Performance of Thin Bituminous Treatments for Low-Volume Roads

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Overview

- Introduction
- MN Historical Perspective
- Current Performance
  - Double Chip Seal
  - Otta Seal
  - Oil Gravel
- Summary

Light bituminous surface treatments … were aimed toward:

1. The reduction of maintenance costs
2. Conservation of gravel
3. Elimination of dust
4. Reduction of vehicle operating costs
5. Increased riding comfort

J. H. Swanberg
Assistant Engineer of Tests
Minnesota Department of Highways
1935

Minnesota Historical Road Oil Treatments

TH18 (169)
Elk River, MN

1925-1929

TH10 (12)
Waverly, MN

TH10 (12)
Waverly, MN
Frost Blowup

Past

1929 Trunk Highway System:

784 miles (1,260 km) - Blotter Treatment
1,149 miles (1,849 km) - Plant Mixed Asphalt
4,600 miles (7,401 km) - Untreated Gravel

Total: 6,946 miles (11,176 km)

Current

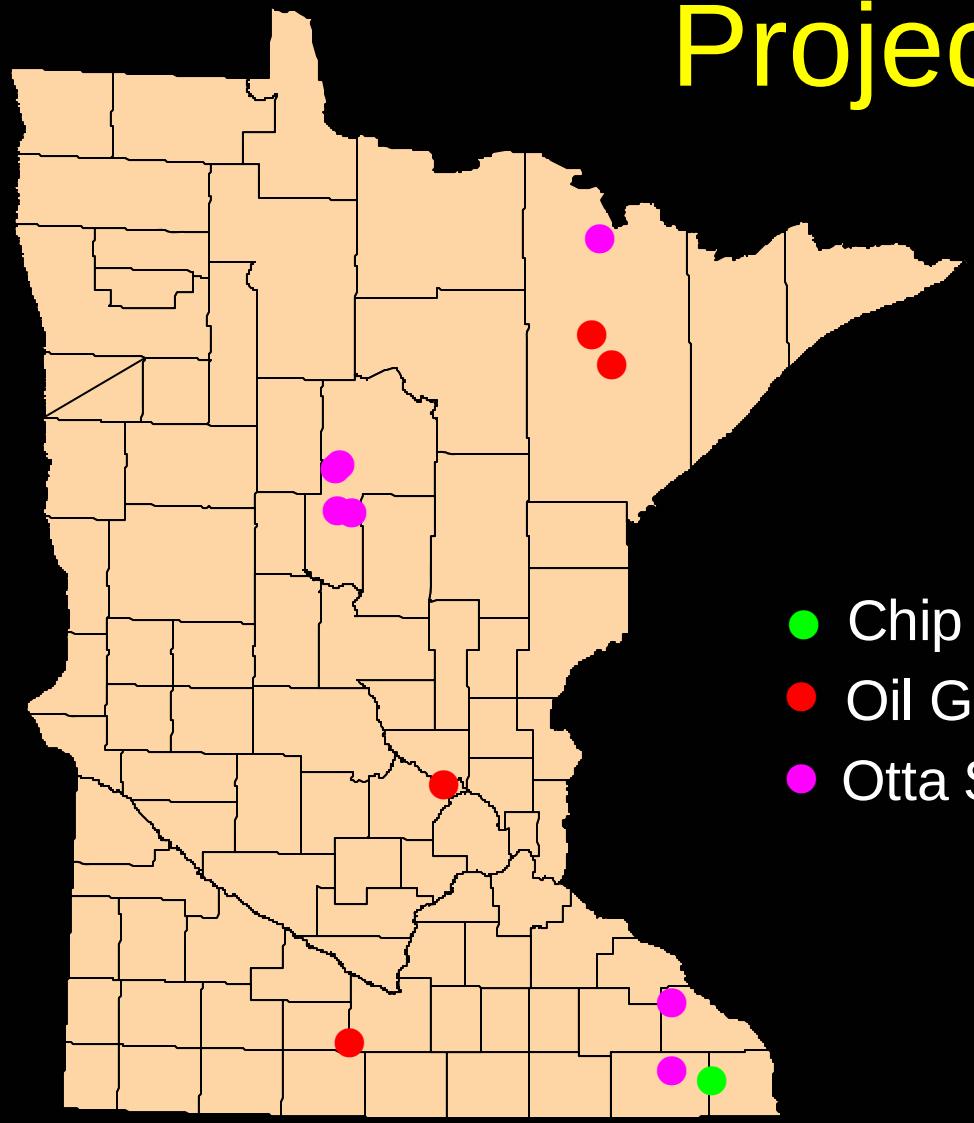
2001 Trunk Highway System

11,963 miles (19,248 km) - Hot Mix Asphalt
2,259 miles (3683 km) - Portland Cement Concrete
9 miles (14 km) – Untreated Gravel

