RECLAIMED BASE COURSE

STABILIZED WITH CALCIUM CHLORIDE

REPORT 94-5

JUNE 1994

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIAL AND RESEARCH DIVISION

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Date: 12 July 1994

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Reclaimed Base Course Stabilized with Calcium Chloride

INTRODUCTION:

Full depth reclamation techniques most commonly used include pulverizing the existing pavement and mixing the re-sized asphaltic concrete material with a portion of the base. The addition of an additive during the mixing process, such as calcium chloride, is believed to significantly improve performance.

The City of Montpelier identified Colonial Drive, a bituminous paved local street, as being in need of major rehabilitation. Based on previous experience with full depth reclamation used in conjunction with calcium chloride, the City Engineer believed that this alternative would be a cost effective approach to the required rehabilitation.

Wishing to support the decisions for this and possible future projects, the city allowed the Vermont Agency of Transportation's Materials and Research Division to monitor the project for long term performance and cost effectiveness.

This report describes the initial testing and construction procedure used.

PROJECT DESCRIPTION & ROADWAY CONDITION:

The project is located in the City of Montpelier. It begins at the northerly intersection of Vermont Route 12 (Northfield Street) and Colonial Drive and extends for 800 m (2625 ft) along existing Colonial Drive to its southerly intersection with Vermont Route 12. The existing roadway is 6.1 m (20 ft) wide and was constructed using 127 mm (5 in) of bituminous concrete with 279 mm (11 in) of gravel subbase classified an A-1-a sandy gravel.

Pavement condition surveys conducted prior to reconstruction revealed severe longitudinal cracking, some transverse cracking and some small areas of alligator cracking. Crack widths measured up to 25.4 mm (1") wide. There was also frequent frost heaving which had resulted in a very poor riding surface.

Seven test sections, each 30.5 m (100 ft) long were established and surveyed for cracking, International Roughness Index (IRI) and rutting on August 6, 1993, three days prior to excavation. The survey revealed a range of 45-149 lineal m (148-489 ft) of cracks for the seven 30.5 m (100 ft) test sections. The extent and width of the cracks found during the survey indicated a failed pavement structure, but the random nature of existing crack patterns made identification of the causes of the failure very difficult.

In order to evaluate the effectiveness of using $CaCl_2$ in the pavement rehabilitation, it was agreed that two 30.5 m (100 ft) control sections would be reclaimed without applying $CaCl_2$. The performance of the two control sections would be compared against that of the five $CaCl_2$ treated test sections.

PRODUCT INFORMATION:

The calcium chloride ($CaCl_2$) additive is intended for use in full depth reclamation to improve the performance of the base receiving new bituminous concrete paving surfaces. Suppliers claim that the use of $CaCl_2$ in reclaimed base material will result in an increased service life of 3 years, resulting in significant cost savings. Results of data gathered from testing granular fill show the resilient modulus of materials treated in this way increases by 30% compared to untreated material. AASHTO'S guide for design of pavement structures equates this to an increase in service life of three years.

The $CaCl_2$ utilized on Colonial Drive was manufactured by General Chemical. The recommended concentration of the $CaCl_2$ stabilizer is 35% in water, and the recommended application is as follows:

a. Pulverize existing bituminous concrete, mixing it with a

predetermined amount of underlying base materials.

b. Apply $CaCl_2$ at the rate of 3.39 L/m^2 (0.75 gal/sy).

c. Pulverize a second time to thoroughly mix the additive and base.

d. Grade the roadbed.

e. Compact the surface using a vibratory roller.

f. Seal the surface with a second application of $CaCl_2$, applied at a rate of 1.1 L/m^2 (0.25 gal/sy). This surface application may require multiple passes to ensure the liquid $CaCl_2$ does not run off. This additional treatment combined with the previous applications serves to securely hold moisture within the base. This moisture causes fines to adhere to each other and to other reclaimed aggregates.

