Minnesota Department of Transportation (MnDOT)
Local Historic Bridge Report- Abridged

Executive Summary — Bridge Number: L6116

Bridge L6116, also known as the Aerial Lift Bridge, was constructed in 1901-1905 and modified in 1929. It is located on Lake Avenue and spans the Duluth Ship Canal, which connects the city of Duluth with Minnesota Point. The City of Duluth owns the bridge. The original 1901-1905 aerial bridge had a gondola car suspended by an inverted steel tower from the underside of the truss. This truss remains extant as a structural member of the bridge. In 1929 the bridge was modified by adding an elevating roadway to replace the traversing platform, lengthening the steel towers, and incorporating new structural support within the confines of the old towers to carry the counterweight roadway. The Aerial Lift Bridge is a span drive configuration movable lift bridge. It is individually listed on the National Register of Historic Places under Criterion C: Engineering as a rare bridge type of engineering at a national level. It is also a contributing resource to the determined-eligible Duluth Ship Canal Historic District.

The Aerial Lift Bridge has had a series of rehabilitation work over the last 30 years. Major rehabilitations were conducted in 1986, 1999, 2007 and 2009. Among other repairs the major work in the rehabilitation included replacement of the operator's house, bridge sidewalk and retaining walls (1986); repainting of the lower portion of the truss and floor system, and replacement of machinery and structural elements (1999); and repainting of the towers and upper portions of the truss (2007, 2009).

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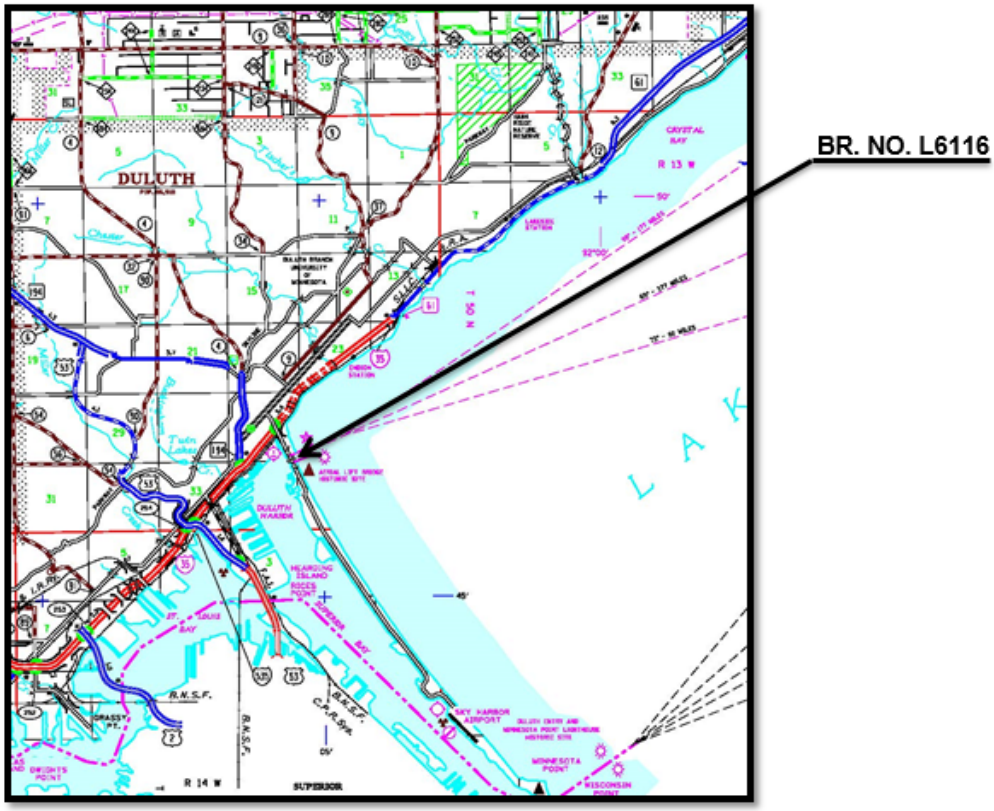
Bridge Location **Bridge Number: L6116**



Bridge L6116 – MSAS 140 (LAKE AVE) over SHIP CANAL

PROJECT LOCATION
ST. LOUIS COUNTY
SEC. 27, TO 050NN, R 14W
UTM ZONE: 15 NAD: 27
USGS QUAD NAME: DULUTH
EASTING: 1867601 ft.
NORTHING: 16998009 ft.

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Minnesota Department of Transportation (MnDOT)
Local Historic Bridge Report- Abridged

I – Project Introduction Bridge Number: L6116

This Abridged Bridge Report is a product of a comprehensive study performed for approximately 140 historic bridges owned by county, city, township, private and other state agencies besides MnDOT. The study is the second phase of a multi-phased process developed and executed in partnership with representatives from the Federal Highway Administration (FHWA): State Historic Preservation Office (SHPO); MnDOT State Aid; MnDOT Cultural Resources Unit (CRU); the US Army Corps of Engineers (USACE); local public works and county highway departments; county and township boards and city councils; the preservation community and the general public. To perform the study, MnDOT retained the consultant team of LHB Inc., Mead & Hunt Inc., and The 106 Group.

The general goals of the study include:

- Gathering and compiling the existing historic and bridge condition data and other relevant information on the bridges in the study group into bridge reports.
- National Register nominations for a select number of bridges within the study group which the bridge owner may request a nomination to be prepared.
- Updating MnDOT's *Management Plan for Historic Bridges in Minnesota* based on the study's findings.
- Producing a narrative for the MnDOT Historic Bridge Website to disseminate information regarding locally owned historic bridges in Minnesota.
- Investigating and preparing a summary regarding how other states have funded historic bridge programs and structured Programmatic Agreements when multiple non-state entities are the owners of historic bridges.

The Bridge Reports compile and summarize the historic and engineering information concerning the structures. It is important to note that this report indicates if a bridge is located within a known historic district, but it does not identify all known or potential historic properties. Potential impacts to adjacent or surrounding historic properties, such as archaeological sites or other structures must be considered. Contact MnDOT CRU early in the project planning process in order to identify other potential historic properties. Due to private ownership, recently completed engineering/preservation studies, or recently executed rehabilitation projects, a small number of bridges were identified for abridged reports. An abridged report compiles readily available information, especially data about the bridge's historic significance. Additionally, recent rehabilitation work that has been completed is described and documented with photographs where available. It is important that historic bridges receive appropriate annual maintenance work. This bridge was not assessed for annual maintenance needs however technical guidance on stabilization, preservation and maintenance activities can be found in the Management Plan for Historic Bridges in Minnesota, available on MnDOT's website.

