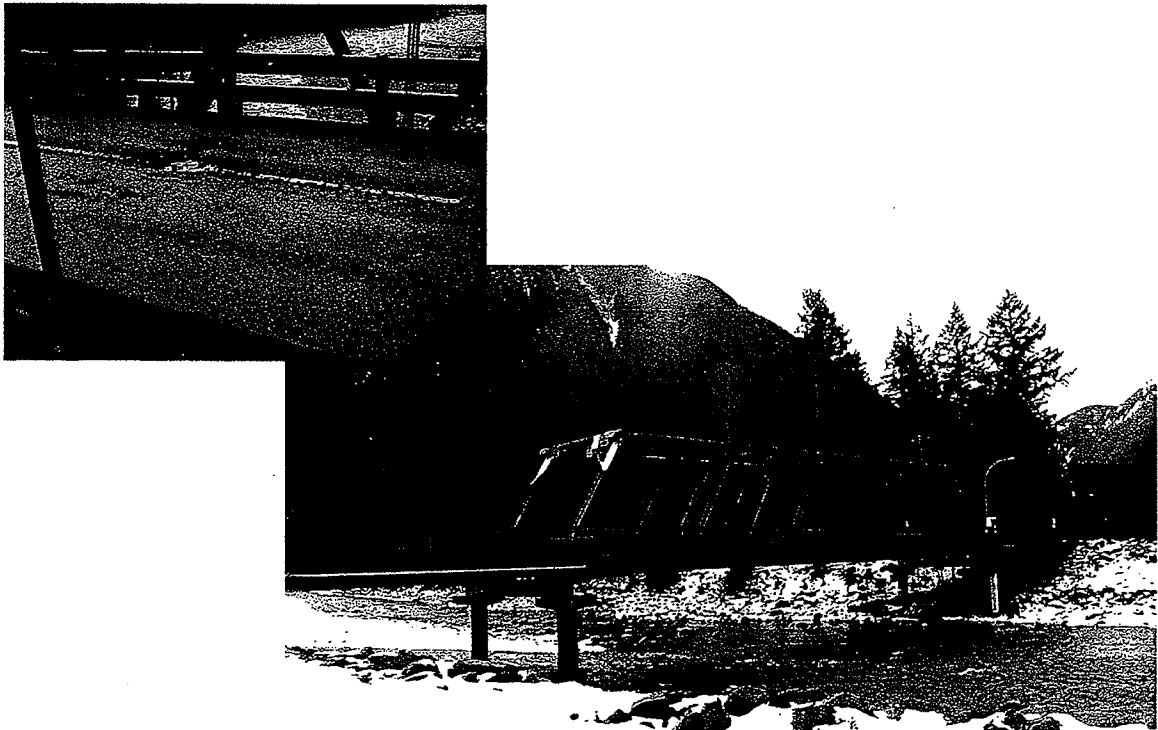


R E P O R T

## DISTRICT OF HOPE

# Kawkawa Lake Road Bridge Repair and Replacement Options Report



ASSOCIATED  
ENGINEERING



September 9, 2004  
File: 022316

James Storey  
Manager of Operations  
District of Hope  
Public Works Yard  
1225 Nelson Avenue  
Hope, BC  
V0X 1L0

Re: **KAWKAWA LAKE ROAD BRIDGE REPAIR  
AND REPLACEMENT OPTIONS REPORT**

Dear Mr. Storey:

Please find enclosed three copies of our final Kawkawa Lake Road Bridge Repair and Replacement Options Report. If you have any questions or comments, please feel free to call me. Thank you for the opportunity to work on this interesting and challenging project.

Respectfully submitted,

ASSOCIATED ENGINEERING (B.C.) LTD.

Prepared by:

Shane Cook, E.I.T.  
Project Engineer

SC/mceb

Reviewed by:

Don Kennedy, P.Eng.  
Senior Bridge Engineer

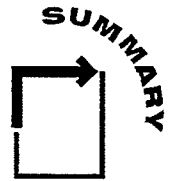
Associated  
Engineering  
(B.C.) Ltd.

