.

**Keystone** – Wedge-shaped stone, or voussoir, at the crown of an arch.
**Load Rating** – The determination of the live load carrying capacity of a bridge using bridge plans and supplemented by field inspection.

**Maintenance** – Work of a routine nature to prevent or control the process of deterioration of a bridge.

**Minnesota Historical Property Record** – A documentary record of an important architectural, engineering, or industrial site, maintained by the Minnesota Historical Society as part of the state’s commitment to historic preservation. MHPR typically includes large-format photographs and written history, and may also include historic photographs, drawings, and/or plans. This state-level documentation program is modeled after a federal program known as the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER).

**National Bridge Inventory** – Bridge inventory and appraisal data collected by the FHWA to fulfill the requirements of the National Bridge Inspection Standards (NBIS). Each state maintains an inventory of its bridges subject to NBIS and sends an annual update to the FHWA.

**National Bridge Inspection Standards** – Federal requirements for procedures and frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of state bridge inventories. NBIS applies to bridges located on public roads.

**National Register of Historic Places** – The official inventory of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture, which is maintained by the Secretary of the Interior under the authority of the National Historic Preservation Act of 1966 (as amended).

**Non-vehicular traffic** – Pedestrians, non-motorized recreational vehicles, and small motorized recreational vehicles moving along a transportation route that does not serve automobiles and trucks. Includes bicycles and snowmobiles.

**Operating rating** – Maximum permissible load level to which a bridge may be subjected based on a specific truck type, expressed in tons or by the rating factor described in design load (see above).

**Pack rust** – Rust forming between adjacent steel surfaces in contact which tends to force the surfaces apart due to the increase in steel volume.

**Pier** – A substructure unit that supports the spans of a multi-span superstructure at an intermediate location between its abutments.

**Pointing** – The compaction of mortar into the outermost portion of a joint and the troweling of its exposed surface to secure water tightness and/or desired architectural effect (when replacing deteriorated mortar).
**Pony truss** – A through bridge with parallel chords and having no top lateral bracing over the deck between the top chords.

**Posted load** – Legal live-load capacity for a bridge which is associated with the operating rating. A bridge posted for load restrictions is inadequate for legal truck traffic.

**Pontis** – Computer-based bridge management system to store inventory and inspection data and assist in other bridge data management tasks.

**Preservation** – Preservation, as used in this report, refers to historic preservation that is consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*. Historic preservation means saving from destruction or deterioration old and historic buildings, sites, structures, and objects, and providing for their continued use by means of restoration, rehabilitation, or adaptive reuse. It is the act or process of applying measures to sustain the existing form, integrity, and material of a historic building or structure, and its site and setting. MnDOT’s *Bridge Preservation, Improvement and Replacement Guidelines* describe preservation differently, focusing on repairing or delaying the deterioration of a bridge without significantly improving its function and without considerations for its historic integrity.

**Preventive maintenance** – The planned strategy of cost-effective treatments that preserve a bridge, slow future deterioration, and maintain or improve its functional condition without increasing structural capacity.

**Reconstruction** – The act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location. Activities should be consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*.

**Rehabilitation** – The act or process of returning a historic property to a state of utility through repair or alteration which makes possible an efficient contemporary use, while preserving those portions or features of the property that are significant to its historic, architectural, and cultural values. Historic rehabilitation, as used in this report, refers to implementing activities that are consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*. As such, rehabilitation retains historic fabric and is different from replacement. MnDOT’s *Bridge Preservation, Improvement and Replacement Guidelines* describe rehabilitation and replacement in similar terms.

**Restoration** – The act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time. Activities should be consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*.

**Ring stone** – One of the separate stones of an arch that shows on the face of the headwall, or end of the arch. Also known as a voussoir.
**Scaling** – The gradual distentegration of a concrete surface due to the failure of the cement surface caused by chemical attack or freeze-thaw cycles or rebar too close to the surface and oxidizing from exposure to chlorides.

**Scour** – Removal of material from a river’s bed or bank by flowing water, compromising the strength, stability, and serviceability of a bridge.

**Scour critical rating** – A measure of a bridge’s vulnerability to scour (see above). MnDOT utilizes letter designations to represent specific descriptions of a bridge's susceptibility and/or present condition in regards to scour. Range in condition and scour susceptibility does not necessarily correlate alpha numerically to the MnDOT scour code letters so it is important to understand the specific scour description for each MnDOT scour code. The scour codes and descriptions can be found in the "MNDOT Bridge Inspection Field Manual".

