CITY OF VICTORIA

JOHNSON STREET BRIDGE

STRUCTURAL CONDITION REPORT

Prepared by:

Graeme & Murray Consultants Ltd.
1137 Yates Street
Victoria, B.C. V8V 3N1

August 1990
JOHNSON STREET BRIDGE
STRUCTURAL CONDITION REPORT

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3105
August 13, 1990

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1. INTRODUCTION

As requested by the City, the inspection was confined to the structural condition of the highway bridge, excluding the electrical and mechanical systems. The bridge was inspected on May 10, May 15, July 26, August 10, and August 23, 1990 by Mr. Vic Vickers of Graeme & Murray Consultants Ltd. He was accompanied by Mr. Greg Beaveridge of Graeme & Murray Consultants Ltd. on May 10, and July 26, Mr. Jim Neuman of B.H. Levelton & Associates Ltd. on May 15, and Mr. Andrew Rushforth of Graeme & Murray Consultants Ltd. on August 23, 1990. The underwater inspection was performed by divers with Ocean Marine Contractors Ltd. on May 10, 1990.

2. SUMMARY OF RECOMMENDATIONS

2.1 Underwater - determine location of cable and bury if necessary - Section 3.

2.2 Paint System - maintenance painting by City crew - Section 5.

2.3 Deck - repair edges and replace support beam and joint at Pier 1 - Section 6.

2.4 Guardrail - replace on north side - Section 7.

2.5 Bearings - clean off pier tops - Section 8.

2.6 Counterweight - seal and ventilate - Section 9.

2.7 Load Rating - see Section 10

2.8 Establish annual inspection program with checklist.

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3. UNDERWATER INSPECTION

Ocean Marine's Report (Appendix C) indicates areas of deterioration on Piers 1 and 2 up to 12 inches deep. These areas are similar to those noted in our 1978 report and are not considered serious. No remedial measures are recommended at this time.

The exposed cable referred to on the west side of Pier 2 may be cause for concern if it could be snagged by shipping. It is recommended that its location be further investigated.

The undermining of Pier 3 referred to in the report is undoubtedly the underside of the Prepak Concrete placed in 1979. Since the pier is founded on rock, there is no cause for concern.

4. SUPERSTRUCTURE INSPECTION

In general, the bridge steelwork is in good condition, with no appreciable corrosion taking place since the extensive repair and painting ten years ago. A few problem areas remain, however, and these are discussed in B.H. Levelton's Report (Appendix B).

Below the deck most of the apparent corrosion is due to leaking deck joints, inadequate paint thickness on the new (1980) steelwork and inadequate cleaning of the old steelwork in some areas.

Above the deck there are a few areas of corrosion, notably bolts which replaced corroded rivets during repairs in 1980, the odd gusset plate and lattice work (see Photos 1 and 2, Appendix A).

5. PAINT SYSTEM

We concur with B.H. Levelton's recommendations regarding maintenance painting, though there may be some areas which can only be adequately cleaned by abrasive blast. It may be possible to contain the blast debris by enclosing small areas at a time, especially if the area is immediately above a concrete deck or pier top. Surface preparation of bare steel to SSPC - SP6 (commercial blast) cleaning is most important.
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5. PAINT SYSTEM (continued).

It would not be wise to topcoat the highway bridge without doing
the railway bridge at the same time because of the possible
difference in appearance. Nor does the labour intensive cleaning
and spot priming lend itself to contract. It is therefore
recommended that City crews do the maintenance painting required
and that both bridges be topcoated by contract.

The cost of this work, based on what was done ten years ago and
assuming that prices have doubled since then, would be $250,000 to
$300,000. It is recommended that the test patch be done this year
and that $50,000 be allocated for maintenance painting next year.