Suite 300  
4940 Canada Way  
Burnaby, B.C.  
Canada  
V5G 4M5

Tel. 604.293.1411  
Fax 604.291.6163

www.ae.ca

## EXECUTIVE SUMMARY



The District of Hope has retained Associated Engineering (B.C.) Ltd. to investigate repair and replacement options for the asphalt wearing surface on the Kawkawa Lake Road Bridge. This investigation has been instigated by the premature deterioration of local areas of asphalt on the bridge. The problem is the formation of a large pothole on the main span of the bridge as well a smaller pothole on the east approach span. This report includes the following discussion:

- Design considerations for the bridge
- Short term repair options - patching
- Medium term repair options - wearing surface replacement
- Long term replacement options for planning - span and bridge replacement
- Recommendations.

When investigating repair and replacement options it is necessary to consider several factors including cost, durability, load capacity, functional requirements, and the life expectancy of the bridge.

This year, locally thickened asphalt patches should be installed to repair the existing potholes. At these locations the existing asphalt should be removed, with sawcut edges. Prior to installing the patch the condition of the waterproof membrane and the deck timbers should be investigated and repairs effected as required. The new patch should have a nominal thickness of not less than 50 mm. The patch edge thickness should be tapered to match the existing asphalt thickness.

If the asphalt continues to deteriorate and local patching is not effective a wearing surface enhancement or replacement may be required in the next few years. Enhancement could be achieved by thickening; however, the traffic load carrying capacity of the bridge would be significantly reduced.

A conventional replacement would be to provide a new, slightly thickened asphalt surface. If deterioration over the next few years gets to the point of needing a full surface replacement it is a good indication that the current asphalt thickness is inadequate for durability. The current asphalt thickness was selected based on load requirements as well as durability. A target asphalt thickness of 50 - 65 mm may provide satisfactory durability but this thickness will reduce the load capacity of the bridge. If a reduction in

---

R E P O R T

the posted load is not acceptable then an alternative wearing surface such as a timber deck with an anti-skid surface could be pursued. (High Maintenance)

The life of the Kawkawa Lake Road Bridge can be extended for a period of time by regular maintenance and rehabilitation, requiring increasing annual amounts on maintenance and repairs. Eventually, it will become necessary to replace the bridge for economic and functional reasons. (2004) Depending on the District's assessment of when annual costs are no longer acceptable, this period may range from several years to perhaps ten to twenty years.

A staged bridge replacement is feasible and could provide a solution which will let the District spread replacement costs over a number of years. However, this limits the crossing to the current alignment, and the overall load capacity of the bridge cannot be increased until all spans have been replaced. Alternatively the structure can be replaced entirely at one time. The existing piers could be used to save significant cost. However, the viability of this depends on the acceptable duration of a bridge closure for construction.

---

R E P O R T

---

# TABLE OF CONTENTS



SECTION	PAGE NO.
<b>EXECUTIVE SUMMARY</b>	<b>i</b>
<b>TABLE OF CONTENTS</b>	<b>iii</b>
<b>1 INTRODUCTION</b>	<b>1-1</b>
1.1 Background	1-1
<b>2 CONSIDERATIONS</b>	<b>2-1</b>
2.1 Costs	2-1
2.2 Durability	2-1
2.3 Load Capacity	2-2
2.4 Life Expectancy of Bridge	2-2
<b>3 SHORT TERM: REPAIR OPTIONS</b>	<b>3-1</b>
3.1 Asphalt Patch	3-1
3.2 Reinforced or Anchored Asphalt Patch	3-2
3.3 Asphalt Patch and Partial Overlay	3-3
3.4 Approach Span Overlay	3-3
<b>4 MEDIUM-TERM: WEARING SURFACE REPLACEMENT OPTIONS</b>	<b>4-1</b>
4.1 Repave with Asphalt	4-1
4.2 Resurface with Concrete Deck	4-2
4.3 Resurface with Timber Deck	4-3