**Section loss** – Loss of a member’s cross sectional area and resulting strength usually by corrosion or decay.

**Serviceability** – Level of facilities a bridge provides for vehicular, bicycle, and pedestrian traffic, compared with current design standards.

**Smart flag** – Special Pontis inspection element used to report the condition assessment of a deficiency that cannot be modeled, such as cracks, section loss, and steel fatigue.

**Spall** – Depression in concrete caused by a separation of a portion of the surface concrete, revealing a fracture parallel with or slightly inclined to the surface.

**Spring line** – The imaginary horizontal line at which an arch or vault begins to curve. As example, the point of transition from the vertical face of an abutment to the start of arch curvature extending from abutment face.

**Stabilization** – The act or process of stopping or slowing further deterioration of a bridge by means of making minor repairs until a more permanent repair or rehabilitation can be completed.

**Stringcourse** – A horizontal band of masonry, generally narrower than other courses and sometimes projecting, that extends across the structure’s horizontal face as an architectural accent. Also known as belt course.

**Structural evaluation** – Condition rating of a bridge designed to carry vehicular loads, expressed as a numeric value and based on the condition of the superstructure and substructure, the inventory load rating, and the ADT.
**Structurally deficient** – Classification indicating NBI condition rating of 4 or less for any of the following: deck condition, superstructure condition, substructure condition, or culvert condition. A bridge is also classified as structurally deficient if it has an appraisal rating of 2 or less for its structural evaluation or waterway adequacy. A structurally deficient bridge is restricted to lightweight vehicles; requires immediate rehabilitation to remain open to traffic; or requires maintenance, rehabilitation, or replacement.

**Sufficiency rating** – Rating of a bridge’s structural adequacy and safety for public use, and its serviceability and function, expressed on a numeric scale ranging from a low of 0 to a high of 100. It is a relative measure of a bridge’s deterioration, load capacity deficiency, or functional obsolescence. MnDOT may use the rating as a basis for establishing eligibility and priority for replacement or rehabilitation. Typically, bridges which are structurally deficient and have sufficiency ratings between 50 and 80 are eligible for federal rehabilitation funds and those which are structurally deficient with sufficiency ratings of 50 and below are eligible for replacement.

**Tee beam** – A reinforced concrete superstructure system distinguished by a “T” shape. The lower portion of the system are rectangular reinforced concrete beams. The upper portion is a reinforced concrete deck. The two parts form an integral system which works together to resist applied loads.

**Through truss** – A bridge with parallel top and bottom chords and top lateral bracing with the deck generally near the bottom chord.

**Under-clearances** – One of five NBI appraisal ratings. This rating appraises the suitability of the horizontal and vertical clearances of a grade-separation structure, taking into account whether traffic beneath the structure is one- or two-way.

**Variance** – A deviation from State Aid Operations Statute Rules that takes into account environmental, scenic, aesthetic, historic, and community factors that may have bearing upon a transportation project. A design variance is used for projects using state aid funds. Approval requires appropriate justification and documentation that concerns for safety, durability and economy of maintenance have been met.

**Vehicular traffic** – The passage of automobiles and trucks along a transportation route.

**Voussoir** – One of the separate stones forming an arch ring; also known as a ring stone.

**Waterway adequacy** – One of five NBI appraisal ratings. This rating appraises a bridge’s waterway opening and passage of flow under or through the bridge, frequency of roadway overtopping, and typical duration of an overtopping event.
Appendix B. Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior's Standards

*The Secretary’s Standards with Regard to Repair, Rehabilitation, and Replacement Situations*

Adapted from:

The Secretary of the Interior's Standards for the Treatment of Historic Properties, first codified in 1979 and revised in 1992, have been interpreted and applied largely to buildings rather than engineering structures. In this document, the differences between buildings and structures are recognized and the language of the Standards has been adapted to the special requirements of historic bridges.

1. Every reasonable effort shall be made to continue an historic bridge in useful transportation service. Primary consideration shall be given to rehabilitation of the bridge on site. Only when this option has been fully exhausted shall other alternatives be explored.

2. The original character-defining qualities or elements of a bridge, its site, and its environment should be respected. The removal, concealment, or alteration of any historic material or distinctive engineering or architectural feature should be avoided.

3. All bridges shall be recognized as products of their own time. Alterations that have no historic basis and that seek to create a false historic appearance shall not be undertaken.

4. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.

5. Distinctive engineering and stylistic features, finishes, and construction techniques or examples of craftsmanship that characterize an historic property shall be preserved.

6. Deteriorated structural members and architectural features shall be retained and repaired, rather than replaced. Where the severity of deterioration requires replacement of a distinctive element, the new element should match the old in design, texture, and other visual qualities and where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
7. Chemical and physical treatments that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the most environmentally sensitive means possible.