CONSTRUCTION:

Pike Industries of Tilton, N.H. was awarded the contract for the Colonial Drive rehabilitation project. Construction operations began on August 9, 1993 with clear skies and the ambient temperature ranging from 15-27 degrees centigrade (60-80 degrees fahrenheit). The full-scale reclamation was performed in three stages over a three week period as follows:

a. Stage One: The initial work began by grinding the pavement and base to a depth of 254 mm (10 in) with a Bomag MPH 100 Reclaimer, at a rate of 6.1-9.1 m (20-30 ft) per min. This

broke up the bituminous concrete pavement and several inches of the base. The $CaCl_2$ was then sprayed onto the road surface via a distributor truck at an application rate of 3.0 l/m^2 (0.65 gal/sy). The BOMAG equipment was next used to grind the surface again to ensure complete mixing of the $CaCl_2$ with the base. Lastly, the road was fine graded.

b. Stage Two: Immediately following Stage One, a second application of $CaCl_2$ was made at a rate of 0.9 l/m^2 (.20 gal/sy), followed by compacting with the vibratory roller. When the compaction was complete, $CaCl_2$ was sprayed onto the road surface in two more passes to make up for the first two applications which had been lighter than specified. Each of these two passes administered 0.9 l/m^2 (0.20 gal/sy), for a total of 5.6 l/m^2 (1.25 gal/sy).

c. Stage Three: During August of 1993, about two weeks later, the reconstituted, compacted and graded base was covered with 50.8 mm (2 in) of Type II, and 38 mm (1.5 in) of Type III bituminous concrete within a one day period.

PROJECT TESTING AND OBSERVATIONS:

Testing included sampling of the pulverized base, undisturbed subbase and subgrade material for gradation, moisture

and density. On August 10, 1993, a test pit was excavated to a depth slightly greater than 406 mm (16 in) to determine material quality. The sieve analysis revealed the subbase material had a significant fines content, or percent passing the #200 sieve, of 19.5% and a moisture content of 10%.

Following reclamation, samples taken from a test pit dug to a depth of 406 mm (16 in) showed the road substructure consisted of a 254 mm (10 in) bituminous concrete/granular base, and the remaining 152 mm (6 in) of undisturbed subbase material had a significant amount of clayey silt pieces. Analysis of the subbase and the base indicated the materials were an A-1-b and A-1-a sandy gravel, respectively.

On August 20, 1993, ten days after reclaiming, field nuclear density and moisture tests were run on all seven test sections. A total of 28 readings were taken. The dry densities ranged from 1856 to 1968 kg/m^3 (116 lb/cf to 123 lb/cf). The lower densities reported at test site six and seven may have been due to the effects of a new drainage pipe installed in these sections. Moisture levels varied from 5.1% to 5.6%. Based on previous studies performed by the Soils Subdivision, an A-1-a sandy gravel has a maximum dry density range of 2032-2240 kg/m^3 (127 lb/cf to 140 lb/cf). Optimum moisture content in this density range

averages 10.4%, but can vary from 7.5% to 17.1%. Data gathered on this project suggests that overall density and moisture levels were somewhat deficient.

During the application of the $CaCl_2$ it was obvious that all of the solution was not absorbed into the base because run-off was observed collecting along either side of the road.

During grinding, and because of the characteristic width of the BOMAG equipment, the area beginning 1.8 m (6 ft) inboard from either edge of the street and extending 0.6 m (2 ft) toward the center line was pulverized twice as often as the remaining roadway. The pavement may develop longitudinal cracks along planes created where repetitions of the reclaimer occurred.

COST INFORMATION:

The contracted unit price for items used in the full depth reclamation are as follows:

a. $CaCl_2$ \$0.90/m^2 (\$0.75/sy)
b. Reclaiming \$2.50/m^2 (\$2.09/sy)
c. Bituminous Concrete \$39.90/t (\$36.20/tn) This translates to a cost of \$8.75/m^2 (\$7.36/sy).
d. The total unit cost for the rehabilitation of Colonial Drive was \$11.45/m^2 (\$10.20/sy).

POST CONSTRUCTION OBSERVATIONS:

Four months after construction a follow-up survey of the road indicated no apparent differences in the performance of the control and test sections. The pavement is crack free, although there was some minor rutting, possibly due to the pavement consolidating under loading. This often occurs during the construction period as traffic or construction vehicles are driven over the pavement before the mix temperature decreases to a point that allows the stone matrix to carry the load without deforming.