---

R E P O R T

---

<b>5</b>	<b>LONG-TERM: BRIDGE REPLACEMENT OPTIONS</b>	<b>5-1</b>
5.1	Staged Span Replacement	5-1
5.2	Bridge Replacement on Same Alignment	5-2
5.3	Bridge Replacement on Parallel Alignment	5-2
<b>6</b>	<b>SUMMARY AND CONCLUSIONS</b>	<b>6-1</b>
6.1	Short-Term Repair and Maintenance	6-1
6.2	Medium-Term Rehabilitation	6-1
6.3	Long-Term Replacement	6-2

# INTRODUCTION

# SECTION 1

The District of Hope has retained Associated Engineering (B.C.) Ltd. to recommend a repair method for the cracking and asphalt deterioration on the east end of the truss span of the Kawkawa Lake Road Bridge, and to a lesser extent of the east approach span. Recognizing that the continued costs to maintain this bridge, and in particular, the wearing surface, the District also requested that Associated Engineering provide a range of maintenance, rehabilitation and replacement options. This range of options is intended to provide a broader and longer term context to assist in short-term planning, and in better understanding the future scenarios that the District is likely to face with this aging structure.

This report includes the following discussion:

- Design considerations for the bridge
- Short-term repair options - patching
- Medium-term repair options - wearing surface replacement
- Long-term replacement options for planning - span and bridge replacement
- Recommendations.

## 1.1 BACKGROUND

The Kawkawa Lake Road Bridge has a total span of 73 m and consists of two glulam timber approach spans and a timber through-truss main span. The bridge was originally constructed in the 1950's and has been modified several times since. For a bridge of this type, conducting regular maintenance is an important process in extending the service life of the bridge and reducing the need for significant rehabilitation measures. The District of Hope owns and maintains the bridge and does not currently have plans to replace the bridge.

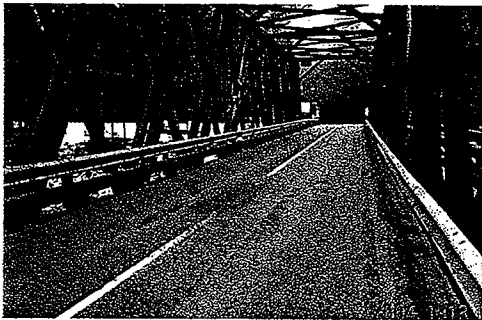
The timber "Howe" truss is one of several dozen constructed by the Ministry of Transportation throughout the Province in the mid 1900s. Very few of these trusses remain in existence, with most having been replaced as a result of rot and deterioration, collapse due to vehicle impacts, fire, flooding or because the narrow roadways became functionally deficient.

---

R E P O R T

The bridge deck is constructed of laminated timber placed transversely on the two approach spans and longitudinally on the main span. The wearing surface is asphalt placed over the laminated timber deck. The predominant cause of asphalt failures for a deck of this construction is due to the deflection of the timbers being larger than can be accepted by the asphalt. In addition, differential movements between timber laminations can lead to reflective cracking along the laminations. Either of these issues will be exacerbated by rot in the deck timbers and moisture between the deck and the asphalt.

In September 2002 the bridge was resurfaced with a single 40 mm lift of asphalt placed over a waterproof membrane. The asphalt thickness was limited in order to maintain the vehicle load capacity of the bridge, as discussed in this Report. Observations indicate that the final rolled thickness of asphalt on the deck was in this range, but local sections have thicknesses of 30 mm or slightly less. The waterproof membrane was installed to both extend the life of the timber deck by preventing water ingress, and also to limit the reflective cracking associated with asphalt installed over timber decks. It was recognized that a membrane in this type of application was novel, but the potential benefits worth pursuing.



*Pothole on main span.*

The asphalt near one of the deck joints (at the east pier) experienced significant cracking shortly after the asphalt was placed. The causes were found to be the reduced asphalt thickness and the local deck deflections. This location was repaired by stiffening the deck end edge, grinding the laminated deck to allow a thickened asphalt layer, and locally replacing the asphalt with the specified thickness. This area is now functioning well.