8. Significant archaeological and cultural resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.

9. New additions, exterior alterations, structural reinforcements, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.

10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.
### Appendix C. Documents

**2014 MnDOT Structure Inventory Report**

**MnDOT Structure Inventory Report**  
Bridge ID: L8923  
18TH AVE S over MIDTOWN GREENWAY  
Date: 10/27/2014

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Additional details include:
- **Latitude**: 44d 57m 00.0s
- **Longitude**: 93d 14m 64.0s
- **Custodian**: COUNTY
- **Owner**: COUNTY
- **BMU Agreement**: CITY OF MINNEAPOLIS
- **Year Built**: 1916
- **Year Fed Rehab**: 
- **Year Remodeled**: 
- **Temp**: 
- **Plan Avail.**: MUNICIPAL

**MORE STRUCTURE**
- **Service On**: HWY-FED
- **Service Under**: PED/BICYCLE
- **Main Span Type**: CCONC DK GIRD
- **Main Span Detail**: 
- **Appr. Span Type**: 
- **Appr. Span Detail**: 
- **Skew**: 5.0
- **Culvert Type**: 
- **Barrel Length**: 
- **Number of Spans**
  - MAIN: 3
  - APPr: 0
  - TOTAL: 3
- **Main Span Length**: 32.0 ft
- **Structure Length**: 95.0 ft
- **Deck Width**: 51.0 ft
- **Deck Material**: C-L-P CONCRETE
- **Wear Surf Type**: BITUMINOUS
- **Wear Surf Install Year**: 
- **Wear Course/ Fill Depth**: 0.35 ft
- **Deck Membrane**: NONE
- **Deck Protect.**: N/A
- **Deck Instal Year**: 
- **Structure Area**: 4,845 sq ft
- **Roadway Area**: 3,035 sq ft
- **Sidewalk Width - L/R**: 8.0 ft
- **Curb Height - L/R**: 0.58 ft
- **Rail Codes - L/R**: 36 36

**MORE ROADWAY**
- **Control Section (TH Only)**: 
- **Date Opened to Traffic**: 01-01-1916
- **Detour Length**: 1 mi
- **Lanes**: 2 Lanes ON Bridge
- **ADT (YEAR)**: 1,018 (2007)

**MORE INSPECTION**
- **HCADT Functional Class**: URBAN LOCAL
- **ROW DIMENSIONS**: if Divided
  - NB-EB SB-WB
- **Roadway Width**: 32.0 ft
  - 31.9 ft
- **Horizontal Clear.**: 31.9 ft
- **Lateral Clr. - Lt/Rt**: 50.0 ft
- **Appr. Surface Width**: 32.0 ft
- **Roadway Width**: 32.0 ft
- **Median Width**: 

**MORE SAFETY FEATURES**
- **Bridge Railing**: 1-MEETS STANDARDS
- **GR Transition**: N-NOT REQUIRED
- **GR Termini**: N-NOT REQUIRED

**MORE WATERWAY**
- **Drainage Area**: 
- **Navigation Control**: NOT APPL
- **Pier Protection**: 
- **Nav. Vert./Horiz. Ctr.**: 
- **Nav. Vert. Lift Bridge Clear.**: 
- **MN Scour Code**: A-NON WATERWAY
- **Scour Evaluation Year**: 1993

**MORE CAPACITY RATING**
- **Design Load**: UNKN
- **Operating Rating**: HS 34.20
- **Inventory Rating**: HS 21.00
- **Postings**: 
- **Rating Date**: 01-23-2013
- **MnDOT Permit Codes**: A, N, C, N
# 2014 MnDOT Bridge Inspection Report

## Mn/DOT Bridge Inspection Report

**Inspected by:** CITY OF MINNEAPOLIS  
**Bridge Number:** L8923  
**18TH AVE S OVER MIDTOWN GREENWAY**  
**INSP. DATE:** 05-29-2014

### Summary and Management Plan

- **Location:** 0.1 MI N OF LAKE ST  
- **Length:** 95.0 ft  
- **Deck Width:** 51.0 ft  
- **Section:** 35 Township: 029N Range: 24W  
- **Local Agency Bridge Nbr:** 7751  
- **Span Type:** CCONC DK GIRD  
- **Brand/Model:** OPEN  
- **Def. Stat.:** S.D.  
- **Suff. Rate:** 68.9

