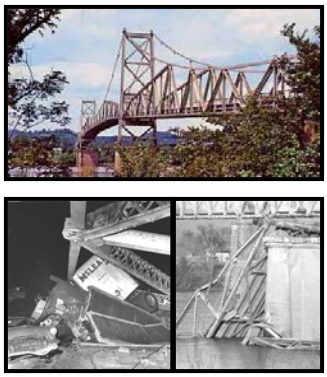
Kingsport Bridge Report

February 14, 2003

The Engineering Division of the Department of Public Works serves as the lead agency in coordinating the City of Kingsport's bridge inspection program with the Tennessee Department of Transportation (TDOT) and in directing maintenance activities as required for continued bridge safety.



It took less than 60 seconds for the collapse of the Silver Bridge in 1967 due to corroded steel.

National Bridge Safety

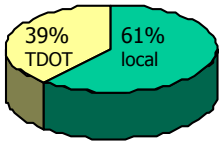
Inspection of the nation's bridges began after the 1967 collapse of the Silver Bridge at Point Pleasant, West Virginia. Undetected corrosion in the steel suspension led to a catastrophic structural failure of the bridge that claimed the lives of 46 people. In response, the United States Secretary of Transportation established National Bridge Inspection Standards (NBIS) with the passage of the Federal-Aid Highway Act in 1968.

The 1968 Act required each state to maintain a condition inventory of all Federal-Aid highway system bridges. This requirement was expanded in 1978 with the passage of the Surface Transportation Assistance Act to include inventory requirements on all local bridges on public roads greater than 20' in length.

The primary purpose of the NBIS is to locate, evaluate and act on bridge deficiencies to ensure the safety of the traveling public.

Tennessee Bridge Safety

In accordance with the NBIS, the Tennessee Department of Transportation (TDOT) inspects 19,174 bridges on public roads in the state of Tennessee. Approximately 61% of those bridges are owned and maintained by local governments (referred to as *"off-system"* bridges) and 39% are owned and operated by TDOT (referred to as *"on-system"* bridges.)



TDOT inspects the bridges in Tennessee on an 18-24 month cycle and makes recommendations for repair and maintenance. Substandard bridges with advanced deterioration are often inspected on a more frequent basis, e.g., every six months.

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The TDOT inspection includes a thorough on-site review of the structural elements of the bridge. Detailed records and photographs are used to identify problem areas and to monitor changes in bridge condition over time. This data is summarized on a TDOT "Structure Inventory and Appraisal Sheet" that is completed by the inspection team for each bridge.

The Structure Inventory and Appraisal Sheets are completed in the field and forwarded to Nashville where the TDOT Structures Division staff complete the bridge assessment. The TDOT engineers use the field data to derive a numeric bridge "sufficiency" rating for each bridge (0=poor to 100=excellent). The sufficiency rating is computed using a weighted formula that takes into account the structural adequacy of the bridge (comprises 55% of total score), the functional adequacy (30%) and bridge traffic volumes (15%). The use of this scoring methodology provides a quantitative indication of relative bridge condition and public safety risk.

TDOT has minimum bridge standards and if bridge ratings fall below those safety standards TDOT may classify a bridge as either structurally deficient and/or functionally obsolete. A structurally deficient bridge typically has significant problems (deterioration, corrosion, strength loss, etc.) in the load bearing parts of the bridge. A functionally obsolete bridge would be an older bridge that was constructed using a design that fails to meet current design standards, e.g., bridge rails substandard, lanes too narrow, vertical and horizontal alignment substandard, etc.

Public safety is the main objective of bridge inspections and because structural deficiencies represent a greater risk to public safety than functional obsolescence, the structural deficiencies are weighted nearly double the functional elements in the sufficiency formula.