Total: 14,321 miles (23,042 km)

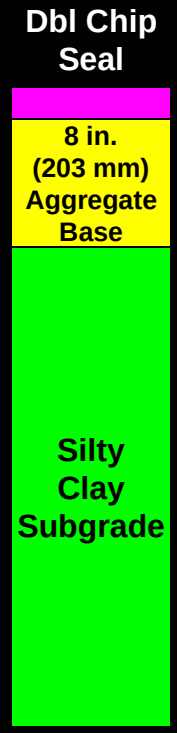
Gravel Surface in MN: 69,300 miles (111,500 km)

Project Locations



- Chip Seal
- Oil Gravel
- Otta Seal

Double Chip Seal



Asphalt

Modified Asphalt – 5

1st Layer = 0.45 gal./yd^2 (2.0 L/m^2)
2nd Layer = 0.40 gal./yd^2 (1.8 L/m^2)

Aggregate

½ inch limestone (Single Size)

1st Layer = 45 lb/yd^2 (24 kg/m^2)
2nd Layer = 35 lb/yd^2 (19 kg/m^2)

Chip Seal Performance

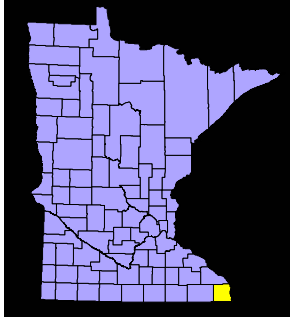
Constructed: 1996

Picture: 2001

Maintenance Reseal
2000 & 2002

- Occasional Thermal Cracks
- No rutting

Picture: 2002



Otta Seal

Asphalt Emulsion	Aggregate
High Float Medium Set (HFMS-2s)	MnDOT Class 5
1st Layer = 0.5 gal./yd^2 (2.2 L/m^2)	1st Layer = 50 lb/yd^2 (27 kg/m^2)
2nd Layer = 0.5 gal./yd^2 (2.2 L/m^2)	2nd Layer = 50 lb/yd^2 (27 kg/m^2)

Otta Seal - St. Louis County

Applied aggregate with a paver over the emulsion

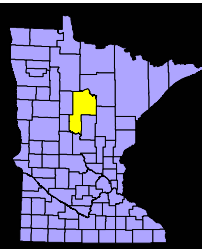
Result:
Non-uniform aggregate application led to potholes and loose aggregate on surface