Recommendations are not included within the Abridged Bridge Reports. However any future work should be consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties (Standards). The Standards are basic principles created to help preserve the distinct character of a historic property and its site, while allowing for reasonable change to meet new engineering standards and codes. The Standards 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.

The Standards were developed with historic buildings in mind and cannot be easily applied to historic bridges. The Virginia Transportation Research Council (Council) prepared Guidelines, which adapted the Standards to address the special requirements of historic bridges. They were published in the Council's 2001 Final Report: A Management Plan for Historic Bridges in Virginia, *The Secretary's Standards with Regard to Repair, Rehabilitation, and Replacement Situations,* provide useful direction for undertaking historic bridge preservation and are included in the Appendix to this plan.

Existing bridge data sources typically available for Minnesota bridges were gathered for the study. These sources include:

- PONTIS, a bridge management system formerly used by MnDOT to manage its inventory of bridges statewide, and its replacement system, SIMS (Structure Information Management System)
- The current MnDOT Structure Inventory Report and MnDOT Bridge Inspection Report. Reports are available for the majority of the bridges (not available for bridges in private ownership)
- Database and inventory forms resulting from the 2012 Minnesota Local Historic Bridge Study and other prior historic bridge studies as incorporated into the database
- Existing Minnesota historic contexts studies for bridges in Minnesota, including *Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945, Minnesota Masonry-Arch Highway Bridges, 1870-1945, Iron and Steel Bridges in Minnesota, 1873-1945 and Minnesota Bridges 1955-1970*
- Field investigations documenting the general structural condition and determining character-defining features

Additional data sources researched and gathered for some of the bridges as available also included:

- Files and records at MnDOT offices
- Original bridge construction plans, rehabilitation plans, and maintenance records of local owners
- Files and documents available at the SHPO office, including previous inventory forms, determinations of eligibility, studies, and compliance documents
- Existing historic and documentary material related to the National Register-eligible bridges

The Appendix contains the following: a Glossary explaining structural and historic preservation terms used in the report, the Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior's Standards, a list of engineering and historic documents available for this bridge, and copies of the MnDOT Structure Inventory and Bridge Inspection Reports current at the time of the report preparation.

The Abridged Bridge Report will provide the bridge owner and other interested parties with detailed information related to the historic nature of the bridge and varied information concerning the condition of the bridge depending on information furnished at the time of report preparation. This information will enable historic bridge owners to make more informed decisions when planning for their historic properties.

This narrative is drawn from previous documents, as available for the subject bridge, which may include determination of eligibility (also known as Phase II evaluation), Minnesota Architecture/History form, National Register nomination, Multiple Property Documentation Form, and/or applicable historic contexts. See Sources for details on which documents were used in compiling this Historic Data section.

Contractor Modern Steel Structural Company

Designer/Engineer Thomas F. McGilvray / C.A.P. Turner

Description

Bridge L6116, also known as the Aerial Lift Bridge, was constructed in 1901-1905 and modified in 1929. It carries Lake Avenue over the Duluth Ship Canal, which connects the city of Duluth with Minnesota Point. Minnesota Point is a natural land formation separating Lake Superior from Duluth Harbor.

The original aerial bridge had vertical riveted steel trussed towers constructed on concrete piers on each side of the canal, with a truss across the top. The structure stood 186 feet high at the apex of the truss and was 34 feet wide, allowing 135 feet clearance overall. A gondola car was suspended by an inverted steel tower from the underside of the truss, traversing the clear span distance of 393 feet 9 inches. The gondola provided access across the channel.

In 1929 the bridge was modified to a vertical lift structure. Modifications added an elevated counterweighted roadway to replace the traversing platform, lengthened the steel towers, and incorporated new structural support within the confines of the old towers to carry the roadway.

The Aerial Lift Bridge is a span drive configuration movable lift bridge. Two, 172-foot-tall riveted steel trussed towers support large diameter sheave wheels with counterweight wire ropes. The counterweight ropes connect to the ends of the roadway lift truss and to the 450-ton concrete counterweight blocks. A second set of wire ropes, (uphaul/ downhaul ropes) at each end of the bridge, wind on and off steel drums. The steel drums are driven by electric motors housed within the machinery rooms at each end of the lift span truss. The rotation of the drums serves to raise and lower the bridge (up to 138 feet) by winding the ropes on and off of the drums. The force needed to turn the drums to raise and lower the bridge is substantially reduced by the counterweight system.

The bridge operator's house, located in a small gabled building in the middle of the movable span, contains the controls. A steel truss span, a remnant of the 1905 aerial bridge, rests on the top of the two towers, and functions as structural support.

The Aerial Lift Bridge has two concrete deck girder approach spans and a central, steel through truss lift span. The main span deck is an open grating that carries two lanes of traffic and 5-foot sidewalks on either side. The deck width is 24 feet, and total surface width is 40 feet. The bridge structure length is 501 feet 9 inches with a main span length of 385 feet 11 inches. The abutments are concrete with pile footings. The lift bridge is powered by electricity and can be raised in 60 seconds. An auxiliary generator is used for emergency stand-by power. During the busy shipping season the bridge is opened approximately 25 times per day.

The Duluth Aerial Lift Bridge was rehabilitated in 1986, 1999, 2007, and 2009. The City of Duluth has performed routine maintenance since that time. Rehabilitation work has maintained the character-defining features of the bridge. In 1986 the original flat roof operator's house was replaced with a larger gabled operator's house. Other rehabilitation activities in 1986 included replacement of select structural steel elements, rivets, the bridge sidewalk, and retaining walls; repairs to the abutments, machinery, superstructure, and lighting system; and bridge painting. Rehabilitation efforts in 1999, 2007, and 2009 included concrete repair, resurfacing of approach pavement, cleaning and repainting, rehabilitation or replacement of machinery, steel, rivet, and sidewalk replacements and repairs, and guardrail modifications.

