Modified Surface Aggregate Stabilization with Calcium Chloride
A Test Project for Lethbridge County Haul Roads
Results from One Year Monitoring Period

2016 AMSA Fall Convention
November 16, 2016 - Edmonton, AB
INTRODUCTION

• Located in Southern Alberta
• Semi Arid Climate
• Population 10,061
• Lowest Linear Taxes in the Area
  $3M Compared to Neighbors ($10M-$27M)
• Highest Concentration of Intensive Livestock in Alberta
  $1.12B GDP Annually
• High Concentration of Heavy Haul Routes
Lethbridge County Haul Routes and Intensive Livestock Operations

- Intensive Livestock Operation
- Provincial Highway
- City of Lethbridge Roads
- Railway
- Urban Boundary
- Water

Rods
Surface Type
- Gravel
- Cold Mix
- Paved

Haul Routes
ASSET DETERIORATION CURVE

CONDITION RATING

ASSET AGE

REINVEST IN MARKET ACCESS NETWORK
PRESENTATION OUTLINE

- BACKGROUND
- TEST SECTIONS – RECAP
- POST CONSTRUCTION ANALYSIS
- FINDINGS/CONCLUSIONS
- 2016 STABILIZATION PROGRAM
- FUNDING & PUBLIC CONSULTATION
- CLOSING COMMENTS/QUESTIONS
BACKGROUND

• 1,800 km of Gravel Road, 215 km of Haul Routes
• Haul Routes Introduced in 2013
• Haul Route Business Case – WSP (2014)
• Determine Most Cost Effective Solution
• Calcium Chloride Stabilization
• Test Project Constructed in 2014
• Report Submitted at the End of 2015
TEST ROAD

- Range Road 20-3 from Hwy 519 to Hwy 23
## TREATMENT TYPES

- 24 Test Sections – 1,000 Feet
- 6 Types – Repeated 4 Times

<table>
<thead>
<tr>
<th>TREATMENT NO.</th>
<th>TREATMENT TYPE</th>
<th>% CaCl₂ BY DRY WEIGHT GRAVEL</th>
<th>APPLICATION TYPE</th>
<th>APPLICATION RATE</th>
<th>MIXING EQUIPMENT</th>
<th>TREATMENT DEPTH</th>
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<tbody>
<tr>
<td>1</td>
<td>Liquid CaCl₂</td>
<td>2.22</td>
<td>Liquid Distributor</td>
<td>3L/m²</td>
<td>Blade Laid</td>
<td>25mm</td>
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<tr>
<td>2</td>
<td>Liquid CaCl₂</td>
<td>1.11</td>
<td>Liquid Injected</td>
<td>3L/m²</td>
<td>MillRazor™</td>
<td>50mm</td>
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<tr>
<td>3</td>
<td>Dry CaCl₂</td>
<td>1.50</td>
<td>Dry Distributor</td>
<td>1.75kg/m²</td>
<td>MillRazor™</td>
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<td>Dry Distributor</td>
<td>2.63kg/m²</td>
<td>MillRazor™</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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</tbody>
</table>
CONSTRUCTION

• Constructed in Summer of 2014
• Blade Mix and Rotary Mixer MillRazor™
POST CONSTRUCTION ANALYSIS

• Sections Monitored from Summer 2014 to Fall of 2015
• Road Condition
• Construction Costs
• Maintenance Costs
• Gravel Loss
• Traffic Counts
• Weather Data
ROAD CONDITION SURVEY

- Road Condition Surveys
- Completed Monthly – Except During Winter
- Evaluate 5 Different Aspects (Washboard, Potholes, Rutting, Loose Gravel and Dust)
ROAD CONDITION INDEX

- Average Road Condition Index 35.6 to 75.3
- Highest Condition Received Highest Ranking

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>CaCl₂ PRODUCT</th>
<th>% CaCl₂ BY DRY AGG. WGT.</th>
<th>TREATMENT DEPTH (mm)</th>
<th>ROAD CONDITION INDEX</th>
<th>RANKING</th>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>Dry at 94% Conc.</td>
<td>1.5</td>
<td>75</td>
<td>75.3</td>
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<td>67.5</td>
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<td>64.0</td>
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<td></td>
<td></td>
<td>35.6</td>
<td>6</td>
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</table>
CONSTRUCTION COSTS