6. DECK

The concrete deck on the approach spans of the bridge is in
generally good condition although there is considerable evidence of
leakage at the longitudinal joints which is corroding the top
flanges of the cross-beams (see photograph 12, Appendix B). These
joints result from the removal of the original tram-car tracks and
have been sealed at the top surface of the deck. They should be/
re-sealed before the steel below is repainted so the effectiveness
of the seal can be assessed. Only by sealing these joints can the
corrosion of the top flanges of the cross-beams be controlled.

There is also considerable spalling of concrete along the outside
dges of the deck. This is an indication that road salt has
penetrated the concrete and corroded the reinforcement which is now
exposed in places. Although not serious structurally, the edges
should be patched and sealed to reduce further damage. Loose
concrete should be chipped away and the steel cleaned of all scale
and rust before patching with a suitable fast-setting concrete such
as Target Fast-Set Patching Concrete.

The support beam under the deck joint at Pier 1 has corroded
severely, and because of its inaccessibility, cannot be adequately
cleaned and painted (see Photographs 3 and 4 in Appendix A). Also
the concrete deck edge above this joint is breaking up (see
Photograph 5 in Appendix A).
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6. DECK (continued)

The deck should be cut back at this joint and the corroded support beam removed and replaced. The deck joint should be replaced with a steel-armoured neoprene strip-seal similar to the one installed at the east abutment (see Photograph 6 in Appendix A). Estimated cost $ 20,000.

The steel grid deck is in good condition, with little indication of broken hold-down welds at this time. These welds are prone to fatigue and will eventually break, especially under heavy traffic. A regular inspection program is important, so that re-welding may be done before the breaks are too widespread; they tend to break at an increasing rate once started.

7. GUARDRAIL

The railing on the north side of the bascule span has been damaged by vehicle impact, and three of the posts have lost their support at the base (see Photographs 7 and 8 in Appendix A). There is no evidence of reinforcement containing the concrete around these posts. Also the railing has been kinked and broken at one of the posts (see Photograph 9 in Appendix A). This railing is substandard and the City could be found negligent in the event of a serious accident.

It is recommended that a new railing similar to the one on the south truss be installed on the north side from Pier 1 to Pier 3 at an approximate cost of $ 25,000.

Many of the concrete anchors intended to hold the posts of the south truss railing are loose due to improper installation (see Photographs 10, 11 and 12 in Appendix A). This is not a serious problem because the rails are fastened to the truss, but the anchors should be replaced with adhesive type anchors embedded more deeply into the concrete.

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8. BEARINGS

New expansion bearings were installed under the east ends of both approach spans some ten years ago, though there appears to be little room for expansion at the end of the north girder on Pier 3 (see Photograph 13 in Appendix A). This photograph was taken during warm weather and the concrete has been chipped away to allow about another quarter inch of expansion, so there is no concern. Total movement at this joint would probably not exceed one-half inch.

However, dirt and debris around the bearing is also evident (Photograph 14 in Appendix A) and this will contribute to the corrosion of the base plate during damp weather. All pier tops tend to collect dirt which should be cleaned off on a regular basis, particularly around the base of the bearings.

9. COUNTERWEIGHT

There is minor corrosion of the steel at the face of the concrete due to moisture collecting on the horizontal steel surfaces and in pockets dug into the concrete. This moisture causes fungi growth which traps more moisture, see Photographs 15 and 16 in Appendix A.

Where possible, drain holes should be drilled through the steel to allow rainwater to escape. Where the sealant has not completely filled the pockets in the concrete, it should be removed and the surfaces of the concrete and steel blast-cleaned to remove all rust and dirt. The pockets should then be completely filled with sealant so that no traps for water collection remain. All bare steel should then be painted as recommended in Appendix B.

The south side of the counterweight concrete has been cast very close to the supporting steelwork so it is impossible to paint it. The space between appears to have been filled with a bituminous compound but a considerable pocket of corrosion remains, see Photograph 17 in Appendix A). This should be thoroughly cleaned out and completely filled with mastic asphalt so no water can collect between the concrete and steel.