Significance

Before 1905, there was no bridge crossing from Duluth to Minnesota Point. Minnesota Point peninsula became an island in 1871 after the City of Duluth dug a canal between it and the mainland to protect harbor facilities from severe storms. By 1889 the canal was widened to 350 feet. The Duluth Ship Canal became significant as one of the nation's most important inland transportation routes. As population and tourism increased, the city determined a better transportation method across the canal was necessary. Designing a bridge over the canal proved a difficult task, and many designs were rejected for expense, design challenges, and opposition from various organizations.

Finally, in 1889 Thomas F. McGilvray designed a bridge that satisfied the city, Board of U.S. Engineers, and the steam ship companies. McGilvray designed an aerial bridge, modeling it after a similar bridge in Rouen, France. C.A.P. Turner modified McGilvray's design by replacing the cable suspenders with a girder, carrying the ferry car in a stiffer and cheaper way. During the design process, the Lake Carriers Association asserted that a 186-foot clearance was necessary for the passage of the highest masted ships of the day. Over the next few years several bridge building companies withdrew bids or failed to construct McGilvray's aerial bridge. In 1901, bridge construction halted, leaving only the bridge foundation completed. Finally, in 1904 the Modern Steel Structural Company of Waukesha, Wisconsin, submitted a successful bid for the steel framework and gondola car construction. The total cost of construction when completed in 1905 was $108,000.

The 1905 bridge had a gondola car suspended by an inverted steel tower from the underside of the truss. It traversed the clear span distance of 393 feet 9 inches. It was capable of carrying 125,000 pounds, and measured 34 by 50 feet with space provided for one streetcar, two wagons, and 350 persons in two enclosed cabins. The car traveled at a height of six feet above the top level of the concrete piers. A round trip in the car took about ten minutes and the car could make twelve complete round trips per hour during peak periods. The car was powered by electric batteries, with manual operations available for emergencies.

For 25 years, the aerial transfer bridge carried traffic over the canal, but due to increased tourism and the increased use of personal automobiles, the bridge was modified for permanent automobile use in 1929. The plans for modification were produced by Harrington Howard and Ash, a prominent firm of consulting engineers of Kansas City. The design incorporated an elevating "lift" bridge to replace the traversing gondola car. This required raising the height of the bridge and incorporating additional structural support

within the confines of the old towers to carry the counterweights and roadway. Modification costs totaled $400,000.

The Aerial Lift Bridge has been rehabilitation four times since 1985. Rehabilitation work maintained the character defining features of the bridge and did not diminish the integrity of workmanship, design, and materials. The bridge continues to carry Lake Avenue over the Duluth Ship Canal and retains integrity of location, association, feeling and setting. The periods of significance for Bridge L6116 are 1905 to correspond with its date of construction and 1929 to correspond with the date of conversion to a lift bridge.

The Aerial Lift Bridge stands as the western gateway to the Great Lakes-St. Laurence Seaway System. It is the unofficial symbol for the city of Duluth, representing its position as the world's largest fresh water port. Each year more than 500,000 people visit the harbor to watch ships from all over the world enter and depart beneath the Aerial Lift Bridge. The Aerial Lift Bridge is individually listed on the National Register of Historic Places under *Criterion C* in the area of Engineering as a rare bridge type of engineering at a national level. It is also a contributing resource to the determined eligible Duluth Ship Canal Historic District.

Historic Context	Historic Minnesota Iron and Steel Highway Bridges (1873-1945)
National Register Status	Listed (Individually); Contributing to Eligible Historic District
Criterion A Significance	N/A
Criterion C Significance	Engineering: Important type
Historic District	Duluth Ship Canal
SHPO inventory number	SL-DUL-2380

Sources Used to Compile Section II -- Historic Data

"Duluth Ship Canal Historic District." National Register Nomination.

"L6116." MnDOT Structure Inventory Report. 30 May 2013.

Harrington, Howard, and Ash. "Lake Avenue South Bridge over Duluth Ship Canal." Prepared for the City of Duluth, 1929.

Howard, Needles, Tammen and Bergendoff. "Rehabilitation Plan for the Duluth Areal Bridge over the Duluth Ship Canal." Prepared for the City of Duluth, 8 March 1984.

LHB Engineers and Architects and Hardesty & Hanover Consulting Engineers. Construction Plan for general, structural, mechanical, and electrical rehabilitation work, Duluth Aerial Lift Bridge, Bridge No. L6116. Prepared for the City of Duluth, 4 May 1999.

LHB. Construction Plans for painting and general structural rehabilitation work Duluth Aerial Lift Bridge, Bridge No. L6116. Prepared for the City of Duluth, 20 November 2007.

LHB. Construction Plans for painting and general structural rehabilitation work Duluth Aerial Lift Bridge, Bridge No. L6116. Prepared for the City of Duluth, 12 March 2009.

Lutz, Tom. “Aerial Lift Bridge.” National Register Nomination. 1973.

Mead & Hunt, Inc. *Historic Context for Louisiana Bridges*. Prepared for the Louisiana Department of Transportation and Development, December 2013.

Young, Frank A. “Duluth’s Most Famous Landmark.” *Duluthian*, July 1973.

Character-Defining Features

Character-defining features are prominent or distinctive aspects, qualities, or characteristics of a historic property that contribute significantly to its physical character. Features may include materials, engineering design, and structural and decorative details. 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. For this reason, it is important to consider both character-defining features and the bridge's historic fabric when planning any work.

Feature 1: Design and construction of a span drive configuration movable lift bridge.

Feature 2: Setting within the Duluth Ship Canal Historic District.

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III – Bridge Data — Bridge Number: L6116

Date of Construction (remodel)	**1905, 1929 (1986, 1999, 2007,2009)**
Common Name (if any)	Aerial Lift Bridge

Location

Feature Carried:	MSAS 140(LAKE AVE)
Feature Crossed:	Ship Canal
County:	St. Louis
Ownership:	City of Duluth

MnDOT Structure Data

*Data Current (as of):	Sep 2014
Main Span Type:	318 STEEL MOVEABLE
Main Span detail:	WARR W/POLY TC
Substructure Type - Foundation Type:	
Abutment:	1-Concrete - 3-Footing/Pile
Piers:	N-Not Applicable - 5-U Type Abut
Total Length:	501.8 ft
Main Span Length:	385.9 ft
Total Number of Span(s):	3
Skew (degrees):	0
Structure Flared:	No Flare
Roadway Function:	Urban, Collector
Custodian/Maintenance Type:	City

