Wildlife Mitigation
At What Cost?

Presentation to
Wildlife Crossing Structure Field Course
Western Transportation Institute
September 10 to 12, 2002
T M McGuire P.Eng

Presentation
• Wildlife Mortality Mitigations
• Wildlife Connectivity Mitigations
• Other Non Wildlife Mitigations
• Mitigation Economics

Costing
• Costs in Canadian Dollars > conversion to US about .63
• Based on historical construction costs
• Factored for inflation to reflect 2002 costs
• Size of project, topography, timing, location, complexity etc will affect costs
• Engineering and environmental costs not included
• Existing grade reference assumes existing highway, traffic accommodation and repair to road surface
• New or existing grade assumes appropriate topography

Part I Mitigations
WILDLIFE MORTALITY

Mortality Mitigation
Wildlife Fencing
• Typically 2.5m high variable expanded metal mesh on pressure treated posts
• 95% effective in keeping most wildlife off highway
• Increased effectiveness with ground apron and outriggers
• Fence ends and openings require special treatment (texas gates etc)
• Provision for extracting wildlife inside fence
• Continuous maintenance required
• Interrupts wildlife/human movement/connectivity hence usually requires passage structures

Wildlife Fencing
150mm x 150mm Mesh
Wood post, no apron (1991)
$28,500/km each side
Steel posts, No apron (1991)
$90,000/km each side
Banff TCH Wildlife Mortality
Apr 1998 to March 2001

(A Clevenger)

• Fencing mitigation effective in reducing mortality despite increasing traffic

• Effective most species save coyotes who access ROW under fence

Wildlife Fence
Ground Apron

Wood post with apron (1997)
• $49,000/km each side

Steel post without apron
• $120,000/km each side
Add $3/m if erected on 2:1 slope (longer post)
Add $9/m if clearing required
Approximately 60% increase in cost over no apron fence

Wildlife Fencing
Openings

Texas Gates - 2 lanes plus shoulder c/w 3 meter snow storage
• $210,000

One way Gates and swing gates
• $500

Wildlife Fencing
Ends

• Ends vulnerable to wildlife intrusion
• Fenced or rip rapped
• Combined with Texas gates on low speed volume roads
• Not applicable solution for high traffic/speed highways

Wildlife Fence
Egress

Double or single swing gate
• $300 to $500/gate

Jump out

Wildlife Fence
Connectivity/Passage

Human Connectivity
• $4200
(Year round use)

Swing gates
• $350 to $500
(Summer use/access)
Rely on user to close gate
Wildlife Fencing
Future Considerations

- Outriggers @ 45 or 90
- All steel posts
- Wildlife activated speed zones at fence ends/openings
- Electrification

Part I Mitigations
Connectivity

Connectivity Mitigation
Underpasses/Overpasses

- Variety of structure type/size solutions available
- Lends themselves to design/build
- Topography considerations needed when choosing a solution
- Species diversity, population as well as type of wildlife to be accommodated also effect final structure choice
- Cost/benefit becomes more subjective
- Need to clearly state/agree to objective of mitigation early on and how “success” will be measured

Barrier Openings

Barrier openings every 50 m
Allows small wildlife species within ROW opportunity to get past barrier

Small Culverts
(0.8m to 1 m x 35m)

- New Grade
  - $130 to $150/m installed
- Existing Grade
  - $150 to $170/m
- Typical Two Lane Crossing
  - $5000 to $6000
- Potential multiple use for drainage and wildlife passage

Creek Pathway
(1.5 m x 32m)

- New Structure
  - $500/m
- Existing Structure
  - $500/m
- Typical Two Lane Crossing
  - $17,500
- Excludes structure costs
- Reduced flow capacity
- Potential fisheries issues
Precast Concrete Box Culvert
(2.4m x 3m x 32m)

New Grade
• $3500/m
Existing Grade
• $4500/m
Typical Two Lane Crossing
• $120,000 to $155,000
• Use where grade an issue
• Quick installation times

Multi-plate Steel Culvert
(4m x 7m x 36m)

New Grade
• $4300/m
Existing Grade
• $5000/m
Typical Two Lane Crossing
• $155,000 to $180,000
• Use where sufficient grade
• Maybe more applicable for weary species

Open Span Structure
(16.5m x 14m x 4m clearance)