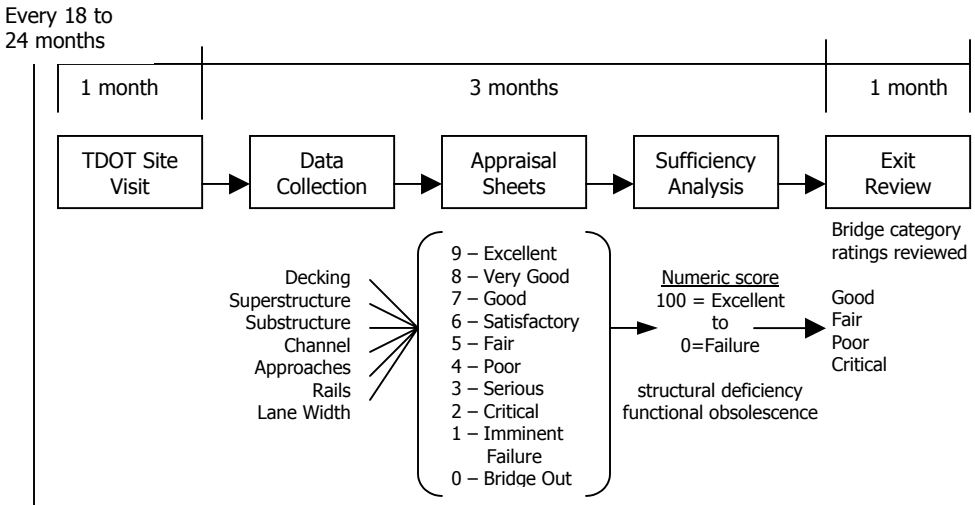
A 2002 TDOT Bridge Audit Report indicated that 18% of bridges in TN were structurally deficient including:

12% of all local bridges
6% of all TDOT bridges

The sufficiency rating loosely correlates to the broad bridge condition categories used by TDOT: Good, Fair, Poor, and Critical. A low sufficiency rating would typically indicate a bridge is in the Poor to Critical range, whereas a high sufficiency rating would be indicative of a bridge in Fair to Good condition.

The bridge condition results are presented to the local governments at an "exit" meeting with TDOT staff and a final report is provided that details the bridge condition findings and indicates recommendations for bridge maintenance and repair.

The bridge inspection process is summarized graphically below:



If structural deficiencies were identified in the inspection, TDOT will re-calculate the safe "operating capacity" of the bridge to determine the maximum permissible load that the structure may be subjected. If the bridge will not carry a minimum of 2.43 tons of live load, the bridge will be closed. Furthermore, if the bridge has declined to the point that its safe load carrying capacity is less than the maximum legal loads allowed on the public road, then TDOT will require the bridge to be posted with a weight restriction.

For *off-system* bridges, TDOT provides recommendations for maintenance activities in the exit report but it is the responsibility of the cities, counties and towns to fund and perform the maintenance work.

Fort Robinson Bridge

Kingsport Bridges

The topography, terrain, waterways and active railroad presence throughout Kingsport necessitates the use of bridges to overcome the natural and man-made impediments to transportation. There are over 100 bridges in Kingsport – which equates to an average of 1 bridge for every 4 miles of roads traveled. An estimated 300,000 cars travel over bridges in Kingsport every day. In addition, Sullivan County has another 300 bridges.

TDOT owns and maintains 66 *on-system* bridges on the major state routes (10 on 11W, 6 on Rte. 36, 15 on Rte. 93, 7 on Rte. 126, 16 on Rte. 181, and 12 on Rte. 81) within the City limits.

TDOT also inspects 30 *off-system* bridges that are located on public roads in Kingsport and are owned and maintained by the City. For TDOT inspection purposes, bridges include typical elevated road structures (see Ft. Robinson Bridge insert at left) as well as drainage culverts (greater than 20' in length) that cross under a road and railroad underpasses. There are also numerous small bridges/culverts (less than 20' in length) that do not meet the inspection criteria of TDOT but are nonetheless a part of the City's roadway/bridge infrastructure.

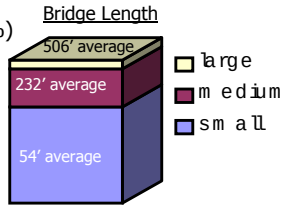
Typical bridge:
65 – 70 vear service life

38 years
is the average age of Kingsport bridges

(54% of service life)

Although bridge service life will vary according to construction materials, bridge design, traffic loadings and maintenance practices, a "typical" bridge service life is approximately 65-75 years. The average age of Kingsport's off-system bridges is 38 years and the estimated replacement value for these bridges is $21 million.

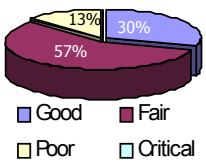
The span length of the City's bridges varies but the vast majority (97%) of the bridges fall within "small" and "medium" sized categories. There are only two bridges that fall within a "large" category and those include the Ridgefields bridge at 450' and the Netherland Inn bridge which is nearly 600' long.