Water appears to be entering the counterweight and leaking out through the bottom access doors, see Photograph 18 in Appendix A.
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9. COUNTERWEIGHT (continued)

This will contribute to deterioration of the counterweight so the top surface of the concrete should be sealed. Ventilation of the interior cavities by means of ventilators on the upper doors and louvers on the lower ones is also recommended.

The total cost of this work on the counterweight is estimated at $10,000.

10. LOAD RATING

The wheel load capacity of the bridge is limited by the sills supporting the steel grid deck. These are American standard channels nine inches deep weighing 13.4 pounds per foot and spanning six feet between the centre stringers. The decking is Irving (Irvico) Standard "V" Bridge Deck with "CK" surface, the bearing bars spanning eighteen inches between sills.

To extend the fatigue life of the welds connecting the grid to the sills and to avoid overstressing the sills, it is recommended that the bridge be limited to legal loading and that all permit vehicles be routed to the Point Ellice Bridge. That is, no vehicle shall carry more than its licensed G.V.W. with maximum axle weights limited as follows:

| Maximum Single Axle       | 9,100 kg |
| Maximum Tandem Axle Group | 17,000 kg|
| Maximum Triple Axle Group  | 24,000 kg|

11. ANNUAL INSPECTION

An annual inspection program is recommended to insure that required maintenance is regularly performed, particularly with regard to cleaning and touch-up painting. A checklist with space for comments should be made up to ensure that all areas of concern are inspected at least annually.
APPENDIX A

PHOTOGRAPHS
1. Rusting bolts at bracing connections.

2. Rusting gusset plate.

Graeme & Murray Consultants Ltd.
3. Underside of deck joint, Pier No. 1

4. Ditto

Graeme & Murray Consultants Ltd.
5. Deck Joint, Pier No. 1

6. Deck Joint, East Abutment

Graeme & Murray Consultants Ltd.
7. Concrete broken away from railing posts.

8. Ditto.
9. Lower rail broken at post on right.


Graeme & Murray Consultants Ltd.
11 and 12. Post anchors not holding.
13. Little room for expansion.

14. Typical dirt around bearings.

Graeme & Murray Consultants Ltd.
15. Horizontal steel adjacent to counterweight

16. Pocket between steel and concrete counterweight

Graeme & Murray Consultants Ltd.
17. Deep inaccessible pocket between concrete and steel

18. Moisture leaking from counterweight doors

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APPENDIX B

B.H. LEVELTON REPORT
Graeme & Murray Consultants Ltd.  
1137 Yates Street  
Victoria, B.C.  

May 17, 1990  
File: 490-424  

Dear Sirs:

Re: Paint Evaluation  
Johnson Street/Bay Street Bridges

Levelton Associates inspected the paint systems on the structural steel for the two bridges on May 15, 1990. Our observations and recommendations are as follows:

2. Johnson Street Bridge

Photograph No. 7 shows the Johnson Street Bridge. Levelton inspected the paint condition on the automobile side of the bridge.

The bridge had maintenance painting performed on it ten years ago by Kerschbaumer Coatings. Repair procedures consisted of spot blasting followed by the application of a red lead primer and a light blue alkyd topcoat.

We estimate that 90 to 95 percent of the existing paint system is intact over the entire bridge. The paint on the structural steel below the bridge seems to be in slightly worse condition than the painted steel above the deck.

The thickness of the paint varies from 5 mils to about 30 mils. The replacement steel beneath the bridge and patches on the girders have a paint thickness of only 5 mils or less. Photograph No. 8 shows the degree of rusting due to the low paint thickness.

- The variation in thickness is also illustrated on Photograph No. 9. The above deck column paint has paint greater than 30 mils thick. The patches have paint 4 to 12 mils thick. This column would have received a spot blast ten years ago. Sound paint was left intact and recoated by Kerschbaumer with the alkyd topcoat. These are areas where the paint thickness is high. The paint is in good condition on this column.