Reported Owner Inspection Date	10/14/2013
Sufficiency Rating	50.5
Operating Rating	HS 27.4
Inventory Rating	HS 15.8
Structure Status	R-Posted-Other Cap
Posting	VEH: SEMI: DBL:
Design Load	HS20

Current Condition Code

Deck:	6
Superstructure:	6
Substructure:	7
Channel and Protection:	8
Culvert:	N

Roadway Clearances

Roadway Width:	24 ft
Vert. Clearance Over Rdwy:	18 ft
Vert. Clearance Under Rdwy:	135 ft
Lat. Clearance Right:	0 ft
Lat. Clearance Left:	0 ft

Current Appraisal Rating

Structural Evaluation:	6
Deck Geometry:	2
Underclearances:	N
Waterway Adequacy:	8
Approach Alignment:	8

Roadway Data

ADT Total:	7093 (2008)
Truck ADT Percentage:	Not given
Bypass Detour length:	99 miles
Number of Lanes:	2

Fracture Critical	Yes
Deficient Status	F.O.

Waterway Data

Scour Code: I-LOW RISK

Non-MnDOT Data

Approach Roadway Characteristics

Lane Widths:	12 ft
Shoulder Width:	N/A (C&G)
Shoulders Paved or Unpaved:	N/A (C&G)
Roadway Surfacing:	Bituminous

****Number of Crashes reported in MnMCAT within 500 feet of Bridge Site** 26

Location of Plans	City of Duluth
Plans Available	1903 Plan Sheets, 1929 Aerial Lift Bridge Remodel, 1986 Rehabilitation; 1999 Rehab Plan, 2008-2009 Lift Span Painting, 2010-2011 Tower Painting

* Non-MnDOT data collected during field survey. All other fields of data collected from MnDOT September of 2014. See Appendix C for MnDOT inventory and inspection report data.
** Unless a significant number of crashes are noted on or near a bridge, the accident data is not detailed in this report.

The Aerial Lift Bridge has been rehabilitated a number of times over the last 30 years. The following summary of work completed was compiled from 1986, 1999, 2007, and 2009 rehabilitation plans prepared by Howard, Needles, Tammen and Bergendoff; LHB Engineers and Architects, and Hardesty & Hanover Consulting Engineers.

In 1986 the 1929 flat roof operator's house was replaced with a larger gabled house. Other rehabilitation activities in 1986 included replacement of select structural steel elements, rivets, the bridge sidewalk, and retaining walls; repairs to the abutments, machinery, superstructure, and lighting system; and bridge painting. In 1999 the bridge underwent another rehabilitation. Efforts included concrete repair on the abutments and approach spans, resurfacing of approach pavement, cleaning and repainting of the lower portion of the lift span, rehabilitation or replacement of machinery, steel repair, new guardrail, and rebuilding of access stairways. More recent rehabilitation undertakings (2007, 2009) include repair of grating; painting of the towers, overhead truss, sidewalk steel fascia, and lift span; concrete repair on abutment and approaches; steel, rivet, and sidewalk replacements and repairs; and guardrail modifications.

An electronic copy of the rehabilitation plans is available from MnDOT CRU (see Appendix C for all electronic resources provided to MnDOT CRU as part of this bridge report).

Summarized Preservation Cost

Due to the recent rehabilitation of this structure, no costs were estimated because an engineering assessment for the structure's current condition and stabilization, preservation and maintenance needs was not performed. Refer to the *Management Plan for Historic Bridges in Minnesota* for technical guidance on stabilization, preservation and maintenance activities, available on MnDOT's website.

Appendix A. Glossary

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 innner 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 Socitety 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 bridges 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 specifc 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 slighty 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 sufficientcy ratings of 50 and below are eligible for replacement.

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:

Clark, Kenneth M., Grimes, Mathew C., and Ann B. Miller, *Final Report, A Management Plan for Historic Bridges in Virginia*, Virginia Transportation Research Council, 2001.

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 historical basis and that seek to create a false historical 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

Additional Electronic Data
Bridge L6116

Historic Data
- Research

Local Data
- No data

MnDOT Reports
- 2005 Inspection Photos
- Accident Report
- Inspection Reports
- Load Ratings
- Plans & Info
- Truss Diagrams & Blank Notes
- 2009 Inspection Procedures – Contacts
- 2010 Condition Sheet L6116
- L6116 Inspection 10-01-12
- L6116 Inspection 10-14-13
- L6116 Inventory 05-30-13
- L6116 Inventory 09-09-14
- L6116 Rating Report 2009

Photos
- 2005 Photos
- Historic Photos
- L6116 2003 General Photos
- L6116 2009 Photos
- L6116 2011 Photos
- Report Photos

Plans
- 1903 Plan Sheets
- 1903 tower scans
- 1929 Aerial Lift Bridge Remodel
- 1986 Aerial Lift Bridge Rehabilitation Original Mylars
- 1999 Lift Bridge Rehab Plan
- 2008-2009 Lift Span Painting - SAP 118-140-029 Record Drawings
- 2010-2011 Tower Painting SP118-140-030

Mn/DOT BRIDGE INSPECTION REPORT

Inspected by: CITY OF DULUTH

BRIDGE L6116 MSAS 140(LAKE AVE) OVER SHIP CANAL INSP. DATE: 10-14-2013

County: ST LOUIS
City: DULUTH
Township:
Section: 27 Township: 050NN Range: 14W
Span Type: STEEL MOVEABLE

Location: 0.6 MI SE OF SUPERIOR ST
Route: MSAS 140 Ref. Pt.: 004+00.184
Control Section: Maint. Area:
Local Agency Bridge Nbr:

Length: 501.8 ft
Deck Width: 24.0 ft
Rdwy. Area / Pct. Unsnd: 12,045 sq ft
Paint Area/ Pct. Unsnd: 273,805 sq ft 18 %
Culvert N/A

NBI Deck: 6 Super: 6 Sub: 7 Chan: 8 Culv: N

Open, Posted, Closed: OTHER LD CAP RES

Appraisal Ratings - Approach: 8 Waterway: 8

MN Scour Code: I-LOW RISK Def. Stat: F.O. Suff. Rate: 50.5

Required Bridge Signs - Load Posting: NOT REQUIRED Traffic: SPEED LIMIT
Horizontal: NOT REQUIRED Vertical: NOT REQUIRED

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
13	BIT. O/L (CONC DECK)	2	10-14-2013	2,718 SF	2,718	0	0	0	0
			09-10-2013	2,718 SF	2,718	0	0	0	0