Up to 2 inches (51 mm) of aggregate over emulsion

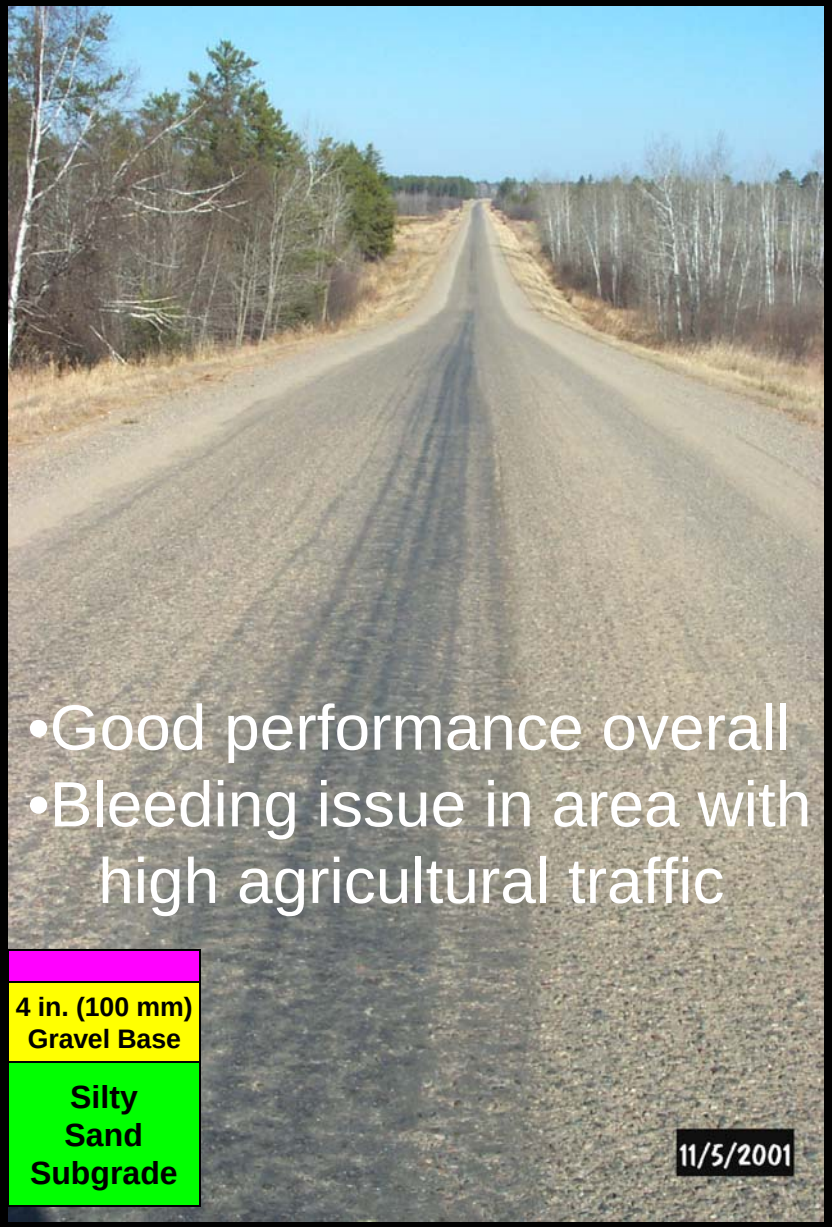
Changes to Procedure

1. Use of a chip spreader for accurate aggregate application rate
2. No driving on the emulsion before aggregate is applied

Otta Seal - Cass County



Constructed: 2001

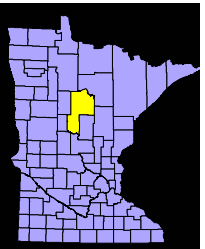


- Good performance overall
- Bleeding issue in area with high agricultural traffic

145 vehicles per day

- Chip seal applied in 2002
- No raveling or rutting
- 100 to 425 feet (30 to 130 m) between thermal cracks