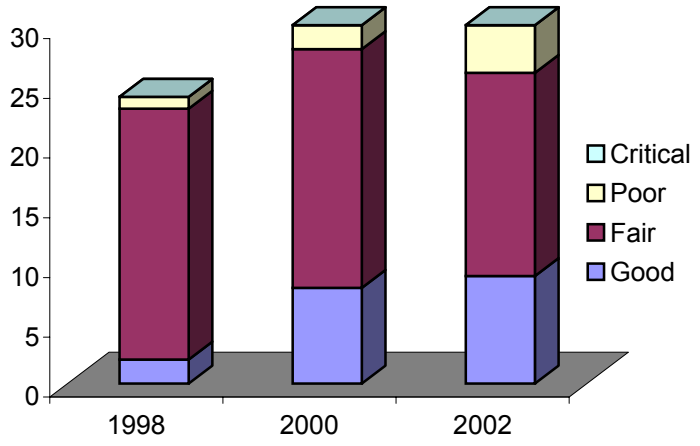


Kingsport Bridges Condition

The last TDOT inspection of Kingsport's 30 off-system bridges was completed in March 2002. The results of the 2002 inspection are compared below with the prior 2 inspections in 1998 and 2000.

2002 Bridge Inspection





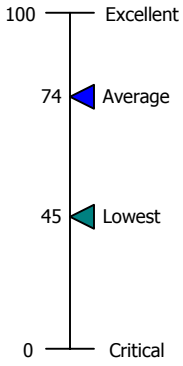
Changes in Bridge Conditions
From 2000 to 2002:
Improved = 1
Worse = 2
Same = 27

In 2002 TDOT found 30% of the City's bridges to be in Good condition, 57% in Fair condition, 13% in Poor condition and no bridges listed as Critical. Between 1998 and 2000 the City added 5 bridges to its inventory as a result of annexation decisions – and all five of the annexed bridges were in found to be in Fair condition. One additional bridge was also constructed with a new subdivision and it was found to be in Good condition.

2002 Bridge Summary	Good Bridges (9)	Fair Bridges (17)	Poor Bridges (4)
Average Age	20 years	45 years	48 years
Ave. Daily Traffic	53,500 (8,900)*	78,100 (4,800)*	46,700 (11,600)*
Bridge Length	117'	90'	340'
Sufficiency Rating	82	74	58

*per bridge

2002 Kingsport Bridge Sufficiency Rating



With the average age of the City's bridges at 54% of their service life, the distribution of bridge conditions is fairly consistent with an expected normal distribution curve. However, it also appears that 2-4 years ago the City's bridge conditions were actually slightly ahead of the curve and the trending suggests that the City is losing ground.

Although no Kingsport bridges were presently found to be in Critical condition, the increase in the number of bridges in Poor condition warrants some concern since the Netherland Inn Road bridge was rated as Poor when it was closed to all traffic.

The top 10 bridges carry 80% of the traffic traveling across Kingsport bridges.

63% of the top 10 bridges have served at least half of their expected service life.

The value of the top 10 bridges is 60% of the total value of Kingsport bridges.

The top 10 bridges include the 3 lowest rated bridges in the City.

Although all 30 Kingsport bridges are important, staff identified 10 bridges that represent the most critical bridges in terms of terms of traffic impacts and transportation corridor needs. The top 10 most critical bridges are listed according to condition categories below:

N. Eastman Road Bridge over Reedy Creek — 2002 Inspection: GOOD; Sufficiency Rating: 67

Average daily traffic = 17,900
Stone Drive Connector, Industrial/Retail Connector

W. Sullivan Street Bridge over Reedy Creek — 2002 Inspection: GOOD; Sufficiency Rating: 97

Average daily traffic = 9,500
Downtown Access Corridor. East-West Connector

Riverport Road over Holston Sluice — 2002 Inspection: GOOD; Sufficiency Rating: 85

Average daily traffic = 6,700
Industrial/Residential Connector

Clinchfield Bridge — 2002 Inspection: FAIR; Sufficiency Rating: 75

Average daily traffic = 16,000
Hospital Route, Downtown Access Corridor

Moreland Drive over Kendricks Creek — 2002 Inspection: FAIR; Sufficiency Rating: 81

Average daily traffic = 10,400
City / County Connector, Access Corridor

N. Eastman Road Bridge over Mad Branch — 2002 Inspection: FAIR; Sufficiency Rating: 81

Average daily traffic = 10,300
Stone Drive Connector, Industrial/Retail Connector