Notes: |[2011-13] Element added to rate the concrete slabs over the hollow abutments. No deficiencies observed.|

28	STEEL GRID DECK-OPEN	2	10-14-2013	9,310 SF	0	0	9,310	0	0
			09-10-2013	9,310 SF	0	0	9,310	0	0

Notes: |2005 Grating tie road between grating webs are heavily rusted at their ends. Not of structural concern as long as grating webs remain welded to stringers for support.
2007 Welds broken @ NW corner. Repair under 2007 contract planned. 10 SF in Condition State 3
2009 Contract original repair Fall 08-Spring 09
2010- Grating webs at northern 10' of steel deck have minor section loss and flaking rust. 240 SF in Condition State 3. Welds are broken at NW corner. Remainder of grating has light surface corrosion throughout.
2011- Top surface has light surface corrosion. The supports, which run parallel with the bridge (not the purlins), have moderate surface corrosion with areas of minor section loss. Flaking rust is also common. Grating supports (parallel to the bridge) 24' from each end of steel deck have measurable loss. 1152 Sf in CS4.
2012- Corrosion of end 24' progressing. These 1152 SF to remain in CS4.
[2013] Surface corrosion continuing. Some rust-through holes observed in deck grating bars near FB15, but not sufficient for CS4 rating (2013FC Photo 7).|

304	OPEN DECK JOINT	1	10-14-2013	68 LF	68	0	0	N/A	N/A.
			09-10-2013	68 LF	68	0	0	N/A	N/A.

Notes: |[2013] Minor surface corrosion. Very smooth transition from approach span pavement to steel grid deck.|

320	CONC APPR SLAB-BITOL	2	10-14-2013	2 EA	0	2	0	0	N/A.
			09-10-2013	2 EA	0	2	0	0	N/A.

Notes: |2011- Bituminous wear surfaces at both ends. Spalls in concrete along north joint (abutment end block). Transverse crack between approach panel and roadway.
2012- No change from 2011; transverse cracking more prominent on south end
[2013] No change. 2013 Annual Inspection Photo B.|

331	CONCRETE RAILING	2	10-14-2013	322 LF	322	0	0	0	N/A.
			09-10-2013	322 LF	322	0	0	0	N/A.

Notes: |2013- Railing concrete and surface finish are in good condition (2013 Annual Inspection Photo G).|

334	METAL RAIL-COATED	2	10-14-2013	1,510 LF	1,510	0	0	0	0
			09-10-2013	1,510 LF	1,510	0	0	0	0

Notes: |Element includes 770 LF of ornamental rail at outside face of sidewalk and 740 LF of plate guardrail attached to inside face of truss.
2013- Plate guardrail in good condition. Surface rust between post angles and at ends of longitudinal angles of ornamental rail. Corrosion does not yet warrant CS2. 2013 Annual Inspection Photo E.
|

107	PAINTED STEEL GIRDER	2	10-14-2013	232 LF	232	0	0	0	0
			09-10-2013	232 LF	232	0	0	0	0

Notes: |2011- Element added to rate the steel girders supporting the approach spans over the hollow abutment. [2013] CS1 assumed. Beams are enclosed in hollow abutments and covered with fire-retardant foam, so they could not be inspected.
2013- CS1 Assumed. Beams are enclosed in hollow abutments and covered with fire-retardant foam, so they could not be inspected.|

Mn/DOT BRIDGE INSPECTION REPORT

Inspected by: CITY OF DULUTH

BRIDGE L6116 MSAS 140(LAKE AVE) OVER SHIP CANAL INSP. DATE: 10-14-2013

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
113	PAINT STEEL STRINGER	2	10-14-2013	4,337 LF	0	0	2,936	1,400	0
			09-10-2013	4,337 LF	0	1,535	1,401	1,401	0

Notes: |2005 Includes floor beam stringers between floor beams. (1536 ft) and stringers which run transverse to floor beam stringer to support deck. Floor beam stringer are in good condition, transverse stringers above include more moderate paint loss/ deterioration particularly on top flange are which is exposed to open deck.
2007 End needs repair, loose. Plan to correct in 2007 repair contract.
2009 Contract ongoing to repair in 08-09
2010 End floor beam stringers repaired in 2008.
2011 This quantity includes the purlins which run transverse to the bridge, sit on top of the stringers, and support the deck. There are tack welds between the stringer webs and FB connection angles on S1 and S4 at most connections. None are cracked. The stringers have paint failure with light surface corrosion on the top flanges CS-2. The purlins have moderate surface corrosion with areas of flaking rust.
2012- Surface corrosion of top flange of stringers and purlins is progressing. Rust is beginning on bottom flanges particularly at flange edges and on the ends of the bridge.
2013- Element includes 1536 LF of stringers (64@24') and 2800 LF of purlins (112@25'). Stringers move to CS 3 with moderate paint deterioration at tops of flanges. No Major section loss. S1 has isolated areas of flaking rust on bottom flange near FB4 (2013FC Photo 8). Purlins split between CS 3 and 4 with moderate to extensive paint loss at tops of flanges. Annual Inspection Photos J and K.|

121	P/STL THRU TRUSS/BOT	2	10-14-2013	778 LF	622	156	0	0	0
			09-10-2013	778 LF	622	156	0	0	0

Notes: |2010 Some pitting and pack rust observed on lower chord, most of which has been arrested and repaired. Segment between L6W and L5W is kinked (24 LF). May have been originally constructed this way. Monitor for future alignment changes.
2011 Light surface corrosion inside the panel points and on the interior plate at the horizontal plate connection(lower lateral bracing connection) where there are areas of moderate surface corrosion.
2012 Corrosion has progressed from 2011, but is to remain in CS2.
[2013] Areas of corrosion and minor pack rust present near panel points and at chord splices. Pigeon nests and piles of sandblasting grit located inside panel points at several locations; these hold water and could lead to accelerated deterioration (2013FC Photos 94 & 97). Lower chords have ponded water between vertical plates and recessed top plate (2013FC Photo 19).
|