Otta Seal
Cass County Township Road

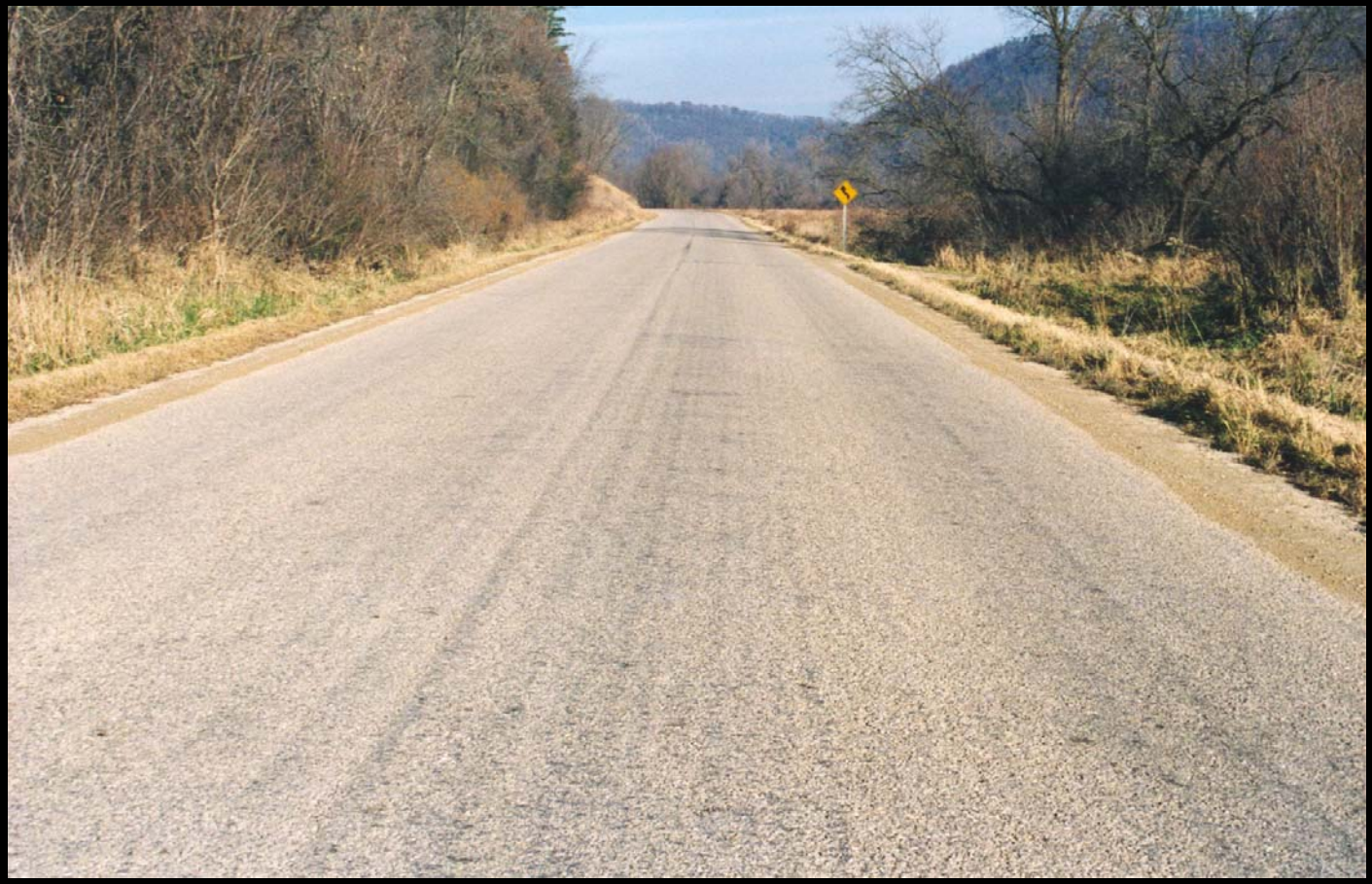


- Sandy loose aggregate on surface
- No thermal cracks or rutting

60 vehicles per day

Constructed: 2001

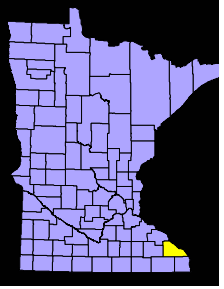
Otta Seal - MN74



6 in.
(152 mm)
Gravel Base

Loamy
Sand
Subgrade

No thermal cracks, dust, or loose aggregate

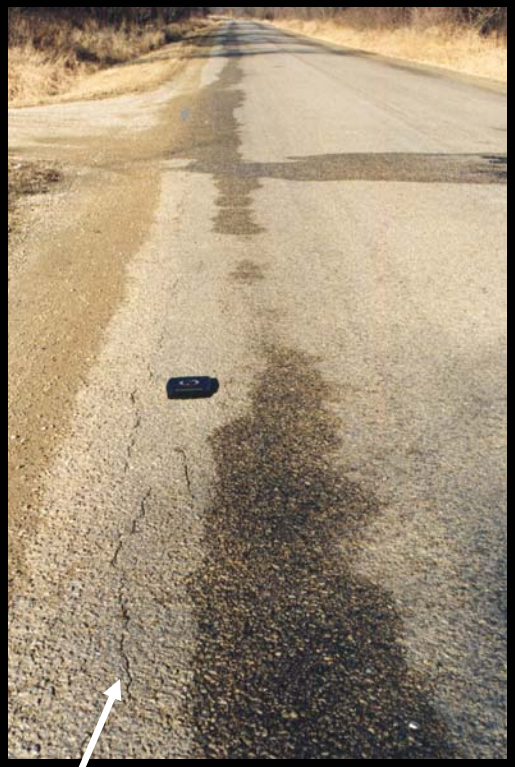


Constructed: 2001

Picture: Fall 2002

Otta Seal

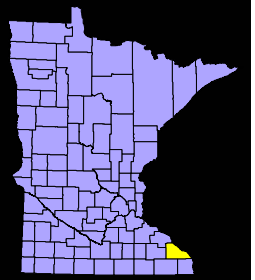
MN74 - 2003 Observations



Cracks along shoulder

Frost Boil

¾ inch (19 mm) rut in “outer wheel path”

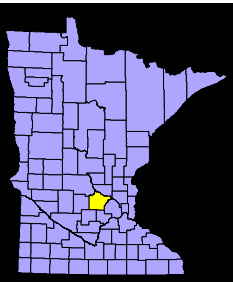


Emulsion Oil Gravel

- Plant mixed ambient temperature mix