Ridgefields Bridge over S. Holston — 2002 Inspection: FAIR; Sufficiency Rating: 81

Average daily traffic = 7,100
S. Holston Crossing

Lincoln Street approaching John B. Dennis — 2002 Inspection: POOR; Sufficiency Rating: 59

Average daily traffic = 12,500
Downtown Access Corridor, John B. Dennis Connector, Active Rail Line

Netherland Inn Road Bridge over N. Holston — 2002 Inspection: POOR; Sufficiency Rating: NA

Average daily traffic = 12.100
N. Holston Crossing, Hawkins – Kingsport Connector

Eastman Rd. Bridge over Lincoln Street — 2002 Inspection: POOR; Sufficiency Rating: 45

Average daily traffic = 11,000
North – South Connector, Industrial Access Corridor

In addition to the 10 bridges that are identified in the TDOT Inspection, Public Works staff have included one other bridge that is too small to meet the TDOT criteria, but due to its location was deemed critical.

Reservoir Road Culvert Bridge at Bays Mtn. — Not Rated

Average daily traffic = seasonal, 200,000 / year
Access to Bays Mtn. Park and Eastman Lodge

The top 10 listing of bridges indicates that there is a large disparity within the condition of the City's most important bridges – as they include both the highest and lowest rated bridges in the City. On the positive side, regular planned and funded maintenance projects should enable the high-end bridges to remain in good condition for years to come. However, the three lowest bridges require immediate attention that will require significant financial investment.

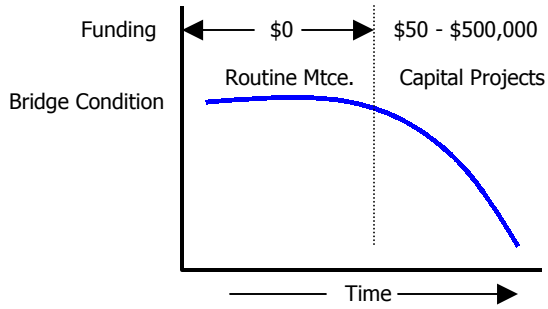
TDOT spends approximately $67 million per year on bridge maintenance and replacement.

Kingsport Bridge Funding

Bridges require routine maintenance, e.g., clean and repaint, deck resurfacing, etc., in order to protect their structural integrity and achieve the full service life of the bridge. The City has not historically provided funding for routine maintenance. In the absence of any designated funding Public Works has attempted to do some minimal bridge work each year out of the street resurfacing budget but as noted in the Street Resurfacing Report (January 2003) that funding has failed to keep pace with expanding needs – and as a result, resources available for bridges has declined.

In the absence of routine maintenance, bridge conditions have typically deteriorated until enough damage is evident to warrant a capital project. Under these circumstances the City has used bonds and other funding sources to create a capital project, e.g, Netherland Inn bridge, Eastman Road bridge, for bridge repair and rehabilitation.

Every $1 spent in preventive maintenance is worth $4 saved in capital repairs.



The level of bridge funding needs varies according to the respective bridge conditions. However, for planning purposes staff calculated funding needs using "typical" costs for each condition category used by TDOT (Good, Fair, Poor, Critical).

Condition Problems	Condition	Condition Solutions	# of Bridges	Funding Balance
advanced structural	"Poor"	repair and replace $50,000 to $500,000	4	$ 1,745,000 need $ 330,000 available ($ 1,415,000) deficit
early structural functional	"Fair"	restoration $15,000	17	$ 255,000 need $ 0 available ($ 255,000) deficit
surface treatment	"Good"	annual maintenance $3,500 / yr.	9	$ 105,000* need $ 0 available ($ 105,000) deficit
			Total Deficit	($ 1,775,000)

* 30 bridges @ $3,500/yr

Based on the data there is a total funding deficit of $1,775,000. Of that balance, there is an immediate capital need of $1,415,000 to repair the Poor rated bridges ($380,000 balance for City share of new Netherland Inn Bridge, $365,000 balance for Eastman Rd. Bridge, $500,000 for Lincoln Street bridge, and $170,000 for the Reservoir Road bridge.) Allocating any funding for the Fair and Good bridges would provide the City's first capital or operating money specifically targeted for preventive maintenance activities.

On average, bridge deck resurfacing costs $85 per square foot.

For a typical bridge with 12' travel lanes that cost equals $2,040 per linear foot.