- Costs Tracked During Construction
- Costs Include All Materials Equipment and Labour
- Majority of Cost is From the 100mm of Aggregate
- Average Construction Costs $51K to $61K per Km
- Lowest Construction Cost Received Highest Rank

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>CaCl₂ PRODUCT</th>
<th>% CaCl₂ BY DRY AGG. WGT.</th>
<th>TREATMENT DEPTH (mm)</th>
<th>TEST SECTION CONSTRUCTION COST (PER 1.2KM)</th>
<th>TEST SECTION CONSTRUCTION COST (PER KM)</th>
<th>RANK</th>
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<tbody>
<tr>
<td>6</td>
<td>Untreated</td>
<td></td>
<td></td>
<td>$62,919.68</td>
<td>$51,607.35</td>
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<td>1</td>
<td>Liquid at 31%</td>
<td>2.22</td>
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<td>$64,518.41</td>
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<td>$68,661.37</td>
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<td>1.5</td>
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<td>$71,814.00</td>
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<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>$75,233.78</td>
<td>$61,707.50</td>
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</table>
### MAINTENANCE COSTS

- Maintenance Costs Tracked by the County
- Costs Include All Materials, Equipment and Labour
- Based on a 15 Month Period
- Average Maintenance Costs $1.1k to $2.5k per Km
- Lowest Maintenance Cost Received Highest Rank

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>CaCl₂ PRODUCT</th>
<th>% CaCl₂ BY DRY AGG. WGT.</th>
<th>TREATMENT DEPTH (mm)</th>
<th>TEST SECTION MAINTENANCE COST (PER 1.2KM)</th>
<th>TEST SECTION MAINTENANCE COST (PER KM)</th>
<th>RANK</th>
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<td>$1,416.64</td>
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<td>$3,060.35</td>
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TRAFFIC DATA

- Each Test Section Assigned a Traffic Volume
- 8 Vehicle Counters Installed Throughout the Project
- Traffic Volumes Ranged from 157 to 220 ADT
- 29% Heavy Truck Traffic
- Highest Volume Received Highest Ranking

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>CaCl₂ PRODUCT</th>
<th>% CaCl₂ BY DRY AGG. WGT.</th>
<th>TREATMENT DEPTH (mm)</th>
<th>ADT</th>
<th>AVG. TRAFFIC VOLUME</th>
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<td>1</td>
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<td>220</td>
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<td>193</td>
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<td>1.5</td>
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<td>174</td>
<td>63,612</td>
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<td>170</td>
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<td>159</td>
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<td>2</td>
<td>Liquid at 31% Conc.</td>
<td>1.11</td>
<td>50</td>
<td>157</td>
<td>57,174</td>
<td>6</td>
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</tbody>
</table>
**GRAVEL LOSS**

- Based Average Weight of Loose Gravel
- Lowest Value Received Highest Rank

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>CaCl₂ PRODUCT</th>
<th>% CaCl₂ BY DRY AGG. WGT.</th>
<th>TREATMENT DEPTH (mm)</th>
<th>AVERAGE LOOSE GRAVEL (KG/KM)</th>
<th>RANK</th>
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</thead>
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<td>Dry at 94% Conc.</td>
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<td>192.76</td>
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<td>221.04</td>
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<td>764.54</td>
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</tbody>
</table>
WEATHER DATA

- Weather Data Obtained from Environment Canada and Alberta Agriculture & Forestry for Lethbridge Area
- Precipitation in 2015 Significantly Less Than 2014

![Precipitation Graph]

![Temperature Graph]
RANKING SYSTEM

• Ranking System Based on Even Weighting of the 5 Characteristics Evaluated (Condition, Traffic, Gravel Loss, Construction Costs and Maintenance Costs)
RANKING SYSTEM

- Treatment 4 (Dry Pellet CaCl₂ at 1.0% at 50mm)