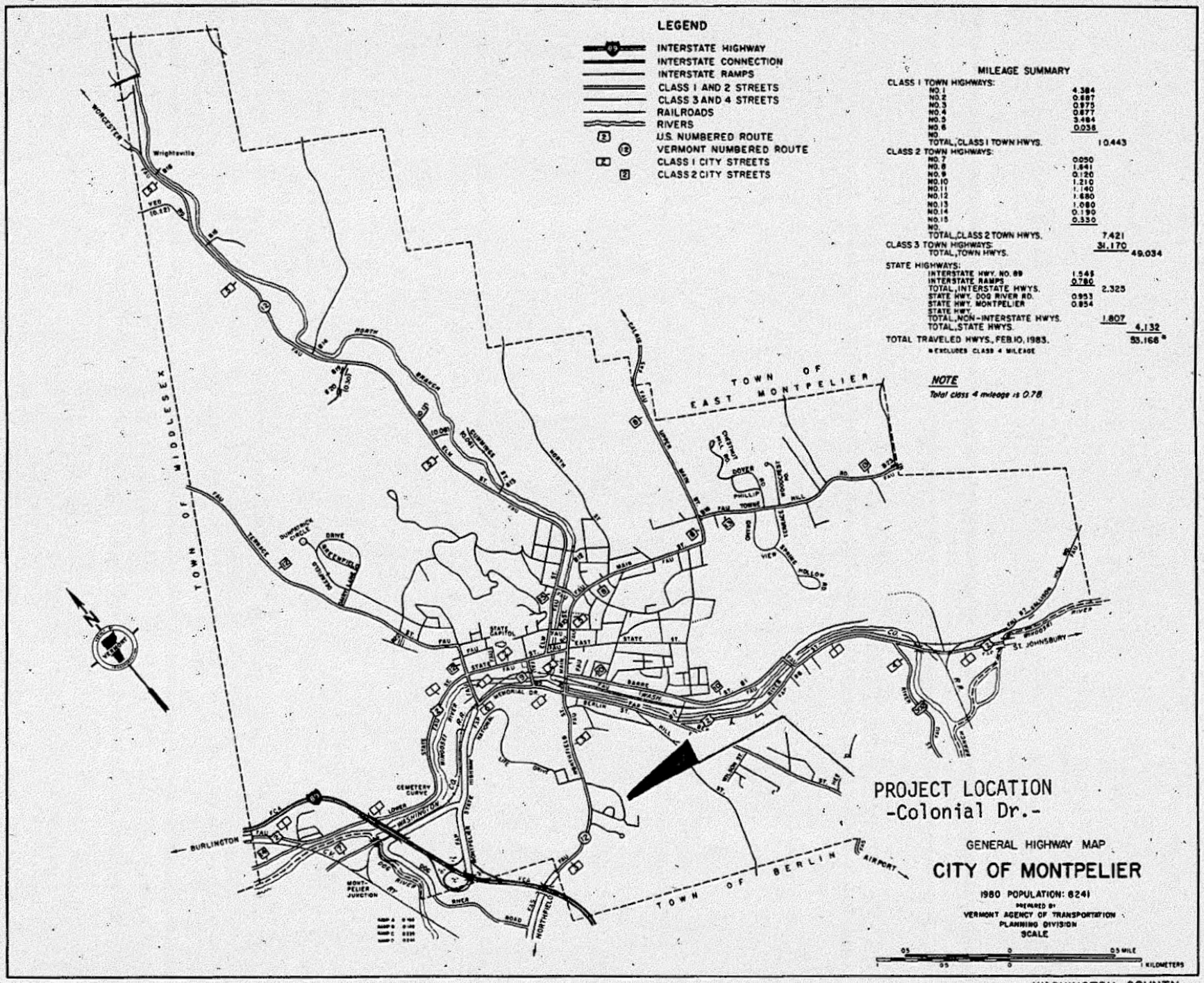
In April, seven months after construction, a section of the rehabilitated street displayed signs of frost heaving. This portion of road located in proximity to test section five (TS5) had two identifiable humps within a 6.1 m (20 ft) length of roadway. Cracks had developed at the centerline joint measuring up to 15.2 m (50 ft) long and were observed throughout the project. This type of longitudinal cracking is most likely a result of construction methods.

SUMMARY:

The full scale reclamation of Colonial Drive was performed in three weeks and involved grinding the existing five inches of bituminous concrete and combining it with the underlying granular base, applying the $CaCl_2$ solution, remixing, and compacting the reconstituted base to prepare for a new surface.

There are two treatments that are being evaluated in this study. The first is the reclaiming process which eliminates existing pavement distress and combines the qualities of the reclaimed pavement with those of the granular base. The second treatment is the application of a chemical to act as a stabilizing additive.