126	P/STL THRU TRUSS/TOP	2	10-14-2013	778 LF	622	156	0	0	0
			09-10-2013	778 LF	622	156	0	0	0

Notes: |2009- Contract ongoing to repaint. Numbers will be updated when project is complete.
2010 Previously reported pitting and corrosion have been arrested by repainting.
2011- Areas of chalking and light freckled rust inside upper panel points and inside the vertical and diagonal members.
2012- Signs of very minor corrosion throughout top truss at connections between plates and angles.
[2013] Corrosion levels unchanged. Several vertical and diagonal members on east truss have very rough clearance holes burned in bottom edge of lower batten plates to clear conduit (2013FC Photo 32).|

152	PAINT STL FLOORBEAM	2	10-14-2013	427 LF	0	376	17	34	0
			09-10-2013	427 LF	0	376	17	34	0

Notes: |2009- Contract ongoing to repaint & repair. Update when project is complete.
2010 Condition State 3 includes small area of paint failure and flaking rust on bottom flange of FB2 and pinhole through web in pitted area of FB5 (painted, no active corrosion). Condition State 2 accounts for moderate deterioration of paint system at tops of both flanges.
2011 All in CS 2 or worse due to surface corrosion on top of top flanges. CS 4 due to section loss along all vertical stiffeners on FB, 6 stiffeners per FB (but 1 LF per FB accounts for all stiffeners). On FB 2, two holes above and below S4 (2"x2" and 1.5" x 2"). There is a hole in the vertical stiffener between S3 and S4 (1" Dia-CS-5). At the ends of the floorbeams, where the horizontal connection plates overlap the FB bottom flanges, there is pack rust (up to 3/8") with section loss (16 LF- CS3 and 16 LF - CS4).
2012- Visual inspection performed from piers, corrosion appears to be progressing throughout especially at t/bottom flage angle and along centerline seam at bottom beam.
[2013] Floorbeams have continuing moderate corrosion and pack rust at the bottom of most web stiffeners (2013FC Photo 49). Moderate to severe pitting and corrosion is present in bottom flanges at connections to horizontal plates at truss panel points. The worst of these are 3/8" @ FB14-E and 1/2" @ FB13-W. FB4 has 1/4" deep pitting and two mis-drilled holes in bottom flange at connection to L4E (2013FC Photo 45). Most floorbeams have minor pack rust and corrosion at center of bottom flange between flange angles. 1" diameter holes in stiffeners previously noted do not contribute to overall section loss in floorbeam and thus do not warrant a CS5 rating. FB15 (West End) has some section loss at gusset connection along edge of horiz gusset plate. FB0 (West Half) top of bottom flange has surface rust with no paint remaining.|

Mn/DOT BRIDGE INSPECTION REPORT

Inspected by: CITY OF DULUTH

BRIDGE L6116 MSAS 140(LAKE AVE) OVER SHIP CANAL INSP. DATE: 10-14-2013

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
423	GUSSET PLATE (PAINT)	1	10-14-2013	84 EA	50	34	0	0	0
			09-10-2013	84 EA	50	34	0	0	0

Notes: |2010 Lower 34 plates have pitted areas which have been arrested by repainting. Active pitting and corrosion along lower edge of inner gusset plate at L6W. 50 upper and middle plates display little to no pitting and repainting was complete in March 2009.
2011- Lower 34 panel points in CS2 due to areas of light surface corrosion at FB connections. Upper and Middle 50 panel points in CS 1. Upper panel points raised to CS-1 due to repainting.
2012- Visual inspection done from piers, sidewalk and catwalk. Surface corrosion is progressing and pack rust is forming on the lower panel points.
[2013] No change. 1/8" pack rust distortion present on the L12E outer plate in the lower south corner. Pack rust is forming between sidewalk brackets and outer gusset plates in some areas -- see note for Element #357.|

380	SECONDARY ELEMENTS	1	10-14-2013	5 EA	0	3	2	0	N/A
			09-10-2013	5 EA	0	3	2	0	N/A

Notes: |2010:
Element 1 Lift Span (CS2)- Surface corrosion on lower diagonals. Pack rust between floor beams and horizontal connection plates.
Element 2 North Tower (CS2)- Repainted in 2010. Minor and isolated deterioration.
Element 3 South Tower (CS3)- Minor section loss, extensive paint failure. Scheduled to be repainted by March '11. (Move to CS2 upon completion of the work).
Element 4 Overhead Truss (CS3)- Paint failure, corrosion and section loss throughout.
Element 5 Specialized Elements (Counterweights, Sheaves, Wire Ropes, Mechanical and Electrial Systems, etc.) (CS2)- sheaves, wire ropes, electrical system and mechanical system replaced in 2000. Counterweight concrete repaired in 2008.

2011:
Element 1 Lift Span (CS 3) - Pack rust and section loss between floorbeams and horizontal connection plates has progressed.
Element 3 South Tower (CS 2)- Repainted and major section loss repaired in March 2011
Elements 2, 4, and 5 unchanged from 2010 notes.
2012:
Element 1 Lift Span (CS 3)- Corrosion of structure below deck is advancing. This area was last painted in 2000 and is need of paint repairs.
Elements 2,3 and 4- Unchanged
Element 5 Specialized Elements (CS 2) Chief Operator reports loud metallic noise coming from east sheave in south tower during lifting of bridge. Recommend to continue monitoring, investigate source of noise and measure counterweight rope tension.
2013:
Elements 1 - Area of paint failure on lower diagonal member L2E-L3W. Most horizontal plates have extensive surface corrosion and moderate pitting throughout.
Elements 2-4 Unchanged
Element 5 – Previously reported noise in south tower sheaves has not been pinpointed, however it has not progressed in intensity. Independent study by Hardesty and Hanover (August 2013) recommends that there is no indication that the bridge cannot be operated as usual.
The study also suggests that a full inspection of the mechanical and electri

311	EXPANSION BEARING	1	10-14-2013	2 EA	2	0	0	N/A	N/A
			09-10-2013	2 EA	2	0	0	N/A	N/A

Notes: |[2013] Bearings appear to be functioning properly. During the 2013 Fracture Critical Inspection, it was noted that "there was a thin metal plate positioned on the NW bearing base plate, which appears to move around with the wind (2013FC Photo 73). If this is a shim, it should be fastened to base plate". However, during the 2013 annual inspection, no such plate was present on the NE bearing.|

313	FIXED BEARING	3	10-14-2013	2 EA	2	0	0	N/A	N/A
			09-10-2013	2 EA	2	0	0	N/A	N/A

Notes: |[2005- 2013] Bearing appears to be functioning adequately.
2013 – Protective concrete fillet is cracked in pieces at the base of both bearing plates. Recommend replacement. Annual Inspection Photo O. |