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>ROAD CONDITION INDEX</th>
<th>TEST SECTION CONSTRUCTION COSTS ($)</th>
<th>TEST SECTION MAINTENANCE COSTS ($)</th>
<th>AVERAGE YEARLY TRAFFIC (VEHICLES)</th>
<th>TOTAL LOOSE GRAVEL WGT (lbs)</th>
<th>RANKING</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>67.5 (3)</td>
<td>$68,661.37 (4)</td>
<td>$1,416.64 (1)</td>
<td>70,525 (2)</td>
<td>253.79 (3)</td>
<td>1 (13)</td>
</tr>
<tr>
<td>3</td>
<td>70.7 (2)</td>
<td>$71,814.00 (5)</td>
<td>$2,073.13 (2)</td>
<td>63,612 (3)</td>
<td>221.04 (2)</td>
<td>4 (14)</td>
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<tr>
<td>5</td>
<td>75.3 (1)</td>
<td>$75,233.78 (6)</td>
<td>$2,073.13 (2)</td>
<td>58,052 (5)</td>
<td>192.76 (1)</td>
<td>3 (15)</td>
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<tr>
<td>1</td>
<td>64.0 (5)</td>
<td>$64,518.41 (2)</td>
<td>$2,073.13 (2)</td>
<td>80,494 (1)</td>
<td>328.97 (5)</td>
<td>2 (15)</td>
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<tr>
<td>2</td>
<td>66.1 (4)</td>
<td>$65,747.18 (3)</td>
<td>$2,764.18 (5)</td>
<td>57,174 (6)</td>
<td>286.00 (4)</td>
<td>5 (22)</td>
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<tr>
<td>6</td>
<td>35.6 (6)</td>
<td>$62,919.68 (1)</td>
<td>$3,060.35 (6)</td>
<td>62,173 (4)</td>
<td>764.54 (6)</td>
<td>6 (23)</td>
</tr>
</tbody>
</table>
FINDINGS/CONCLUSIONS

- Dry Pellet CaCl$_2$ Sections Highest Condition Ratings
- Treatment 5 Highest Condition Rating
- Use of Rotary Mixer Increased Performance
- Minimizing Segregation Extends Surface Life
- Subgrade Strength Increased by 38%
- Chloride Retention Increases with Compaction
- Untreated Sections – Lowest Construction Cost
  Highest Maintenance Cost
- Lack of Precipitation has Adverse Effects on Performance
RECOMMENDATIONS

• Calcium Chloride Stabilization is a Cost Effective Surfacing Treatment for Lethbridge County’s Haul Route Network

• Develop a Surfacing Aggregate Specification with Higher PI and Fracture

• Develop and Implement Maintenance Practices for CaCl$_2$ Stabilized Roadways

• Increase Crown to 4% Minimum

• Continual Monitoring of CaCl$_2$ Haul Route Stabilization Program
## MODIFIED AGGREGATE SPECIFICATION

<table>
<thead>
<tr>
<th>MOISTURE</th>
<th>FRACTURE</th>
<th>PI</th>
<th>80 um Sieve with Bentonite</th>
<th>PI + 80um Sieve with Bentonite</th>
<th>25,000</th>
<th>20,000</th>
<th>16,000</th>
<th>12,500</th>
<th>10,000</th>
<th>5,000</th>
<th>1,250</th>
<th>630</th>
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<td>11.4</td>
<td>13.4</td>
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<td>99</td>
<td>93</td>
<td>85</td>
<td>79</td>
<td>62</td>
<td>39</td>
<td>27</td>
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</tbody>
</table>

### GRADATION CHART

- **MODIFIED AT 2-20**
- **AVERAGE**
- **AT 4-20**
2016 STABILIZATION PROGRAM

- County Purchased a Mill Razor from RM Equipment
- Planned on Stabilizing 23 Km of Haul Route in 2016 and Upgrading the 7 km of Test Road to Selected the Treatment
- RFP was Issued for Modified Aggregate Production
- ~2,000 tonnes per km for 8.5m width x 100mm deep
- Bentonite Clay Pellets Added to Increase PI
- Produced using a Pug Mill for Consistency
- 27 Km of Haul Routes Stabilized in 2016
2016 STABILIZATION PROGRAM
FUNDING CHALLENGES