- Initially, cutback asphalt (MC-3000), now emulsion (HFE-300)
- Aggregate, 100% crushed, continuously graded

Oil Gravel - City of Ostego

6th International LVR conference demonstration project (1995)



1996

- Distressed areas repaired.
- Inadequate base strength

8 in. (203 mm) Gravel Base

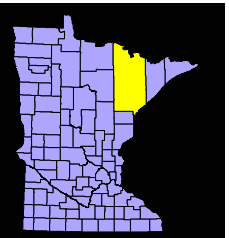
Silty Clay Subgrade

Current Condition

- No rutting
- 3 major thermal cracks
- Oxidized surface

Picture: 2003

Oil Gravel - St. Louis Co. Rd. 68



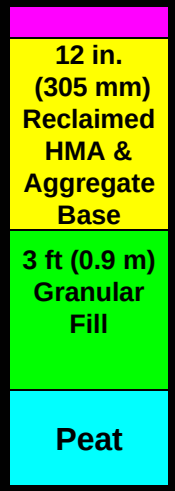
Constructed: 1996 Pictures: Fall 2002

- Ruts

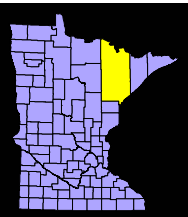
  1 to 1.5 inch (25 to 38 mm)