Mn/DOT BRIDGE INSPECTION REPORT

Inspected by: CITY OF DULUTH

BRIDGE L6116 **MSAS 140(LAKE AVE) OVER SHIP CANAL** **INSP. DATE: 10-14-2013**

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
202	PAINT STL COLUMN	2	10-14-2013	8 EA	0	8	0	0	0
			09-10-2013	8 EA	0	8	0	0	0

Notes: |2010 North Tower inside columns painted March 2010. South Tower to be painted by March 2011 (Move to CS 2 upon completion of paint work).
2011- Painting of south tower is complete.
2012- Column legs begining to rust at sidewalk interface on all 8 legs. Recommend spot painting.
[2013] Diagonal brace on north tower, west side has large rust-through area in web at sidewalk level. This has been repainted to arrest further corrosion.|

215	CONCRETE ABUTMENT	2	10-14-2013	98 LF	98	0	0	0	N/A
			09-10-2013	98 LF	98	0	0	0	N/A

Notes: |2011- Quantity adjusted to account for rear stem of hollow abutments.
[2013] Front stems of abutments are in good condition with little or no deterioration. Rear stems are enclosed in hollow abutments and could not be inspected.|

220	CONCRETE FOOTING	2	10-14-2013	8 EA	8	0	0	0	N/A
			09-10-2013	8 EA	8	0	0	0	N/A

Notes: |[2013] Add element for tower leg footings. All footings are in good condition with little or no cracking and spalling. Minor delaminations (approx. 5 SF per location) noted at SW inboard & outboard and NE & NW outboard. Supplemental anchor bolts added in 2008 to inboard footings and are in good condition. Annual Inspection Photo P.|

387	CONCRETE WINGWALL	2	10-14-2013	4 EA	4	0	0	0	N/A
			09-10-2013	4 EA	4	0	0	0	N/A

Notes: |2013 – There is 8 SF of surface delamination of the SE wingwall.|

357	PACK RUST	2	10-14-2013	1 EA	0	1	0	0	N/A
			09-10-2013	1 EA	0	1	0	0	N/A

Notes: |2010 Located in lower portion of Lift Span.
2011- Pack rust between lower chord and gusset plates (up to 1/8") at few connections. Up to 3/8" where the horizontal connection plates overlap the FB bottom flanges. This is the same as 2009.
[2013] In addition to pack rust noted previously, there is moderate to heavy pack rust forming between sidewalk brackets and the outer gusset plates in several locations. The worst of these is at L1E (2013FC Photo 116). See notes for elements 152 & 423 for other measurements.|

362	TRAFFIC IMPACT	2	10-14-2013	1 EA	0	1	0	N/A	N/A
			09-10-2013	1 EA	0	1	0	N/A	N/A

Notes: |2011- There is a minor traffic impact at the sway bracing at M9 and U3 over the SB lane. This is a new finding.
[2013] No change.|

363	SECTION LOSS	1	10-14-2013	1 EA	0	1	0	0	N/A
			09-10-2013	1 EA	0	1	0	0	N/A

Notes: |2010 Several Members of lower chords and floor system have pitting that has been arrested by repainting, with total section loss less than 10%.
2011- See Element #152.
[2013] No change.|

964	CRITICAL FINDING	2	10-14-2013	1 EA	1	0	N/A	N/A	N/A
			09-10-2013	1 EA	1	0	N/A	N/A	N/A

Notes: |[2013] There were no critical findings noted during this inspection.|

966	FRACTURE CRITICAL	2	10-14-2013	1 EA	1	0	0	N/A	N/A
			09-10-2013	1 EA	1	0	0	N/A	N/A

Notes: |Fracture critical inspect complete in 09.
2011- In depth fracture critical inspection completed by MN/DOT September 6-7, 2011.
[2013] Fracture-critical members have minor deterioration but are structurally sound.|

981	SIGNING	1	10-14-2013	1 EA	0	1	0	0	0
			09-10-2013	1 EA	0	1	0	0	0

Notes: | 2011- This element rated CS-2 due to the fading of he sign face and loss of reflectivity at each end.
[2013] No change.|

Mn/DOT BRIDGE INSPECTION REPORT

Inspected by: CITY OF DULUTH

BRIDGE L6116 **MSAS 140(LAKE AVE) OVER SHIP CANAL** **INSP. DATE: 10-14-2013**

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
986	CURB & SIDEWALK	1	10-14-2013	1 EA	0	1	0	N/A	N/A
			09-10-2013	1 EA	0	1	0	N/A	N/A

Notes: |2010 Steel fascia support channel and 30 LF of sidewalk grating pan and concrete repaired/replaced in 2009. Moderate section loss present in steel grating pans of remaining 740 LF of sidewalk.
2011- No change.
2012- Steel grating pans of sidewalk continuing to deteriorate especially on northeast corner of bridge where there is pronounced bulging in the end 7' of the sidewalk surface and heavy corrosion on top and above the end support channel.
2013- Sidewalk distortion progressing throughout entire sidewalk system with the worst bulge in the surface at FB14E. Minor ponding of water occurring in some areas of sidewalk. Stay-in-place forms under sidewalk have moderate to heavy corrosion and flaking rust along seams. Pack rust on some sidewalk brackets at connection to lower gusset plates -- see note for Element #357. Annual Inspection Photos E and F.|

988	MISCELLANEOUS	1	10-14-2013	1 EA	1	0	0	N/A	N/A
			09-10-2013	1 EA	1	0	0	N/A	N/A

Notes: |[2013] Conduits, lighting and security cameras appear to be in good condition. The 2012 Underwater Inspection showed that the steel sheet pile wall 50 LF east and west of the bridge is in CS1, with tight connections, small rust nodules over 50% of the surface, minor pitting (1/32") and zebra mussels in a 1/2" thick layer.|

967	GUSSET DISTORTION	1	10-14-2013	1 EA	0	1	0	0	N/A
			09-10-2013	1 EA	0	1	0	0	N/A

Notes: |2010 Several lower chord gusset plates have bowing of 1/8" or less due to pack rust.
[2011-13] Up to 1/8" distortion due to pack rust at some lower chord panel points. |