Photographs No. 10 to 17 depicts areas beneath the bridge deck that require attention. Maintenance work is recommended in the following areas:

- steel near expansion joints and other areas where water leaks onto the steel (Photographs No. 10 and 11);
- upper edges of flanges (Photograph No. 12);
- lattice work on small girders (Photograph No. 13) where access is difficult.
and surface preparation was probably less than satisfactory ten years ago;

- paint missles on isolated structural steel (Photograph No. 14);
- rivets and edges on structural steel (Photograph No. 15);
- west fixed span paint is the worst area of the bridge. Paint was applied over a poorly prepared surface. The lumps in Photograph No. 16 are rust scale. Extensive rusting is shown in Photograph No. 17.

The above deck painted structural steel is in better condition. Heavy chalking is evident on the paint. Paint failure and rusting is typically found on edges of lattice work and inside girders. Photographs No. 18 and 19 illustrate these failures.

The alkyd topcoat has also peeled from the galvanized hand rail (see Photograph No. 20). Rusting is evident on the top rail weld to the vertical bars in Photograph No. 21.

Maintenance work can be performed by either a combination of water blasting and tool cleaning or by abrasive blast cleaning. Unfortunately, the existing paint system contains lead. Special measures will be required to prevent spent abrasive and paint chips from entering the water. Fisheries and Oceans Canada requires containment of all waste material and paint overspray. Containment is expensive and depending on the bridge configuration and the waterway effected, costs can easily double or triple. The cost to water wash, abrasive blast, spot prime, topcoat the entire bridge and contain the hazardous material will be at least $10 per square foot.

Special tarps that retain spent abrasive and paint chips but allow air to pass through them, must be suspended beneath the bridge. The waste material must be funnelled to a collection area on a barge or on the shore. Appendix II contains illustrations of products that are available. Similar tarping is used to retain paint overspray.

The blast debris must be treated as a hazardous waste since it will contain lead. No landfill sites in Vancouver will take the material; it must be trucked to the United States for incineration.

Another factor that must be taken into account is bridge openings for marine traffic. This makes it difficult to use certain types of containment systems which use tarps attached to a barge beneath the bridge.

The alternative to abrasive blast cleaning is power washing to remove surface contamination and hand and power tool cleaning to remove rust scale. This method is labour intensive but it avoids the need for elaborate containment procedures and the generation of large quantities of hazardous waste. The cost to prepare the surface using this method, to spot prime with a surface tolerant epoxy and to apply a suitable topcoat to the entire bridge is about $3 per square foot.
Prior to proceeding with the work, coating test patches should be applied to at least one area of the bridge that is exposed to the weather. The purpose of the test patch will be to:

- test the chemical compatibility of the primer and topcoat with the existing paint;
- test the suitability of the method of surface preparation (washing and tool cleaning);
- test the adhesion of the existing paint to the steel and the adhesion of the new coatings to the existing paint.

We suggest testing a surface tolerant epoxy such as Devoe Bar-Rust 235 and at least one topcoat that would have excellent colour and gloss retention and fast dry properties to prevent overspray problems with automobile traffic. Devoe Vy-Kote 444 is a vinyl acrylic gloss enamel with these properties.

The cost to conduct these tests would be approximately $1,500. This includes two trips to site. Equipment, coating materials, travel costs, labour and report preparation are also included.

The test patch should be applied this summer to provide a test period of at least six to eight months.

Should you have any questions, please contact this office.

Yours sincerely,

B.H. LEVELTON & ASSOCIATES LTD.

M.J. Magee, P.Eng
7. Overall view of Johnson Street Bridge
8. Extensive rusting on replacement steel beneath the bridge due to low paint thickness

9. Variation in paint thickness on column above bridge surface
10. Corrosion on steel at expansion joint

11. Paint failure and rust on steel frequently wetted by water leakage
12. Rust on flange edges

13. Rust on small girder lattice work
14. Paint miss on top of girder

15. Paint failure on rivets and edge of girder

Graeme & Murray Consultants Ltd.
16. Rust lumps beneath paint on west fixed span

17. Extensive rusting on west fixed span girder

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18. Corrosion inside girder and on lattice work