In late 2003, a large pothole, approximately 0.5 m x 3 m formed near the road centreline of the east end main span. The cause of the ravelling in these areas has not been definitely confirmed. Probable causes include the local asphalt thickness, debonding of the membrane, and possibly local rot in the deck timbers. Over the winter of 2003/2004 this area has been maintained by patching with cold-mix asphalt. The cold mix repairs are not durable and a more permanent repair is required. A small area on the east approach span deck is also showing signs of cracking. The asphalt cracking here may lead to the formation of a pothole. Other minor asphalt cracking is occurring throughout the spans, which is normal for asphalt on timber decks.

## CONSIDERATIONS

In deciding which rehabilitation strategy is most appropriate a number of factors must be considered such as costs, durability, future bridge life, and load capacity. The following sections describe these factors and provide recommendations on which repair strategy should be pursued.

### 2.1 COSTS

The cost of a repair or rehabilitation scheme is a primary concern when selecting an appropriate repair option. For each of the options considered we have estimated an order of magnitude construction cost. For an older bridge with ongoing maintenance issues the magnitude of spending must be balanced with the expected service life of the component and the structure as a whole.

Significant variations in construction costs have been observed during the past year. Factors including material costs, labour shortages, high workloads, and seasonal variability have all combined to produce highly variable costs. The cost estimate provided are order of magnitude construction costs. Prior to budget preparation more detailed cost estimates should be prepared.

### 2.2 DURABILITY

The deck on the Kawkawa Lake Road Bridge is a laminated timber deck. The deck is constructed of 2 x 6 and 2 x 8 timbers placed side by side and laminated together through nailing. On the truss span the laminations run longitudinally along the bridge, on the approach spans the laminations run transversely.

The durability of a wearing surface overlay on a laminated timber deck will be affected by several factors. These factors include thickness and strength of overlay, deflection of the timber deck, rot in the timber deck, and bond of the wearing surface to the deck.

On an existing structure, there is limited opportunity to cost-effectively modify the characteristics of the existing laminated timber deck. Furthermore, locating and removing deteriorated (rot) timbers will be ongoing. Both of these issues can contribute to the debonding of the asphalt or membrane.

### 2.3 LOAD CAPACITY

The bridge is currently posted at 21 tonnes with a maximum 16 tonne axle load. This load posting effectively limits truck traffic on the bridge to a loaded tandem axle truck, e.g., gravel trucks and flat beds. The load posting does not allow loaded logging trucks or highway semi-trailers to cross the bridge. Reduction of the load posting on the bridge will reportedly have an impact on local commercial traffic and businesses.

Due to the area of the wearing surface, a relatively small increase in its thickness would have a significant impact on the bridge's load capacity. A heavier, more durable wearing surface would likely preclude tandem truck traffic on the bridge.

### 2.4 LIFE EXPECTANCY OF BRIDGE

The bridge was constructed in the 1950's and is approaching 50 years in age. The construction, condition and age of the bridge indicate that the end of its economic life expectancy is being approached. As the bridge continues to age and deteriorate, the cost required to maintain the structure will increase. Experience around the Province shows clearly that timber truss bridges are vulnerable to collapse from vehicle impacts (to height or over wide loads), fire, flooding, overload, or local deterioration.

A bridge has reached its economic life when the cost and benefits of maintenance outweigh the cost and benefits of replacement or decommissioning. The District should begin to consider the long-term approach for this bridge. Replacement will inevitably be required. The life expectancy should not affect the implementation of a short-term patching program.

## SHORT TERM: REPAIR OPTIONS

An immediate repair to the potholes is needed. Three options are discussed below. Before, or as part of, any repairs, the condition of the deck timbers and the membrane at the location of the pothole should be confirmed.

The condition of the deck timber should be confirmed in this area to determine if there is any rot present. If deteriorated timbers are found, it will be necessary to repair the affected area prior to installing the patch. The condition of the timbers can be checked by sounding or drilling the deck timbers. Our engineers have probed through the damaged area using nails, which did not indicate extensive rot. This was not a comprehensive test, and the condition must still be determined.

If minor local deterioration or rot is found, the area can be cleaned out with hand tools and the area filled with a fast-setting fibre-reinforced grout. If, on the other hand, the timbers are extensively rotted, it will be necessary to replace the affected timbers. Because the timbers need to be continuous over several floor beams, replacing rotted timbers may lead to a more extensive repair.

