Full Depth Reclamation
the Le Sueur County Experience

Darrell Pettis P.E.
Le Sueur County Highway Engineer
Le Sueur County, Minnesota

County Highway System Consists of:
- 267 miles of County State Aid Highways (CSAH).
- 239 miles of County Roads (CR).
- Total of 506 miles

About 300 miles are paved and 206 miles are aggregate surfaced.
Agenda for Presentation

2008 FDR Projects
- County State Aid Highway 2
- County State Aid Highway 13
- County State Aid Highway 24

Lessons Learned
CSAH 2 Existing Conditions

- Project Length of 4.79 miles
- 480 AADT (2007)
- Reconstructed in 1976
- Surfaced with 7” of P.M. Bituminous in 1979
- ¾” Overlays in 1989 & 1995
- Springtime load posted at 7 tons per axle
CSAH 2 Full Depth Patch
CSAH 2 Edge Cracking
2007 Pavement Condition Data

- PSR 2.7 to 3.1
- SR 2.6 to 2.8
- PQI 2.6 to 2.9
- IRI 77 in/mi to 137 in/mi
### CSAH 2 FWD Data Analysis

#### Summary of Analysis Results

<table>
<thead>
<tr>
<th>Axle Load for Design Defl.</th>
<th>( v_{BB_{95}} )</th>
<th>Eng.</th>
<th>Eff.</th>
<th>E.O.E.</th>
<th>Tons</th>
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Midwestern States In-Place Recycling Conference
Proposed Typical Section

CSAH 2 RECLAIM, CIR & OVERLAY
SURFACING SECTION

STA. 0+00 TO STA 101+00
STA. 110+50 TO STA 252+90
24' BITUM. INP. - 24' OVERLAY
10 TON DESIGN

TYPE 2 MULCH MATERIAL BOTH SIDES

SEE FIGURE E BELOW FOR DRAIN DETAIL

1:4

SEE DETAIL "C"
HEADWALL
Typical Section Pavement Detail

**DETAIL "B"**

STA. 0+00 TO STA. 101+00
STA. 110+50 TO STA. 252+90

- 2.0" MVWE45035C WEAR
- 4.0" LVNW35030C NON-WEAR
- FLY ASH
- 3.0" AGGREGATE, CL. 5
- INPLACE APPROX. 8.0" BIT. SURFACE (2331)
- SUBGRADE
- 25" GE

- RECLAIM BIT./AGGR.
- 12" DEEP
- 24" WIDE

- CIR BIT./AGGR. MIX
  - (FLY ASH MOD.)
  - 12" DEEP
  - 26' WIDE
CSAH 2 Design

- Edge Drain Tile
- Reclaim 8" of existing Bituminous Pavement (Pre Grind)
- Add 3" of Aggregate Material
- Reclaim 12" Bituminous / Aggregate Mixture with 6% Class C Fly Ash
- Place a 6" bituminous surface
CSAH 2 Reclaiming Existing 8” Bituminous Pavement
CSAH 2 (Pre Grind)
CSAH 2 Initial FDR
3” of Additional Aggregate Material
CSAH 2 Blade and Compact the 3" of new Aggregate
CSAH 2 Surface Prior to 2nd FDR and Fly Ash
CSAH 2 Soft, Wet and non compacted Areas
Vane Spreader for Fly Ash
Transferring Fly Ash from Tanker Truck to Van Spreader
CSAH 2 Fly Ash on the Base Material
Fly Ash
Mixing Fly Ash, Aggregate Material and Reclaimed RAP
Reclaimed Material
Compaction Equipment
Steel Drum and Water Truck
Compaction Equipment and Motor Patrol with Rubber Tired Roller
Finish Rolling
CSAH 2 Stabilized Base
CSAH 2 Stabilized Base and First Lift of Bituminous Non-Wear
<table>
<thead>
<tr>
<th>Spec Number</th>
<th>Item</th>
<th>Unit</th>
<th>Estimated Quantities</th>
<th>Bid Price</th>
<th>Amount</th>
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<td>8,200</td>
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CSAH 2 Cost Summary

- Total Bid Price of $2,120,586.25 or $443,000/mile.
- Bid Price of $1.15/sq yd for Reclalm Bit Surface and $1.00/sq yd for CIR Bit / Aggr. / Fly Ash a total Reclamation cost of $143,000 or $30,000/mile.
- Fly Ash Bid Price of $60.00/ton for a total cost of $154,200 or $32,000/mile.
- Bituminous Surface Bid Price of $58.00/ton for a total cost of $1,427,000 or $297,000/mile.
CSAH 2 Lessons Learned

This process is an effective way to rehabilitate Full Depth / Deep Strength designed asphalt pavement.