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**Notes:**
- [THERE ARE MANY RANDOM CRACKS, MEDIUM RPT CRACKS OVER BOTH THE ABUTMENTS WITH MINOR SETTLEMENT. OPEN JOINTS AT GUTTERLINE.]

| 407 | BITUMINOUS APPROACH | 05-29-2014 | 2 EA | 0 | 2 | 0 | 0 | N/A |
| 333 | RAILING - OTHER | 05-29-2014 | 190 LF | 0 | 190 | 0 | 0 | N/A |
| 110 | CONCRETE GIRDER | 05-29-2014 | 856 LF | 0 | 471 | 365 | 0 | N/A |

**Notes:**
- [THERE ARE AREAS OF HEAVY MAP CRACKING, LEACHING, EFFLORESCENCE, SPALLS WITH REBARS EXPOSED. THE WORST CONDITION ON THE WEST SATURATED. THERE IS HEAVY SPALLING ON BOTH FASCIA WITH REBARS EXPOSED.]

| 205 | CONCRETE COLUMN | 05-29-2014 | 8 EA | 0 | 6 | 2 | 0 | N/A |

**Notes:**
- [TWO OF THE EIGHT COLUMNS HAVE SHOTCRETE REPAIRS WITH REBARS EXPOSED AND HOLLOW AREAS. TIMBER TOE WALL BEHIND COLUMNS ON S. SIDE HAS FIRE DAMAGE AND MINOR UNDERMINING. REPAIRED.]  

| 215 | CONCRETE ABUTMENT | 05-29-2014 | 102 LF | 0 | 76 | 25 | 0 | N/A |

**Notes:**
- [THE EAST SIDE OF THE SOUTH ABUTMENT IS BOWED OUT AS MUCH AS 8". BOTH OF THE ABUTMENTS HAVE SHEAR BLOCKS. THE FACES HAVE FULL HEIGHT FINE TO MEDIUM SIZE CRACKS. THE BACKWALLS HAVE HEAVY MAP CRACKING WITH LARGE AREAS OF LEACHING AND SCAILING. THERE ARE SPALLS WITH REBARS EXPOSED AND HOLLOW DELAMINATED AREAS.]  

| 234 | CONCRETE CAP | 05-29-2014 | 102 LF | 0 | 92 | 10 | 0 | N/A |

**Notes:**
- [THERE IS EFFLORESCENCE ON BOTH BENT CAPS ON THE WEST, BOTH SIDES HAVE SCALE DELAMINATION AND SPALLS.]  

| 367 | CONCRETE WINGWALL | 05-29-2014 | 4 EA | 0 | 4 | 0 | 0 | N/A |

**Notes:**
- [THE WINGWALLS HAVE HEAVY SCALE WITH SMALL TO LARGE SIZE CRACKS, DELAMINATION, SPALLS WITH REBAR EXPOSED, MINOR SETTLEMENT. THERE IS SOME VEGETATION. N.W. WINGWALL HAS NEW BLOCK RETAINING WALL BUTTING INTO THE WINGWALL FOR THE GREENWAY EXTENSION RAMP.]  

| 359 | CONC DECK UNDERSIDE | 05-29-2014 | 1 EA | 0 | 0 | 0 | 1 | 0 |

**Notes:**
- [THE SUBSURFACE HAS AREAS OF SEVERE EFFLORESCENCE AND MAP CRACKING WITH SPALLS ALONG THE LONGITUDINAL JOINT. THE SIDEWALK SUBSURFACE SHOWS SATURATION AND HAS SEVERE UNIFORM EFFLORESCENCE, SCALE. MANY FINE TO MEDIUM SIZE TRANSVERSE CRACKS. WATER MAIN REMOVED.]
### Mn/DOT Bridge Inspection Report

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**General Notes:** AREA UNDER, GREENWAY CONNECTION BIKEWAY AND PEDESTRIAN WALKWAY. 2011 DECK ASPHALT THICKNESS CORE TAKEN AT 4 1/4", S.E. APPROACH SIDEWALK PANEL REPLACED.

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**Inspector's Signature**

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**Reviewer's Signature / Date**

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**June 2015**
# 2013 Load Rating Report

**FORM RC-CL**  
Revised Jan. 2012

## MnDOT Bridge Rating and Load Posting Report  
For County and Local Agencies

<table>
<thead>
<tr>
<th>Bridge Location and Description</th>
<th>Bridge No.</th>
<th>L8923</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hwy. No.</td>
<td>18th Ave S</td>
<td></td>
</tr>
<tr>
<td>Under</td>
<td>Midtown Greenway</td>
<td></td>
</tr>
<tr>
<td>Year Built</td>
<td>1916</td>
<td></td>
</tr>
<tr>
<td>Year Remodeled</td>
<td></td>
<td>Replaces Br.</td>
</tr>
<tr>
<td>Type</td>
<td>206-C Clear Dk Gird</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>Hennepin</td>
<td></td>
</tr>
<tr>
<td>Ref. Pt.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description:** Bridge L8923 is a 3-span continuous reinforced concrete deck girder. It has a 32'-0" roadway width, 50'-8" deck width, 2 - concrete parapets w/ metal railings, 2 - 8'-0" sidewalks and a 7.47 degree skew.