- Thermal cracks

  3 foot (0.9 m) spacing

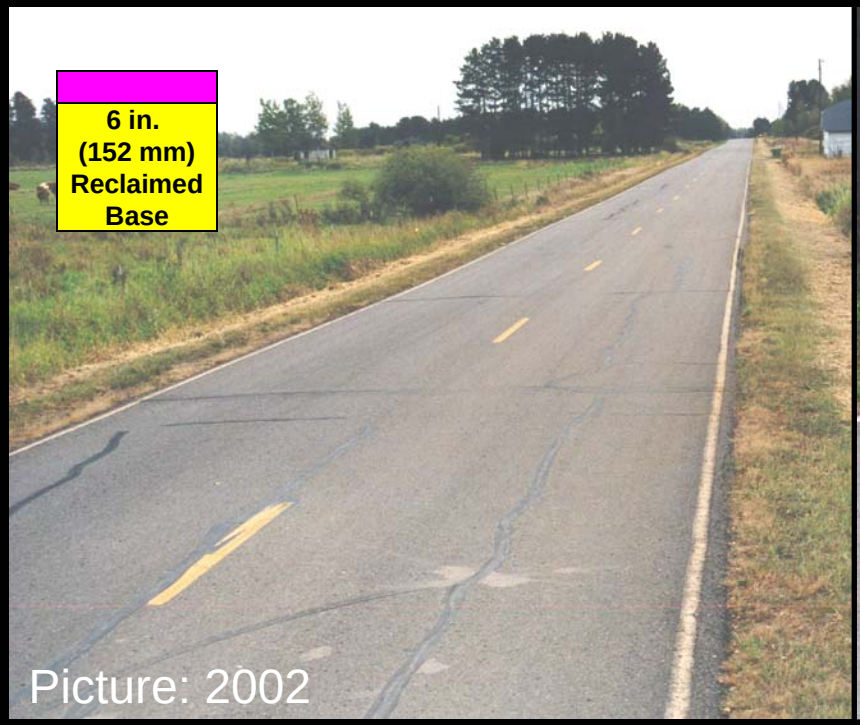


Oil Gravel - St. Louis Co.



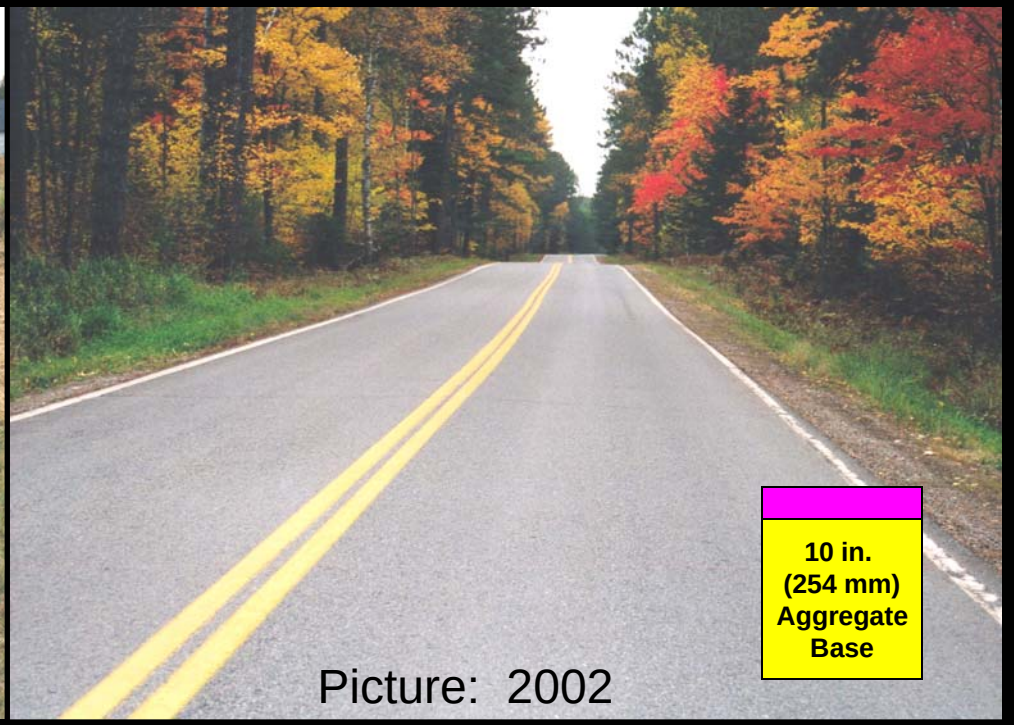
Constructed: 1996

St. Louis Co. Rd. 636



- Thermal Cracks
  60 to 100 ft (18 to 30 m)
- Longitudinal cracks
  between wheel paths
- 1/8 in. (3 mm) rutting