General Notes: *1998
Sheave shafts still make noise.
Replaced south B motor, bad fields.
Needs cleaning and painting.
Unenforceable traffic speed limit.
*2000 Crew on bridge runs inspections of bridge since they are on it all day every day.
*2004 Spalled concrete on south counterweight, needs to be removed & repaired. Bridge needs to be painted from 12' off of deck to top of bridge. Request that MN/DOT perform fracture critical inspection
2007 Contract to paint & general structural rehab to start in Jan 08- Jun 09.
2010 Counterweight concrete repaired in 2008. Upper portion of lift span repainted in 2008 and 2009. Fracture Critical Inspection performed in 2009.
2011- Indepth Fracture Critical Inspection conducted by MN/DOT Sept 6-7, 2011. Annual Bridge Inspection completed by LHB December 12, 2012. The "primary inspector" field in SIMS must be filled in, and only inhouse inspector names are available to select. However, it should read Lisa Marynik, LHB and Joe Litman, LHB in that field.
2012- Annual Bridge Inspection completed by Lisa Marynik & Joe Litman of LHB, Inc.
[2013] In-depth Fracture-Critical and routine inspection performed 9/9/13 and 9/10/13 by MnDOT team Joe Fishbein, Scott Theisen, Ken Rand and Pete Wilson. Accumulated sandblasting grit and pigeon nests should be removed to prevent further deterioration inside panel points. Gap between side plates and top plate of lower chord should be caulked to prevent water ponding. 2013 Annual Bridge inspection completed by Lisa Karlgaard, Rich Majerle & Joe Litman of LHB, Inc. on 10/14/2013.

Inspector's Signature

Reviewer's Signature / Date

Mn/DOT Structure Inventory Report

Bridge ID: L6116 **MSAS 140(LAKE AVE) over SHIP CANAL**

Date: 09/09/2014

+ GENERAL +

Agency Br. No.	
District	1
Maint. Area	
County	69 - ST LOUIS
City	DULUTH
Township	
Desc. Loc.	0.6 MI SE OF SUPERIOR ST
Sect., Twp., Range	27 - 050NN - 14W
Latitude	46d 46m 44.35s
Longitude	92d 05m 34.46s
Custodian	CITY
Owner	CITY
Inspection By	CITY OF DULUTH
BMU Agreement	
Year Built	1905
Year Fed Rehab	2000
Year Remodeled	1985
Temp	
Plan Avail.	MUNICIPAL

+ STRUCTURE +

Service On	HWY;PED
Service Under	STREAM
Main Span Type	STEEL MOVEABLE
Main Span Detail	WARR W/POLY TC
Appr. Span Type	CONC DECK GIRD
Appr. Span Detail	
Skew	
Culvert Type	
Barrel Length	

Number of Spans

MAIN: 1 APPR: 2 TOTAL: 3

Main Span Length	385.9 ft
Structure Length	501.8 ft
Deck Width	24.0 ft
Deck Material	OPEN GRATING
Wear Surf Type	OTHER
Wear Surf Install Year	1955
Wear Course/Fill Depth	
Deck Membrane	NONE
Deck Protect.	N/A
Deck Install Year	
Structure Area	12,545 sq ft
Roadway Area	12,045 sq ft
Sidewalk Width - L/R	5.0 ft 5.0 ft
Curb Height - L/R	
Rail Codes - L/R	43 43

+ ROADWAY +

Bridge Match ID (TIS)	1
Roadway O/U Key	1-ON
Route Sys/Nbr	MSAS 140

Roadway Name or Description

MSAS 140

Roadway Function	MAINLINE
Roadway Type	2 WAY TRAF
Control Section (TH Only)	
Ref. Point (TH Only)	
Date Opened to Traffic	01-01-1930
Detour Length	99 mi.
Lanes	2 Lanes ON Bridge
ADT (YEAR)	7,093 (2008)
HCADT	
Functional Class.	URB COLL

+ RDWY DIMENSIONS +

If Divided	NB-EB	SB-WB
Roadway Width	24.0 ft	
Vertical Clearance	18.0 ft	
Max. Vert. Clear.	18.0 ft	
Horizontal Clear.	23.9 ft	
Lateral Clr. - Lt/Rt		
Appr. Surface Width		40.0 ft
Roadway Width		24.0 ft
Median Width		

+ MISC. BRIDGE DATA +

Structure Flared	NO
Parallel Structure	NONE
Field Conn. ID	RIVETED
Cantilever ID	

Foundations

Abut.	CONC - FTG PILE
Pier	
Historic Status	ON REGISTER
On - Off System	ON

+ PAINT +

Year Painted	2000	Pct. Unsound	18 %
Painted Area	273,805 sf		
Primer Type	OTHER		
Finish Type	OTHER (UNKNOWN)		

+ BRIDGE SIGNS +

Posted Load	NOT REQUIRED
Traffic	SPEED LIMIT
Horizontal	NOT REQUIRED
Vertical	NOT REQUIRED

+ INSPECTION +

Deficient Status	F.O.
Sufficiency Rating	50.5
Last Inspection Date	10-14-2013
Inspection Frequency	12
Inspector Name	DULUTH
Structure	R-POSTED - OTHER CAP

+ NBI CONDITION RATINGS +

Deck	6
Superstructure	6
Substructure	7
Channel	8
Culvert	N

+ NBI APPRAISAL RATINGS +

Structure Evaluation	6
Deck Geometry	2
Underclearances	N
Waterway Adequacy	8
Approach Alignment	8

+ SAFETY FEATURES +

Bridge Railing	1-MEETS STANDARDS
GR Transition	N-NOT REQUIRED
Appr. Guardrail	N-NOT REQUIRED
GR Termini	N-NOT REQUIRED

+ IN DEPTH INSP. +

Frac. Critical	Y	24 mo	09/2013
Underwater			
Pinned Asbly.			
Spec. Feat.			

+ WATERWAY +

Drainage Area		
Waterway Opening	10500 sq ft	
Navigation Control	PERMIT REQD	
Pier Protection	NOT REQUIRED	
Nav. Vert./Horz. Clr.	135 ft	324.0 ft
Nav. Vert. Lift Bridge Clear.	19.9 ft	
MN Scour Code	I-LOW RISK	
Scour Evaluation Year	1992	

+ CAPACITY RATINGS +

Design Load	HS20
Operating Rating	HS 27.40
Inventory Rating	HS 15.80
Posting	
Rating Date	02-17-2009

Mn/DOT Permit Codes

A: N B: N C: N

V2006