At the same time, the membrane should be checked for debonding. We expect that the membrane is debonded under the pothole. Debonding of the membrane allows differential movements between the deck and the asphalt, accelerating deterioration. If the membrane is debonded then it should be locally cut out and an appropriate liquid mop-on membrane applied to enhance bond and protect the deck timbers from moisture. It is possible to not apply a liquid membrane, but local water ingress would accelerate deck deterioration. A roll-on membrane can also be used, but is not preferred for this small area. Asphalt patching would be as described below, with an asphalt mix meeting the requirements of MMCD Section 02512, Upper Course No. 1.

### 3.1 ASPHALT PATCH

The simplest patching option would be a plain hot-mix asphalt patch. Before installing the patch, the asphalt adjacent to the pothole would be removed over the full width of the deck. The edges of the patch should be cut vertical, as feathered patch edges will delaminate easier and reduce the life of the patch. The deck timbers and membrane should be checked and repaired as described above. The patch should have a maximum thickness of 50 mm with the edges tapered to match the existing.

---

R E P O R T

---

The benefits of this patching option are:

- Simplicity
- Low cost
- Limited effect on live load capacity
- Patch can be milled for future resurfacing.

The disadvantages of this patching option are:

- May not be as durable as other patching options.

### **3.2 REINFORCED OR ANCHORED ASPHALT PATCH**

A variation on a plain hot-mix asphalt patch is to repair the wearing surface with a reinforced asphalt patch. The patch area would be prepared as described above. A mesh reinforcing grid would be added to the asphalt during placing. In addition the patch could be anchored to the deck using partially driven nails which would project up into the asphalt.

The benefits of this patching option are:

- Limited effect on live load capacity
- Potentially more durable than a plain asphalt patch.

The disadvantages of this patching option are:

- More difficult to install than a plain patch
- The grid and anchoring nails would foul a milling machine used to remove the deck asphalt for a future resurfacing
- Additional durability is not assured with this option.

Pavement reinforcing grids have been used on this bridge previously, and demonstrated limited effectiveness in limiting asphalt cracks. The grid may have prevented pieces from falling out, and, therefore, appears to have some value.

### 3.3 ASPHALT PATCH AND PARTIAL OVERLAY

The most robust option would likely be to install an asphalt patch as described above. Following the installation of the patch an additional overlay lift of asphalt could be added. It appears that the thickness of the asphalt on the bridge deck varies and the potholes have formed at locations where the asphalt is reduced. The addition of an overlay would provide additional thickness and improve durability. The overlay could be installed locally over the centre portion of the deck, or locally near the patch location. If an overlay is installed locally, the edges of the overlay area should be partially milled to provide an edge to pave up to. If the edges are simply feathered out the thin asphalt may break up prematurely. In order to be effective the overlay thickness should be a minimum of 40 mm, and preferably 50-65 mm.

The benefits of this patching option are:

- A more durable repair may be achieved
- If the overlay is installed locally the chance of a pothole reforming will be reduced
- If the overlay is installed over a larger portion of the deck it will reduce the potential for future potholes.

The disadvantages of this patching option are:

- Additional weight will affect the live load posting of the bridge
- Repair is more costly than the previous alternatives
- A local overlay will leave a minor transition which may be noticeable to drivers.

If local patching does not prove to be durable, then medium-term solutions should be implemented.

### 3.4 APPROACH SPAN OVERLAY

The asphalt on the two approach spans is in better condition than the main truss span. However, local cracking has begun with the potential for potholes forming. The capacity of the glulam approach spans is greater than the main truss span; therefore, there is an opportunity to increase the overlay thickness on the two approach spans.

If the asphalt on the approach spans continues to deteriorate, any potholes or cracked asphalt should be locally patched. After patching, an additional 40 mm asphalt overlay could be placed over the full extent of the approach spans. The ends of the overlay should be feathered into the existing asphalt. A sawcut transition could be provided to achieve a more durable edge.

