Highway 417 Bridge Replacement
West of Maitland Avenue to East of Island Park Drive

Canadian Society of Value Analysis
2006 Conference
October 24, 2006

Presentation Outline

• Description of Project
• Heavy Lift / Rapid Replacement Technology
• Risk Assessment Process

Overview of Project Area
Highway 417 Bridge Rehabilitation - West of Maitland Avenue to East of Island Park Drive

G.W.P. 4058-01-00

Island Park Drive Bridge – South Side

Description of the Work – Contract No. 1

Island Park Drive Bridge – North Side

Island Park Drive Bridge

Description of the Work – Contract No. 1

Island Park Drive Bridge

Description of the Work – Contract No. 1
**Heavy Lift Technology**

- Use of Rapid Replacement Technology is new to MTO
- Save $$$
- Reduce congestion during construction
- Reduce overall project duration
- Pave the way for future projects

**Heavy Lift Technology**

- SPMT - Self Propelled Modular Transporters.
- Adaptable.
- “Turns on a dime”.
- Transports over uneven surfaces.
- MAMMOET - Heavy Lift Specialist.

**Mammoet Animated Video**
Description of the Work – Contract No. 2

**Bridge replacement using heavy lift for:**
- Carling Avenue westbound;
- Kirkwood Avenue;
- Carling Avenue eastbound; and
- Clyde Avenue.

**Bridge rehabilitation:**
- Merivale Road.

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Widening 417 for construction continued...
- Storm sewer replacement (median if required);
- New storm sewer for outside widening (new construction);
- Overhead signs; and
- Upgraded illumination.
Highway 417 Bridge Rehabilitation - West of Maitland Avenue to East of Island Park Drive

Local Roadways Construction - Contract No. 2

- Lowering of profiles to maintain bridge clearances - staged construction;
- Rehabilitation of underground plant (as required):
  - Storm and sanitary sewers;
  - Watermains;
  - Illumination / traffic signals; and
  - Bell, hydro, gas, etc.
- Reinstatement of roadway elements.

Risk Assessment - Objectives

- Comprehensive risk assessments for both contracts
- Increase confidence in project development
- Identify project risks and their impact on the project cost and schedule
- Determine mitigation measures and responsibilities for addressing the project risks
- Particular emphasis to be given to rapid-lift issues

MRC’s Project Risk Management Process - RECAP

- Risk Management Planning
- Risk Identification
- Qualitative Risk Analysis
- Quantitative Risk Analysis
- Risk Response Planning
- Risk Monitoring & Control

Risk Assessment Workshop

Risk Management Report
- Risk-Based Cost Estimate & Schedule
- Risk Register

MRC R.C.A.P. Risk Team
- Facilitator
- Risk Analyst/Modeler

Project Team
- MRC Design Team
- MTO P.M. & Key Staff

Stakeholders
- City of Ottawa
- N.C.C.

Expert Panel
- Independent S.M.E.
- MRC Bridge Specialist
- MRC Construction Specialist
- General Contractor
- Heavy Lift Specialist

- Historical Data
- Experience
- Researched Opinion
Project Risks

Variations in project costs
- Project Scope Creep - Add-ons
- Economic changes - inflation, market conditions
- Unknown/Changed Conditions (Geotechnical, Environmental, Structural etc)
- Third Party Approvals
- Quantity under runs / overruns
- Property Impacts
- Utilities
- Planning or Design Errors & Omissions
- Schedule Delays (weather, labour, material / equipment supply)

Variations in project schedule
- Schedule Delays (weather, labour, changed conditions, material/equipment supply)

Results of Risk Assessment
1. Risk-Based Construction Schedule for Rapid Lift Operation
2. Risk-Based Cost Estimates for Contracts 1 and 2
3. Risk Assessment, Risk Register and Risk Management
4. Summarize Key Benefits of Risk Assessment

Island Park Drive Bridge – Plan View

Island Park Drive Bridge – Cross-Section
Roadway Closures for Contract No. 1

Potential Road Closures:
- Kirkwood
- Island Park
- Merivale
- Parkdale
- Bayswater

Potential Detours:
- Carling at Kirkwood eastbound on-ramps closed
- Island Park off-ramp and adjacent local roads to nearest intersection closed
- Westbound on-ramp closed at Parkdale
- All ramps closed at Rochester
- Bronson
- Preston
- Booth
- Carling

Description of the Work – Contract No. 1
- Rehabilitation of Island Park Drive Bridge:
  - Superstructure replacement;
  - Abutment refacing;
  - Removal of existing sound barrier and installation of new sound barrier;
  - Replacement of sidewalks and curbs;
  - Removal of old connection to Merivale Road from Island Park Drive;
  - Deck construction / demolition within construction staging area; and
  - Reinstatement of construction staging area.