New Grade
• $1300/sq m
Existing Grade
• $1500/sq m
Typical Two Lane Structure
• $300,000 to $350,000
• Simple span up to 25m
• Assumes sufficient topography
• Maintenance/safety issues

Elevated Roadway
(> 25 m x 14m x 5m clearance)

New Grade
• $23,300/m
Existing Grade
• $31,265/m
Typical Two Lane Structure (50 m)
• $1,165,000 to $1,560,000
• Continuous span/piers/joints req’d
• High maintenance/ decreased safety

Overpass Structure
(52m x 16m x 8 m clearance)

New Grade
• $17,500/m width
Existing Grade
• $19,000/m width
Typical Structure Crossing
• $910,000 to $990,000
• Simple structures
• No detours, low maintenance
• No safety issues

Overpass Details
Overpass Details

- Design/build
- Precast fabrication off site
- Trucked to site as needed

- Strip footing along side highway
- Minimal traffic disruption

Overpass Details

- No falsework
- Detour during work hours only

- 7 to 10 days erection time per arch
- Waterproofing, backfill, headwalls & landscaping add time
- Large quantities of backfill req’d

Summary

- Minimum Traffic Disruption
- Easily Expandable
- Low maintenance
- Requires large quantity of fill
- Best suited where grade high on both sides of highway

Buried Roadway (Tunnel)

New/Existing Grade

- $69,250/m (basic)
- $6,500/m (lights/pump)
- $1,140/m (rehab)

= $76,900/m

Average Cost (50m - 2 lanes)

- $13,850,000 (basic)
- $15,150,000 (lights/etc)
- $15,380,000 (total)

Part I Mitigations

Other

Other Mitigations

Vegetation

- Indigenous species grown and planted from seed collected from ROW (grasses, shrubs, trees)
- Chipping of grubbed material and passive composting
- Hwy design to minimize footprint and hence alienation of park lands
- No imported topsoil, excess stockpiled for future use
- Regrade/rehabilitate borrow pits for grazing
- Balance cut and fill, salvage any granular material from ROW
Other Mitigations

Aquatics
- Steep rock or concrete retaining walls to avoid wetlands/river
- Construction/restoration of any lost fish, amphibian and waterfowl habitat (no net loss)
- Regrade/address existing “hanging culverts” to permit fish passage
- Build outside fishbearing stream wetted perimeter and spawning seasons
- Silt fencing during construction
- Retention ponds and “stormceptor” drains to attend to oils, siltation and salt

Other Mitigations

Construction
- Recycle all salvaged material (i.e. guardrail, asphalt)
- No burning
- Traffic management plan (minimal detours, 1-800 number, variable message boards, traffic coordinator)
- Environmental surveillance officer/contractor environmental briefings
- Steep back/sideslopes and natural contouring

Part II Mitigations

ECONOMICS

Mitigation Cost Summary
(2 Lanes)

<table>
<thead>
<tr>
<th>Structure Type</th>
<th>Cost/structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5m Fence c/w apron (1 km)</td>
<td>$100,000</td>
</tr>
<tr>
<td>2.4 x 3 (32m)</td>
<td>$150,000</td>
</tr>
<tr>
<td>4 x 7 (36m)</td>
<td>$180,000</td>
</tr>
<tr>
<td>16.5m Open Span (4m)</td>
<td>$350,000</td>
</tr>
<tr>
<td>50m Overpass (16m)</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>50m Elevated Rd (14m)</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>50m Tunnel (14m)</td>
<td>$3,850,000</td>
</tr>
</tbody>
</table>

TCH Mitigations
Phase I & II

<table>
<thead>
<tr>
<th>Structure Type</th>
<th>Cost/structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 - 16.5m Open Span Underpasses</td>
<td>$3.35 million</td>
</tr>
<tr>
<td>1 - 3m Diameter Culvert</td>
<td>$0.1 million</td>
</tr>
<tr>
<td>2 - Stream Crossings</td>
<td>--</td>
</tr>
<tr>
<td>54.5 km of fence (no apron) c/w 9 texas gates</td>
<td>$3.25 million</td>
</tr>
<tr>
<td>Surveillance</td>
<td>in house</td>
</tr>
<tr>
<td>EA</td>
<td>$0.9 million</td>
</tr>
</tbody>
</table>