Drainage is critical, especially if Pre Grinding is allowed. Use Edge Drains.

Dust can be an issue if Fly Ash stabilized base is not cover quickly.

The road grade is raised so shoulders do get narrower.
CSAH 2 Lessons Learned

- FWD tests were done this summer for strength, results are not in yet.
- Depth of bituminous surfacing could be reduced to save cost if stabilized base is stronger than predicted.
- GPS grade control on the motor patrol would improve the final product.
CSAH 13 Project

- Project Length 5.54 miles
- Reconstructed in 1989
- Surfaced in 1992 with 3” of Class V aggregate base and 5.5” of P.M. Bituminous
- Spot Overlays by County Forces
- 510 AADT in 2007
- Spring time load posted at 7 tons per axle
CSAH 13 Existing Condition
2007 Pavement Condition Ratings

- PSR 2.7 to 2.9
- SR 3.7
- PQI 3.3
- IRI 111 in/mi to 157 in/mi
### CSAH 13 FWD Data Analysis

#### Summary of Analysis Results

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#### Table Data

- **Average**:
  - vBB_m = 62.2
  - Env. = 6.338
  - Eff. = 10.0
  - E.O.E. = 20.9
  - Tons = 9.2
  - TONN = 9.4

- **Median**:
  - vBB_m = 59.9
  - Env. = 6.091
  - Eff. = 9.3
  - E.O.E. = 21.3
  - Tons = 9.1
  - TONN = 9.0

- **Std. Dev.**:
  - vBB_m = 18.4
  - Env. = 2.212
  - Eff. = 4.2
  - E.O.E. = 4.3
  - Tons = 1.8
  - TONN = 1.3

- **85th %**:
  - vBB_m = 42.7
  - Env. = 4.134
  - Eff. = 5.9
  - E.O.E. = 18.8
  - Tons = 7.3
  - TONN = 7.5

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CSAH 13 Typical Section
CSAH 13 Typical Section Detail

DETAIL "A"
STA. 0+00 TO STA. 292+45

2.0” MVWE45035C WEAR
4.0” LVNW35030C NON-WEAR
APPLY FLY ASH
RECLAIM INPLACE BITUM. 5.5” DEPTH
CL. 5 AGGREGATE 3” INP.
25” GE

RECLAIM BIT./AGGR. 7” DEEP 24’ WIDE
CIR BIT./AGGR. MIX FLY ASH & ENG. EMULSION 7” DEEP 24’ WIDE

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CSAH 13 Design

- Edge Drain Tile
- Reclaim existing 5.5” of Bituminous Surface into 3” of Aggregate Base
- Place 2% by weight Fly Ash on top of reclaimed material
- Reclaim Fly Ash and 3% Engineered Emulsion
- Place a 6” Bituminous Surface
CSAH 13 Fly Ash Applied
CSAH 13 Reclaim Fly Ash and Emulsion into Base Material
Stabilized Material
Initial Compaction with Vibratory Pad Foot Roller
Rubber tire roller
Reclaimer with compaction equipment
Motor Patrol to finish surface
First lift of pavement on stabilized base
Bituminous Pavement
<table>
<thead>
<tr>
<th>Spec Number</th>
<th>Item</th>
<th>Unit</th>
<th>Estimated Quantities</th>
<th>Bid Price</th>
<th>Amount</th>
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<tr>
<td>2021.501</td>
<td>Mobilization</td>
<td>Lump Sum</td>
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<td>$25,000.00</td>
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<td>2051.501</td>
<td>Maint &amp; Restoration of Haul Roads</td>
<td>Lump Sum</td>
<td>1</td>
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<td>2104.513</td>
<td>Saw Bituminous Pavement</td>
<td>Lin Ft</td>
<td>100</td>
<td>$3.50</td>
<td>$350.00</td>
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<td>2221.501</td>
<td>Aggregate Shouldering, Class 1</td>
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<td>2331.609</td>
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<td>Ton</td>
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<td>2350.501</td>
<td>MV4 Wear Course Mixture (PG 58-34)</td>
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<td>LV 3 Nonwear Course Mixture (PG 58-34)</td>
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<td>19,100</td>
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<td>MV4 Bituminous Mixture Production</td>
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<td>2502.501</td>
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Totals $2,616,712.11
CSAH 13 Project Costs