Risk Assessment
1. Risk-Based Construction Schedule for Rapid Lift Operation
   - Hwy 417 Closure Duration ?
   - Ministry Preference - ASAP
Superstructure Replacement

1. Pre-rapid lift operations (on prior weekend(s));
2. Rapid lift operations (on a weekend); and
3. Post-rapid lift operations (on subsequent weekend)

Pre-Rapid Lift Operations

1. Removal of existing approach slab;
2. Excavation of backfill to structure;
3. Sawcutting of ballast wall;
4. Securing ballast wall to existing girders;
5. Temporary reinstatement of granulars and asphalt pavement

- Note work completed in stages by maintaining one or two lanes of traffic in each stage

Rapid Lift Operations

1. Remove asphalt and granulars behind ballast wall;
2. Remove existing EBL and WBL superstructures to staging area for demolition;
3. Transport new EBL and WBL superstructures from staging area;
4. Level EBL and WBL superstructures;
5. Granular backfill;
6. Pave bridge deck and approaches (waterproofing completed in staging area);
7. Install temporary concrete barriers and open to traffic
Project Team Estimates of Duration of Operations (Hrs) *

<table>
<thead>
<tr>
<th>Option</th>
<th>Pre-rapid Lift</th>
<th>Post-Rapid Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>1b</td>
<td>38</td>
<td>9</td>
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<tr>
<td>1c</td>
<td>38</td>
<td></td>
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<tr>
<td>3</td>
<td>-</td>
<td>43</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>47 &amp; 22</td>
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</table>

* Excluding time to close down 2 lanes or all lanes on the Queensway

Risk-Based Schedule for Rapid Lift Duration (Hrs)
Highway 417 Bridge Rehabilitation - West of Maitland Avenue to East of Island Park Drive

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Rapid Lift Operations

- Risk Events (likelihood of occurrence and likelihood for delays if event occurs)

Model Uncertainty in Total Task Duration

“Base” Task Durations

Distribution for Task 20 - Level Structure Duration

Distribution for Task 18 - Remove Asphalt/Granular Behind Ballast Walls
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Distribution for Rapid Lift Operations - Hwy 417 Closed...

0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.350

Mean=14.10703

Probability

Hwy Closure Duration (Hrs)

80th Percentile

47 & 22

13

13

12 (13.7)

13

13

11.86

0.000 0.050 0.100 0.150 0.200 0.250 0.300

Mean=14.10703

Hwy Closure Duration (Hrs)

5% 90% 5%

1.86

16.8

15.3 Hrs

Hwy Closure Duration (Hrs)

Alternative 1A - Distribution for Hwy 417 Closure Duration During Rapid Lift (Hrs)

Risk-Based Estimates for Duration Of Operations (Hrs) *

<table>
<thead>
<tr>
<th>Option</th>
<th>Pre-rapid Lift**</th>
<th>Rapid Lift***</th>
<th>Post-Rapid Lift**</th>
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<td>12 (15.3)</td>
<td>20</td>
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<tr>
<td>1b</td>
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<tr>
<td>1c</td>
<td>38</td>
<td>13 (12.8)</td>
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<td>38</td>
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<td>3</td>
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<td>13 (13.7)</td>
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</table>