St. Louis Co. Rd. 405

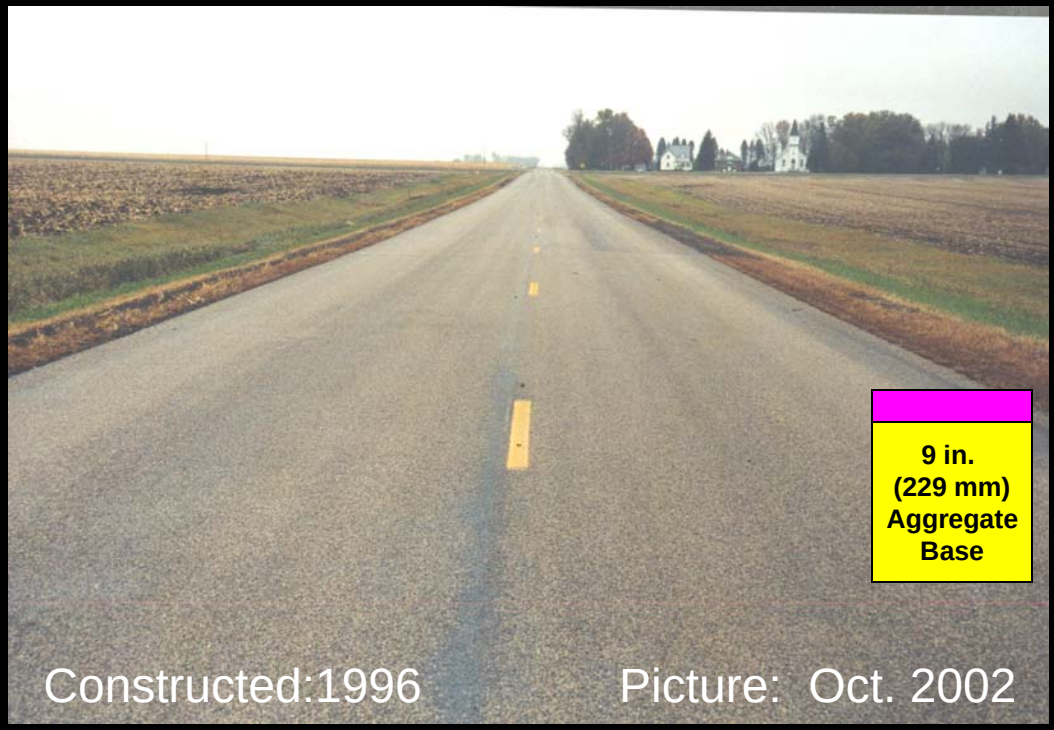


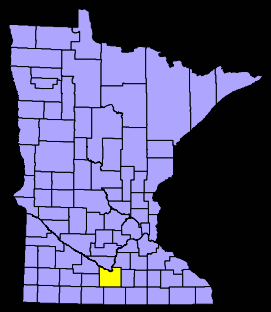
- Thermal cracks
  70 to 150 ft (21 to 46 m)
- No rutting

Oil Gravel - Blue Earth County

- Thermal Cracking
  70 to 200 ft
  (21 to 61 m)

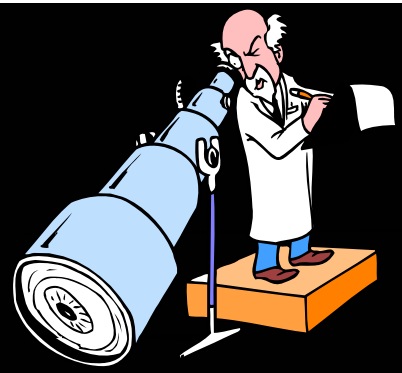
- 1/8 in. (3 mm) rutting





- No performance difference between
  100% quartzite and 50/50 gravel blend
- Segregation problems at time of construction
- Seal coat applied one year later

Surface Treatment Summary



Surface Treatment	Surface Thickness Inches (mm)	Cost $/mile ($/km)	Quality of Aggregate	Design Complexity	Construction	Typical Traffic Volumes (ADT)
Chip Seal	5/8 (16)	25,000 (15,535)	Medium to High	Moderate	Agency or Contractor	50-200
Otta Seal	1 3/8 (35)	34,000 (21,126)	Low to Medium	Low	Agency or Contractor	40-400
Oil Gravel	2 (50)	45,000 (27,961)	High	High	Contractor	150-500

Recommendations

- Surface treatments can be used as a surfacing technique
- Use a chip spreader for accurate application rates (Otta Seal)
- Need strong stable base!
- Project Selection is key to success


Thank You
Questions/Comments?