TOTAL $7,600,000
TCH Phase I & II Costs
(1982-87)

Length Twinned: 27km
Total Cost: $59,800,000
Construction Cost: $42,650,000
Interchanges: $10,000,000
Fence/Texas gates: $3,245,000
Underpasses: $3,450,000
EA/ Surveillance: $900,000
Monitoring: --
Environmental: 13% or 15%

TCH Phase IIIa Costs
(1995-97)

Length Twinned: 18.5 km
Total Cost: $31,000,000
Construction Cost: $22,168,000
Fencing: $1,890,000
Over/Under Passes: $5,200,000
E/A & Surveillance: $580,000
Monitoring: $1,200,000
Environmental: 29%

TCH Connectivity
( Nov 1996 to June, 2002)

- Total Wildlife Crossings: 41,764
  - Phase II: $7.6 million
  - Avg Crossings/yr: 991
  - Crossings/Structure/yr: 591
- Phase IIIa: $9.2 million
  - Avg Crossings/yr: 154
  - Crossings/Structure/yr: 93
  - Cost/crossing: $400

Part II Mitigations

TCH Phase IIIa Mitigations

- 2 – 50m Overpasses: $3.6 million
- 3 - 4x7m Culverts: $940,000
- 4 - 2.4 x 3 Culverts: $665,000
- 2 - 1.5 m Stream Walkways: $10,000
- 37 km of Fence C/W apron: $1.89 million
- EA and surveillance: $580,000
- Monitoring: $1.2 million
TOTAL: $9,170,000

FUTURE TRENDS
TCH Phase IIIb Mitigation Cost (per IIIa Standard)

3 Primary Overpass (50m) $4.5 million
• Assumes Modified Bow Rr Bridges km 70 & 77
15 underpass structures (1.5km spacing) $7.1 million
( Assume 1/3 16.5 structures, 2/3 culverts)
Full fencing with apron (46 kms) $2.3 million
Bubble Fence/Texas Gates around Lake Louise $1.4 million
Likely four additional underpasses $1.4 million
(93N, 93S, LL Drive and Whitehorn)

TOTAL $16,700,000

TCH Phase IIIb Mitigation (per T Clevenger recommendations 2002)

7 Primary Underpasses (50 to 70 meters) $18 to 25.5 million
• Assumes uses modified Bow Rr Bridge Km 70
2 Secondary Underpass (Twice x 16.5) $2.8 million
5 Tertiary Underpasses (1.5 x 16.5) $5.3 million
90 to 245 Culverts (300 to 150 m spacing) $0.4 to 1.1 million
Full fencing with apron (46 kms) $2.3 million
Bubble Fence/Texas Gates around Lake Louise $1.4 million
Likely four additional underpasses (twice x 16.5) $2.8 million
(93N, 93S, LL Drive and Whitehorn)

TOTAL $33,000,000 to 41,000,000

TCH Phase IIIB Estimated Costs (1999)

Length to be twinned 27km
Total Cost $66.8 to 91.1 million
Construction Cost $48,300,000
Fencing/Texas gates $3,700,000
Underpasses $13 to 37.5 million
EA & Surveillance $700,000
Monitoring (4yrs) $1,000,000

Environmental 27.5% to 47%

SUMMARY

AT WHAT COST?

Wildlife Mitigation At What Cost?

• Progressive increased mitigation/costs each phase
• Wildlife Mortality 6% of cost 95% effective for most species
• Wildlife Connectivity effectiveness more difficult to measure
• Pressure to accommodate interlopers, rare crossings/dispersal events and unfettered crossing
• Pressure to modify previous phases prior to proceeding with further expansion
• If current stds 80% effective will spending double to increase effectiveness by say 10% make fiscal sense

Wildlife Mitigation At What Cost?

• Diminishing cost/benefit to substantiate project
• Difficult to cost wildlife mortality/connectivity in C/B (most species not on endangered lists and hunted outside park)
• Rising expectations against limited budget
• Increased low cost porosity versus concentrated crossing points versus combination
• NEED TO CLEARLY DEFINED OBJECTIVES OF MITIGATIONS AND MEASURABLE RESULTS, OTHERWISE …….
Question Not So Much

**At What Cost?**

But Rather.....

**AT WHAT RANSOM?**

Further Information & Links

www.hsctch-twinning.ca