## MEDIUM-TERM: WEARING SURFACE REPLACEMENT OPTIONS

If the patching option described above provides an acceptable repair, it will not be necessary to undertake any additional work in the near future. If the local patching does not prove satisfactory, it will be necessary to undertake a more significant rehabilitation involving a wearing surface replacement. Before undertaking a complete wearing surface replacement long-term planning for this bridge should also be considered, including the economic life expectancy of the bridge. The suitability of the following options should be balanced with the expectations for the life span of bridge. Three resurfacing options are discussed below.

Prior to implementing any of the options discussed below the condition of the timber deck should be verified. If the deck timbers are deteriorated extensively, the repair costs will need to be considered prior to implementing the additional repairs.

If the condition of the timber deck is adequate or repairable, the wearing surface replacement can be implemented. Several wearing surface options are available. A conventional repair would be to repave with asphalt, but other options are available, including concrete and timber decking.

### 4.1 REPAVE WITH ASPHALT

An asphalt wearing surface has several benefits: it provides a uniform, smooth wearing surface with good traction characteristics. The durability of asphalt is largely dependent on the asphalt thickness and the stiffness of the substrate. Experience is showing that for a timber bridge deck an asphalt thickness of at least 50 mm appears necessary to achieve acceptable durability. Asphalt thicknesses of 80 mm are typically provided on concrete decks where long-term durability is essential, and this thickness would also be preferable on a timber deck.

The simplest approach is to construct an asphalt overlay over the existing asphalt wearing surface. Prior to installing the overlay any potholes or areas of cracked asphalt must be repaired. The overlay should be 40 mm thick yielding a total asphalt thickness of 65 - 80 mm on the bridge deck. There are several benefits to this option including simplicity, short construction period, low construction cost, and increased durability.

The primary disadvantage to this approach is the significant reduction in live load capacity due to the asphalt weight. The addition of 40 mm of asphalt corresponds to an increased self weight of 20 tonnes. Considering that the bridge is posted for 21 tonnes the direct addition of 40 mm of asphalt is clearly prohibitive.

A refinement on the above approach is to mill off the existing asphalt before constructing a uniform thicker asphalt overlay. Ideally, a finished asphalt thickness of 50 mm - 65 mm would be installed. The final thickness must be balanced with the required load capacity. By milling the asphalt before resurfacing any existing deteriorated asphalt will be removed. In addition, inspection and repairs to the deck timbers or membrane could be undertaken at this time. The benefits of this approach include removal of deteriorated asphalt, an opportunity to repair the deck and membrane, and increased durability. The disadvantage of this option is a reduction in the live load capacity due to the additional asphalt thickness. The effects on the live load capacity will be reduced from the first option with no asphalt removal.

A cost estimate for repaving the bridge, including a new membrane and removal of existing asphalt, is approximately \$30,000 - \$40,000 dependent on the thickness of asphalt installed.

#### **4.2 RESURFACE WITH CONCRETE DECK**

A very durable resurfacing option is to construct a reinforced concrete overlay on the existing laminated timber deck. A concrete overlay would be much more durable than asphalt. A properly detailed concrete deck will have a life expectancy of over 20 years.

The concrete slab would be detailed as a structural slab spanning between the floor beams. The slab would have a thickness of approximately 200 mm. With this option the existing timber deck becomes “permanent form work” once the concrete is cast. The condition and strength of the deck timbers are then unimportant once the deck is constructed.

The significant advantage of a concrete deck is durability. The life expectancy of a reinforced concrete deck is significantly longer than that for an asphalt wearing surface.

The disadvantages of this option are the weight of the concrete deck due to the required thickness and costs associated with strengthening. For the Kawkawa Lake Road bridge

significant strengthening would be required for the truss span to achieve an acceptable load capacity with the concrete deck. Strengthening would probably be required to simply support the weight of the concrete.

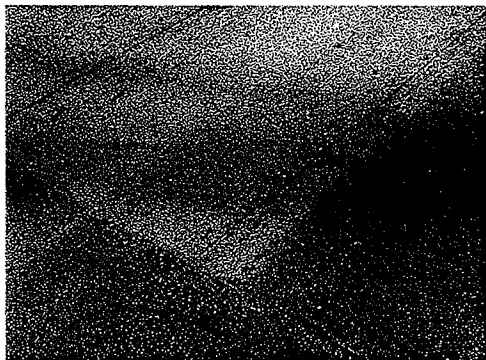
An order-of-cost for a concrete overlay on the approach span is 2002 and was \$75,000.