* Excluding time to close down 2 lanes or all lanes on the Queensway

** Lane reductions on weekends

***Highway closures on weekends

Results of Risk Assessment

2. Risk-Based Cost Estimates for Contracts 1 and 2

Base Cost Estimate
- Level of Detail – early in design process
- 2006 $ $
- No contingency
- No escalation
- No engineering costs
- No property costs
- Validated by Risk/Cost Team
### Base Cost Estimate (Contracts 1 & 2)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Highway Component (Grading, paving, etc...)</td>
<td>$61,959,074.05</td>
</tr>
<tr>
<td>2</td>
<td>Bridge Replacement - Island Park Drive</td>
<td>$1,105,230.00</td>
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<tr>
<td>3</td>
<td>Bridge Widening/Rehabilitation - Merivale Road</td>
<td>$4,733,950.00</td>
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<tr>
<td>4</td>
<td>Bridge Replacement - Carling WB</td>
<td>$4,987,120.00</td>
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<td>5</td>
<td>Bridge Replacement - Kirkwood Avenue</td>
<td>$5,151,650.00</td>
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<td>6</td>
<td>Bridge Replacement - Carling EB</td>
<td>$4,113,270.00</td>
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<td>7</td>
<td>Bridge Replacement - Clyde Avenue</td>
<td>$3,041,900.00</td>
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<tr>
<td>8</td>
<td>Bridge Replacement - Carling EB</td>
<td>$3,041,900.00</td>
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<td>9</td>
<td>Bridge Replacement - Merivale Road</td>
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<td>10</td>
<td>Bridge Widening/Rehabilitation - Merivale Road</td>
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<td>Bridge Replacement - Kirkwood Avenue</td>
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<td>$3,041,900.00</td>
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<tr>
<td></td>
<td>Total Construction Base Cost Estimate</td>
<td>$61,959,074.05</td>
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</tbody>
</table>

### Distribution of Total Project Cost - 2006 $(Contracts 1 & 2)

- **5% Percentile**: $74.2 M
- **90% Percentile**: $80.7 M

### Risk-Based Cost Estimate for Contract 1

- **80% Percentile**: $5.68 M

### Exclusions:
- Property Costs
- Engineering Costs
Risk Assessment

3. Risk Register and Risk Management

- 34 Risks / Opportunities Identified
- Risk Register Populated By Risk Team - Spreadsheet
- Risks/Opportunities Ranked By Risk Team
- Preliminary Response Strategy Identified
- Monitoring & Control By Project Design Team

Risk Register

Key Risk/Opportunity Areas - Contract 1

- Prequalification of Contractors
- Traffic Management & Communication Plans
- The construction schedule, including lead time for steel supply / fabrication, is challenging and consideration of an acceleration of the design / tendering process is recommended;
- Incentive / Disincentive clauses should be tied to realistic expectations of the duration of the rapid lift replacement
- Subsurface conditions in staging area (Geotechnical investigation not complete).
- Consideration of advance work required for Contract 2 (WM, Road Lowering, Storage of Granular for Staging Areas)
- Approvals (N.C.C., City of Ottawa)
Highway 417 Bridge Rehabilitation - West of Maitland Avenue to East of Island Park Drive

Key Risk/Opportunity Areas - Contract 2
- Overall Project Cost;
- Additional cost escalation due to labour shortage (Ottawa LRT Project);
- Traffic Management & Communication Plans;
- Prequalification of Contractors;
- Additional cost escalation due to labour shortage (Ottawa LRT Project);
- Subsurface conditions @ Structure Widений / retaining walls;
- Constraints imposed by utilities incl. major 1200 dia WM;
- Constraints imposed by Hydro One Towers & high-voltage conductors;

Examples of Contract 2 Risk Areas
- (WM & Hydro Towers)
- Retaining walls

Examples of Contract 2 Risk Areas . . . Cont’d
- Remoteness of Clyde Avenue Staging Area
- Overhead Utilities on Clyde Avenue

Need to stage / limit number of local road closures at same time;
Utility relocations in local roads;
Likelihood that overnight Hwy 417 closures will be in 13- 15 hrs range;
Need for additional stand-by equipment
Depth of existing asphalt on bridge decks;
Property impacts;
Remote location of Clyde Avenue staging area and utilities on route;
Approvals (N.C.C., City of Ottawa)
4. Summary - Key Benefits of Risk Assessment

- Risk management plan has been implemented (mitigation, elimination, acceptance of key risks)
- Design development for Rapid Lift has been significantly improved
- Risk-based cost estimates for Contracts 1 & 2 developed
- Risk-based Hwy 417 closure duration (14-15 hrs) for Rapid Lift defined for contact planning/approvals
- Risk-based Schedules for both Contracts 1 & 2 developed

Questions?