19. Corrosion on structural steel

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20. Paint peeling from galvanized handrail

21. Rust on top rail weld

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ENVIROTARP

A TEXTILE SYSTEM USED FOR MAXIMUM CONTAINMENT OF SPENT BLASTING MEDIA, DISLODGED DEBRIS, AND DUST IN A CONTROLLED EVACUATION SETTING.
ENRONET

DESIGNED FOR BRIDGE REHABILITATION, THIS MESH NETTING CATCHES PAINT FLAKES AND OTHER DEBRIS DISLODGED BY SANDBLASTING.
APPENDIX C

OCEAN MARINE REPORT
PIER #1 (Mudline was at 15' water depth)

<table>
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<th>PICTURE</th>
<th>LOCATION</th>
<th>CONDITION</th>
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<tbody>
<tr>
<td>#1</td>
<td>3' above waterline</td>
<td>exposed aggregate</td>
</tr>
<tr>
<td>#2</td>
<td>8' below waterline</td>
<td>Void area: 2' wide x 12&quot; high x 12&quot; deep</td>
</tr>
<tr>
<td>#3</td>
<td>13' below waterline</td>
<td>Void area: 18&quot; wide x 12&quot; high x 6&quot; deep</td>
</tr>
<tr>
<td>#4</td>
<td>12' below waterline</td>
<td>Void area: 8&quot; wide 6&quot; high x 3&quot; deep</td>
</tr>
<tr>
<td>#5</td>
<td>14' below waterline</td>
<td>Eroded area: 18&quot; wide x 12&quot; high x 3&quot; deep</td>
</tr>
<tr>
<td>#6, #7, #8</td>
<td>2' below waterline</td>
<td>Eroded area: 15' long x 18&quot; high x 12&quot; deep</td>
</tr>
<tr>
<td>#9, #10,</td>
<td>5' below waterline</td>
<td>Eroded area: 10' long x 18&quot; high x 12&quot; deep</td>
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<tr>
<td>#11, #12</td>
<td>5' below waterline</td>
<td>Eroded area: 10' long x 18&quot; high x 12&quot; deep</td>
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PIER #2  (Mudline was at 18' water depth)

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<th>PICTURE</th>
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<tr>
<td>#13</td>
<td>3' above waterline</td>
<td>Exposed aggregate</td>
</tr>
<tr>
<td>#14</td>
<td>1' above waterline</td>
<td>Eroded area: 18&quot; long x 8&quot; high x 4&quot; deep</td>
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<td>#15</td>
<td>19' below waterline</td>
<td>Void area: 12&quot; long x 8&quot; high x 8&quot; deep</td>
</tr>
<tr>
<td>#16</td>
<td>10' below waterline</td>
<td>Eroded area: 5' long x 5' high</td>
</tr>
<tr>
<td>#17</td>
<td>17' below waterline</td>
<td>Void area: 10&quot; long x 6&quot; high x 5&quot; deep</td>
</tr>
<tr>
<td>#18</td>
<td>8' below waterline</td>
<td>Void area: 2' diameter, 6&quot; deep</td>
</tr>
<tr>
<td>#19</td>
<td>8' below waterline</td>
<td>Eroded area: 10' long, 12&quot; wide, 6&quot; deep</td>
</tr>
<tr>
<td>#20 #21</td>
<td>Cable approx. 8' off mudline, located West side of pier.</td>
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PIER #3 (Mudline was at 20' water depth)

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<th>PICTURE</th>
<th>LOCATION</th>
<th>CONDITION</th>
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<tr>
<td>#22</td>
<td>5' above waterline</td>
<td>exposed aggregate</td>
</tr>
<tr>
<td>#23</td>
<td>mudline</td>
<td>undermining of pier</td>
</tr>
<tr>
<td>#24</td>
<td>mudline</td>
<td>undermining of pier</td>
</tr>
<tr>
<td>#25</td>
<td>mudline</td>
<td>undermining of pier</td>
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