Farmland mill rate is 20
  • 3x Provincial average as the County doesn’t receive oil and gas revenue

Assessment challenges
  • Very little oil & gas revenue
  • Farmland assessment limitations

Limited revenues
  • In 2015 collected $14 million in Municipal taxes
  • Bridge funding grants not available
  • New Provincial and Federal governments
FUNDING OPTIONS CONSIDERED

- Local Improvement Tax
- Business Licences
- Development Levy
- Business Tax
- Special Tax

- Had an existing by-law referencing NRCB units in 1998 but it was never implemented
WHAT’S AT RISK

• $1.06 Billion in producers’ revenue
• Road Closures – increased detour length
• Increased safety and liability risks
• Maintenance and repair costs increase exponentially
• Adapting to changing mobile infrastructure (tractors, heavy haulers)
• 1 bridge closed now – more to follow
HOW DID WE ADDRESS THE PROBLEM

• Held four roundtable discussions with key stakeholder groups
• Developed a public consultation strategy to engage residents in process
GOALS OF ENGAGEMENT STRATEGY

• Educate stakeholders on options that have been developed and why
• Understand stakeholders views about the options that have been developed (benefits and concerns)
• Provide opportunity to submit alternative funding solutions
ENGAGEMENT PLAN CONSIDERATIONS

- Risks include “pitting” stakeholder groups against each other (livestock producers against irrigated/dryland farmers). Also, residential properties will want to see farmland producers pay their fair share.
- There is a sensitivity to the amount of revenue that needs to be collected by a minimal amount of owners.
- Tight timelines to conduct public consultation sessions.
- There are imminent risks to The County if they do not collect the required $3.5M in 2016.
- 7 open houses scheduled (5 prior to 1\textsuperscript{st} reading and 2 prior to 3\textsuperscript{rd} reading).
ADVERTISING CAMPAIGN

• Radio Advertising
• Newspaper Advertising
• Dedicated Website
• Social Media
• Media Interviews
• Op-ed
• Key Messaging for staff/council
• On-line feedback forms
RESULTS

• Over 300 participants through open houses and/or feedback forms
• Council deliberated options and passed the following motion
## FUNDING OPTIONS

### Business Tax

<table>
<thead>
<tr>
<th>Animal Unit</th>
<th>$ per Animal Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>70% ($3/unit)</td>
<td>$1,855,695</td>
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<tr>
<td>Dairy</td>
<td></td>
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<tr>
<td>Chicken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hogs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat/Sheep</td>
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</table>

### Special Tax

<table>
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<tr>
<th>Farmland</th>
<th>30%</th>
<th>$694,286</th>
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</table>
PRIORITIZATION SESSIONS

• Feedback from first round open houses resulted in second series of open houses
• Detailed questionnaire developed to prioritize market access network
• Four additional workshops scheduled to work through questionnaire to assist traffic modelling study
LESSONS LEARNED

• Lack of understanding of municipality’s opportunities for revenue generation and infrastructure status
• Long term reinvestment strategies
• Importance of Asset Management Plan
  – Inventory
  – Condition
  – Level of Service
  – Risk
• Implementation Strategies
• Continuing dialogue with residents and stakeholders
MOVING FORWARD

• Advantages of completing all haul roads in 2017
  - All rate payers will have improved roads at the same time
  - Locked in 2017 material prices
  - Low interest rates provide for the ability to debenture over longer period and defer capital expenditures
  - Realizing efficiencies of reduced road maintenance and supplied aggregate volumes
FUNDING

Anticipated annual budget reductions
- A 30% reduction in annual gravel use over the entire County
- A 30% reduction in the road reconditioning budget
- A 25% reduction in road reconstruction budget
- A 100% reduction in dedicated haul route maintenance
- A 12% reduction in general road grading

Expenses including assumed annual maintenance costs and surfacing treatment every 6 years equates to approx. 50% of the annual savings leaving a net gain.
Contacts/Further Information

- Lethbridge County – Rick Bacon
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  russell.pinchak@wspgroup.com

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  403-519-8651
  mmtetreault@gmail.com