**4.3 RESURFACE WITH TIMBER DECK**

Replacing the existing asphalt with a timber wearing surface may provide a low-cost and lightweight alternative. The timber wearing surface may be in the form of longitudinal planks or plywood panels. Given the traffic volume on the bridge a full width wearing surface is required, timber planks at discrete wheel lines are not acceptable.



*Casorso Bridge.*



*Plywood panels on the Casorso Bridge.*

The primary disadvantages of a timber wearing surface are serviceability and perception issues. A timber wearing surface will not be as smooth as asphalt and does not provide as much traction. The rideability of the wearing surface is an issue that has to be accepted with a timber deck. The traction of the timber deck can be improved through the use of proprietary surface treatments which provide an abrasive surface to the timbers. A timber deck would not be expected to last as well as a thick

asphalt surface but the durability can be balanced with the lower cost and the ease of maintenance. For this bridge, a thick asphalt overlay is not achievable.

Several bridges in BC have been resurfaced with timber decks. Three examples are the Westham Island Bridge in Delta, the Casorso Bridge in Kelowna, and the Cowichan River Bridge. The deck on the Westham Island Bridge was replaced with longitudinal planks. Discrete wheel lines



*Westham Island Bridge.*

were treated with “SRM Grip”, a proprietary abrasive wearing surface, to enhance traction along the wheel lines. The Casorso Bridge was resurfaced with plywood panels, screwed down, whose surface was also pretreated with SRM Grip. The Cowichan River Bridge deck was surfaced with longitudinal timber planks with a “chip seal” abrasive surface, and is performing fairly well after 6 years of service.

The advantages of a timber wearing surface are light weight, ease of maintenance, and moderate cost. The disadvantages include limited durability and a lower quality driving surface for the traffic. The lower durability may be offset by the ease of maintenance. The cost to replace the existing asphalt wearing surface with a timber wearing surface would be approximately \$20,000 - \$30,000, including milling of the existing asphalt. However, timber and plywood prices are variable and this estimate should be reviewed prior to implementing a deck replacement.

## LONG-TERM: BRIDGE REPLACEMENT OPTIONS

The Kawkawa Lake Road Bridge is approaching the end of its economic life. This year \$30,000 was spent replacing several rotted timbers on the trusses, in addition to other routine and unplanned maintenance costs. Given the condition of the bridge, it may be expected that expenditures of this magnitude would be required most years. As the life of the bridge is extended beyond 5+ years the amount of maintenance required will increase. For this reason we suggest that planning for the replacement of the Kawkawa Lake Road Bridge begins now. We recognize that some consideration has been given to this option, but recommend that a capital plan be developed if not already done.

### 5.1 STAGED SPAN REPLACEMENT

The bridge is comprised of two distinct structure types. The main span is the original timber truss. The two approach spans are constructed of glulam timber girders. The glulam approach spans are newer than the main span truss and have a higher load capacity. Currently the limiting factor for the bridge is the main span truss. Due to flood damage the bridge piers were previously rebuilt. The updated piers are in good condition.

Given the condition of the two approach spans and the piers, a staged replacement of the bridge is a feasible option. The existing main span truss could be removed and replaced with a new steel girder with concrete deck span. The structural depth of the new girders would be greater than the existing glulam girders. It would, therefore, be necessary to jack up the existing approach girders and regrade the approaches to achieve a uniform deck height.

The replacement of the approach spans would be scheduled when required due to traffic requirements or deteriorated condition.

An order of magnitude cost estimate for staged replacement on the same alignment and utilizing the existing substructure is \$650,000 - \$750,000 for the main span, and \$500,000 - \$600,000 for the approach spans. These estimates do not include demolition of the existing bridge spans.

## 5.2 BRIDGE REPLACEMENT ON SAME ALIGNMENT

Replacement of the existing bridge utilizing the existing alignment offers economic benefits. As the existing piers are in good condition, it appears feasible to replace the superstructure only on the existing piers. Some work would be required to the piers to suit the replacement bridge configuration. In addition to utilizing the piers, the extent of road works required is minimized if the current alignment is followed.