- Total Price of $2,616,712.11 or $472,000/mile.
- Bid Price of $0.78/sq yd for Reclaim Bit Surface and $0.75/sq yd for CIR Bit / Emulsion / Fly Ash for a total Reclamation cost of $124,000 or $22,000/mile.
- Fly Ash Bid Price of $60.00/ton for a total cost of $33,214 or $6,000/mile.
- Bituminous Material for Cold Mix (CIR-EE) Bid Price of $500/ton for a total cost of $485,000 or $87,500/mile.
- Bituminous Surface Bid Price of $58.00/ton for a total cost of $1,670,000 or $302,000/mile.
CSAH 13 Lessons Learned

- Compaction of Material after Pre-Grinding.
- Emulsion must break to gain strength.
- The low side of super elevated curves can collect moisture and take longer for emulsion to break.
- Once the excess moisture is out of the Stabilized Base it is very stable and a great paving platform.
CSAH 24 Existing Conditions

- Project Length of 5.0 miles
- Road was reconstructed in 1992.
- Road was surfaced with 6” of aggregate base and 4” of bituminous in 1995.
- Springtime load posted at 7 tons per axle.
CSAH 24 Existing Conditions
CSAH 24 Pavement Failure Area
CSAH 24 Cracking
Wheel Path Cracking
2007 Pavement Condition Ratings

- PSR 3.2
- SR 3.4
- PQI 3.3
- IRI 86 in/mi to 115 in/mi
# CSAH 24 FWD Data Analysis

<table>
<thead>
<tr>
<th>Summary of Analysis Results</th>
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<td>Axle Load for Design Defl.</td>
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<td>Avg.</td>
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CSAH 24 Typical Section
CSAH 24 Typical Section Detail

DETAIL "A"
STA. 0+00 TO STA. 266+04

2.0" MVWE45035C WEAR
4.0" LVNW35030C LEVEL
INPLACE BITUM. 4.0" DEPTH
INPLACE CL. 5 AGGREGATE 6" DEPTH
26" GE

RECLAIM (10" DEPTH)
24' WIDE
CSAH 24 Typical Section Detail

DETAIL "C"

6.0" BITUM. OVERLAY

10" BITUM. & AGGR. BASE RECLAIMED

12" FLY ASH SUBGRADE STABILIZATION (26" WIDE)
CSAH 24 Design

- Edge Drain tile.
- Reclaim existing bituminous pavement into the aggregate base.
- Salvage the reclaimed material into a stockpile.
- Apply Fly Ash to the sub grade material.
- Reclaim Fly Ash into the sub grade.
- Place salvaged reclaimed material onto stabilized sub grade.
CSAH 24 Pre Grind
Reclaimed Surface
Loading Reclaimed Material with Milling Machine
Condition of subgrade
Application of Fly Ash
Van Spreader
Fly Ash on the sub grade
Reclaimer with Water Truck
Incorporating Fly Ash
Check Moisture Content
Initial Compaction
Compaction
Shape sub grade
Water subgrade
Completed sub grade
Place Reclaimed Aggregate Base
Blade and Compact Base Material
Completed Base
Final Shaping of the Base with string line
Shaped, watered and rolled base
First lift of Bituminous
CSAH 24 Project Costs

- Total Price of $2,501,676.54 or $500,000/mile.
- Reclaim Bituminous and Aggregate Base bid price of $0.64/sq yd for a cost of $46,104 or $9,200/mile.
- Salvage and Place Reclaimed Material bid price of $4.12/cu yd each for a cost of $129,500 or $26,000/mile.
- Sub Grade Soil Stabilization bid price of $1.60/sq yd for a cost of $123,500 or $24,700/mile.
- Fly Ash Bid Price of $60.00/ton for a total cost of $304,500 or $60,900/mile.
- Bituminous Surface Bid Price of $58.00/ton for a total cost of $1,492,000 or $298,000/mile.
CSAH 24 Lessons Learned

The process worked.
Reclaimed material can be difficult to fine grade.
Here is what we are up against.
Thank You

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