The average length of a Kingsport bridge is 125 linear feet.

Resurfacing an average bridge costs $256,000.

The City has 30 average bridges or 3,800 linear feet of bridge decks.

To resurface all Kingsport bridge decks would cost an estimated $7,600,000.

"Poor" Bridge Funding Needs

1. Netherland Inn Bridge ($380,000)

In January 2002 TDOT closed the Netherland Inn bridge due to structural strength loss in the floor beams and steel truss. The City spent $565,000 in repairs from the original capital budget created to replace the bridge -- leaving a balance of $220,000. Meanwhile, TDOT is continuing to design a replacement bridge that is estimated to cost $3 million. The City's share (@ 20%) will be $600,000. With a $220,000 balance in the Netherland Inn project account there is a net project deficit of $380,000.

2. Eastman Road Bridge at Lincoln Street ($365,000)

In the 2001 Capital Improvement Plan $110,000 was allocated for repairs of the Eastman Road Bridge. Staff subsequently hired Spoden & Wilson to analyze the bridge condition and develop repair plans. The Spoden & Wilson repair plan recommends: 1,594 sq. ft. of bridge deck repairs, 324 sq. ft. of repairs to concrete columns and bents, replacement of sub-standard guardrails, expansion joint repairs, cleaning and painting of beam bearing devices, installation of new guardrails, sidewalks and curbs. Construction time is estimated at 90 days. The bid specifications are complete and are ready for bid pending funding availability. The original project budget for these repairs was $110,000 but Spoden & Wilson estimates $475,000 in required repair work, leaving a deficit of $365,000.

3. Lincoln Street Bridge approaching John B. Dennis ($500,000)

In the March 2002 TDOT Inspection Report, this bridge was also listed in Poor condition. No actual engineering work (e.g., detailed condition analysis, repair plan estimates) has been performed yet because there is no project funding established. The TDOT report indicated that the wearing surface is poor with heavy scaling, de-lamination, concrete patches, potholes with reinforcement bar exposed in the decking-railings-abutments-bents, hairline cracks, and scouring around the abutments, as well as substandard guardrails and bridge rails. Based on the presence of these conditions Public Works staff made some preliminary attempts to estimate costs using costs from other bridge projects as a guide and the suggested cost is $500,000. A true engineering estimate is needed and that would cost $20,000 to complete.

4. Reservoir Road Bridge to Bays Mountain ($170,000)

The Reservoir Road bridge is located at the intersection of Reservoir Road and Bays Mountain Park Road. Due to its size (less than 20') it is not inspected by TDOT. The guardrail on the west side of the bridge has been knocked off into the creek numerous times and it is not possible to re-secure the guardrail without re-designing and replacing the bridge structure itself. The bridge is located half in the City and half in the County and the County Road Commissioner has also identified this bridge as a repair need. Preliminary engineering review was completed in-house and it is estimated that the project will cost $170,000. There is no funding established for this project leaving a deficit of $170,000.

"Fair" and "Good" Bridge Funding Needs

Public Works staff have created an internal work team that is currently reviewing each bridge that received a Fair and Good rating to identify trends and opportunities to maximize bridge maintenance and repair efforts. This team is researching best in class practices and state of the art technologies to develop a modified preventive maintenance approach in the repair of the 26 bridges rated as Fair or Good.

Capital Improvement Plan

As a comparatively "new" City, Kingsport has benefited from having a reasonably young inventory of bridges and has subsequently not had high maintenance needs so there has not been the impetus to routinely direct funding towards bridge maintenance. From an infrastructure condition perspective this strategy has not appeared to have had adverse consequences until the last decade. But now, as most of the City's bridges have passed their mid-life point, the symptoms of deferred maintenance are increasingly emerging and require more effective resource attention.

The availability of the comprehensive bridge data summarized in this report and maintained in a database in Engineering provides a basis to develop short and long term strategies to address bridge condition needs in a well-planned and fiscally responsible manner. In times of fiscal constraints it is imperative to have the necessary data to be able to prioritize project needs and optimize the impacts of limited resources. From a data driven position, maintenance and financial strategies can be developed together, working towards a common end, and in a mutually beneficial manner through the vehicle of a capital improvement plan.

Using the capital model deployed in the water and wastewater funds, critical infrastructure needs can be met with a balanced and progressive financial plan. To that end, bridge funding will be recommended for consideration in the FY04 Capital Improvement Plan.