**Location:** Minneapolis

**Data for Basis of Report (Check all that apply):**

- Bridge Inventory File
- Previous Bridge Rating and Load Posting Report
- **Bridge Plans**
  - New
  - Overlay
  - Repair/Reconstruction: Assumed 6" overlay, repair of spalls
  - Other Dead Load Modifications
- Bridge Inspected by JRM and JGB
  - Date 3/15/2012
  - Damaged Component
  - Deteriorated Component

**Types of Analysis:**
- Manual
- Computer
- BARS
- VIVS, V-8-12
- Other

**NSI Condition Ratings:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck</td>
<td>4</td>
</tr>
<tr>
<td>Superstructure</td>
<td>4</td>
</tr>
<tr>
<td>Substructure</td>
<td>4</td>
</tr>
<tr>
<td>ADTT</td>
<td>44</td>
</tr>
</tbody>
</table>

**Method of Rating (Check appropriate box):**

- Load Factor (LF)
- Assigned Load Ratings
- Design Load: Unknown
- Allowable Stress (AS)
- Load & Resistance Factor (LRFR)
- Load Testing
- No Rating Computations performed

**Design Method:** ASD

## Summary of Rating and Load Posting Analysis

<table>
<thead>
<tr>
<th>Load Posting</th>
<th>Required</th>
<th>Not Required</th>
<th>Bridge Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign</td>
<td>TONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R12-1A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R12-5a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R12-5</td>
<td>M3</td>
<td>M3S2, M3-3</td>
<td></td>
</tr>
<tr>
<td>R12-X11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Inventory:**

| HS RF | 21.0 |
| HS RF | 34.2 |

**Operating:**

| HS RF | 45   |

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I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

**Signature:** [Signature]

**Date:** 11/23/2013

(name)

License No. 49106

(Typed or Printed) Employed by: TKDA

My signature below indicates that I have read and fully agreed with the load rating report.

**Program Administrator's Signature:** [Signature]

**Date:** 02/05/2013
**BRIDGE RATING DETAILS**

<table>
<thead>
<tr>
<th>Bridge Type</th>
<th>CConc Deck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating Method</td>
<td>LFD</td>
</tr>
<tr>
<td>Roadway Width</td>
<td>32'-0&quot;</td>
</tr>
<tr>
<td>Beam Spacing</td>
<td>5'-6&quot;</td>
</tr>
<tr>
<td>Live Load Distribution Factor</td>
<td>Single 0.846, Multiple 0.917</td>
</tr>
</tbody>
</table>

**Bridge No.** L8923

- **Design Load:** Unknown
- **Inventory Rating:** 21.0
- **Operating Rating:** 34.2
- **Rated:** JRM
- **Checked:** MID
- **Date:** 1/22/2013
- **Sheet:** 2 of 2

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**BEAM ELEVATION**

Show span lengths, structure/beam depths.

<table>
<thead>
<tr>
<th>Truck</th>
<th>Rating Factor</th>
<th>Span/ Pier</th>
<th>Location</th>
<th>Limit State</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS 20 Inventory</td>
<td>1.05</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot; - Truck</td>
</tr>
<tr>
<td>HS 20 Operating</td>
<td>1.71</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot; - Truck</td>
</tr>
<tr>
<td>Post, M3</td>
<td>2.14</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
</tr>
<tr>
<td>Post, M3S2</td>
<td>2.11</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
</tr>
<tr>
<td>Post, M3S3</td>
<td>2.14</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
</tr>
<tr>
<td>Type SU4</td>
<td>1.96</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
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<tr>
<td>Type SU5</td>
<td>1.84</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
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<tr>
<td>Type SU6</td>
<td>1.83</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
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<tr>
<td>Type SU7</td>
<td>1.72</td>
<td>Pier 1</td>
<td>N/A</td>
<td>Ultimate Shear</td>
<td>Beam &quot;G6&quot;</td>
</tr>
</tbody>
</table>

1. Choose from: service or ultimate; shear or moment
2. Elevation may be on back or another sheet if it won't fit here.