Replacing the bridge on the existing alignment will have an impact on local traffic. It would be necessary to detour all traffic via the Coquihalla Highway for the duration of the project. The construction schedule would be in the order of 8 weeks minimum and possibly longer.

A replacement superstructure utilizing the existing piers would probably consist of a multiple steel girder bridge with a concrete deck. With a conventional superstructure the future bridge width would be limited to two lanes and a sidewalk. To achieve a wider bridge deck, the pier would have to be widened.

An order of magnitude cost estimate to replace the existing bridge on the same alignment and utilizing the existing piers is \$0.8 to 1.0 Million. This estimate does not include demolition of the existing bridge. An allowance of \$50,000 to \$150,000 may be needed, depending on acceptable durations of road closures.

## 5.3 BRIDGE REPLACEMENT ON PARALLEL ALIGNMENT

Construction of a replacement structure adjacent to an existing bridge is fairly typical. In the case of the Kawkawa Lake Road Bridge, constructing a replacement adjacent to the existing structure would provide opportunities to improve the existing alignment, including deck width and road alignment. Also, the impact on local traffic would be greatly minimized with essentially continuous traffic flow maintained during construction.

A variety of replacement configurations should be investigated including, two or three span steel girder bridge or a three- or four-span concrete girder bridge. It would be

technically possible to construct a clear span bridge but the costs would probably be prohibitive. Based on our discussion with the District regarding current usage a two-lane bridge with sidewalk on one or both sides will probably be appropriate. Future community planning may dictate a wider or narrower bridge.

An order of magnitude cost estimate to replace the existing bridge on an adjacent alignment assuming a two-lane (12.0 m) wide deck is \$1.3 to 1.5 million. This estimate does not include demolition of the existing bridge and realignment of the roads. Road realignment could conceivably be similar or even greater than the structure cost.

## SUMMARY AND CONCLUSIONS

### 6.1 SHORT-TERM REPAIR AND MAINTENANCE

We recommend that the plain asphalt patch described in Section 3.1 be implemented at this time over a liquid membrane. Generally, the deck asphalt is in fair to good condition. Replacing the deteriorated areas with a 50 mm thick patch should provide a durable repair.

For the approach spans, any potholes that have formed can be repaired as described above. In addition, a 40-mm asphalt overlay can be added to the approach spans in the future, if desired.

### 6.2 MEDIUM-TERM REHABILITATION

We recommend that the District begins long-term planning for the future of this bridge. The need for longevity, load capacity, rideability, and durability must be balanced with traffic requirements and budget.

If the existing asphalt deck continues to deteriorate and the patches do not last then as part of the deck system selection, the condition of the deck timbers should be investigated. If the timbers are rotted, it would be necessary to repair the timber deck, which may involve a significant cost depending on the extent of rot. Covering rotted deck timbers would result in ongoing accelerated deterioration of the wearing surface. Local patching (e.g., steel plating) of local rot has not provided a satisfactory solution in other Lower Mainland municipalities as the limited adhesion of the asphalt and flexibility of the steel plates results in the asphalt patches failing.

If the deck timbers are in an acceptable condition, a wearing surface replacement will be possible. If a reduction in the load posting is acceptable then we recommend partial milling or removing of the existing asphalt and repaving with a 50 to 65 mm lift of asphalt. If the reduction in the load posting is not acceptable then the wearing surface could be replaced with timber.

### 6.3 LONG-TERM REPLACEMENT

The life of the bridge can be extended for a period of time by spending ever increasing amounts on maintenance and repairs. However, it will eventually become necessary to decommission or replace the bridge for economic or functional reasons. Several replacement plans have been identified, including staged replacement, replacement on the existing alignment and replacement on a parallel alignment.

A more detailed assessment of replacement options will eventually be required. This report provides a starting point for discussions or investigations. The option assessment should involve liaison with the District and consider community planning, traffic levels (current and future), budget considerations, and environmental concerns.

# Ductile Iron Pipeline Steady State