Performance will be monitored over the life of the project to evaluate the cost effectiveness of the treatments.



TRANSPORTATION DISTRICT NO. 6

WASHINGTON COUNTY

FULL DEPTH RECLAMATION
USING CaCl ADDITIVE
COLONIAL DR. MONTPELIER
CONSTRUCTED 1993

CONTROL SECTIONS #1 & #7

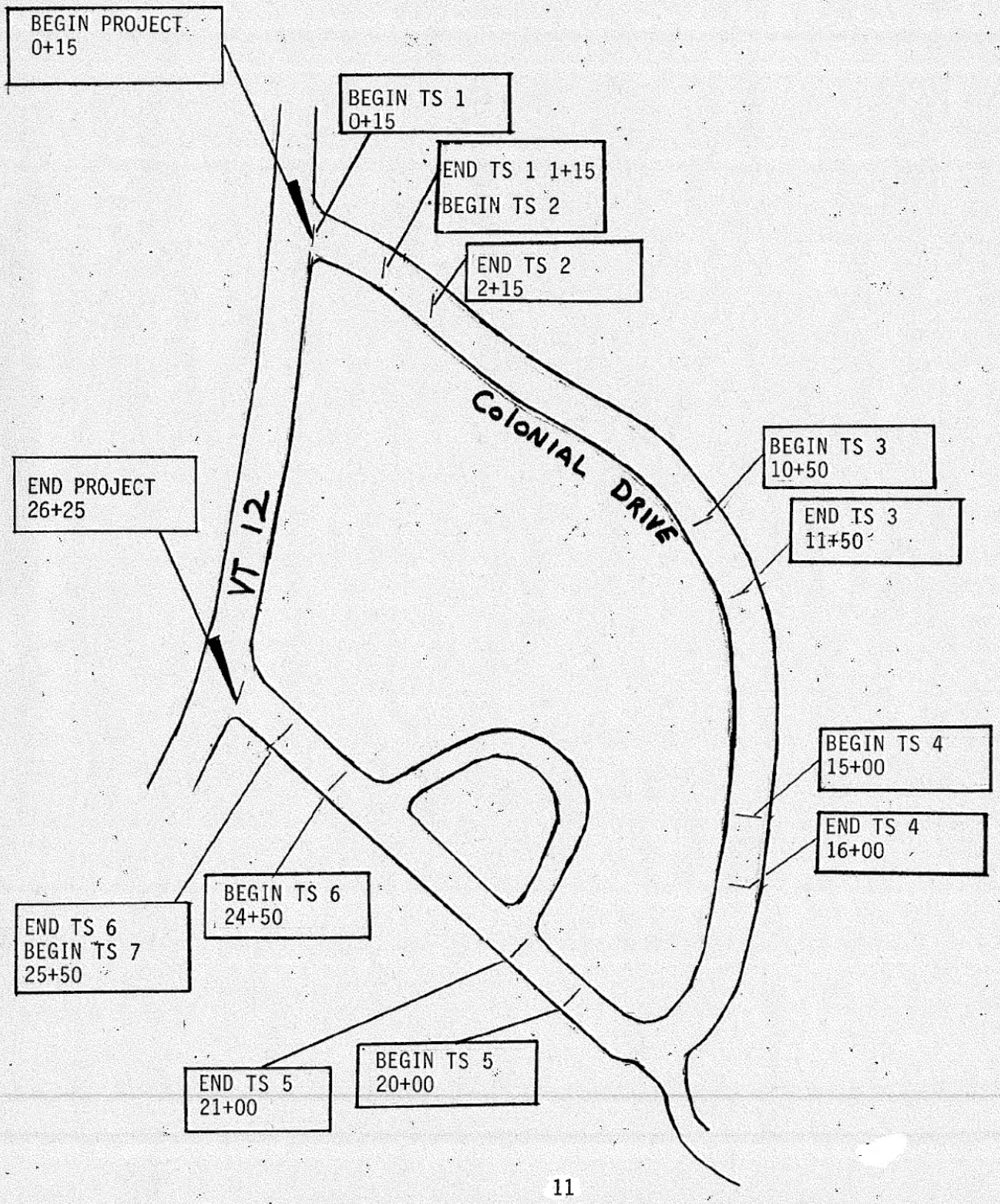
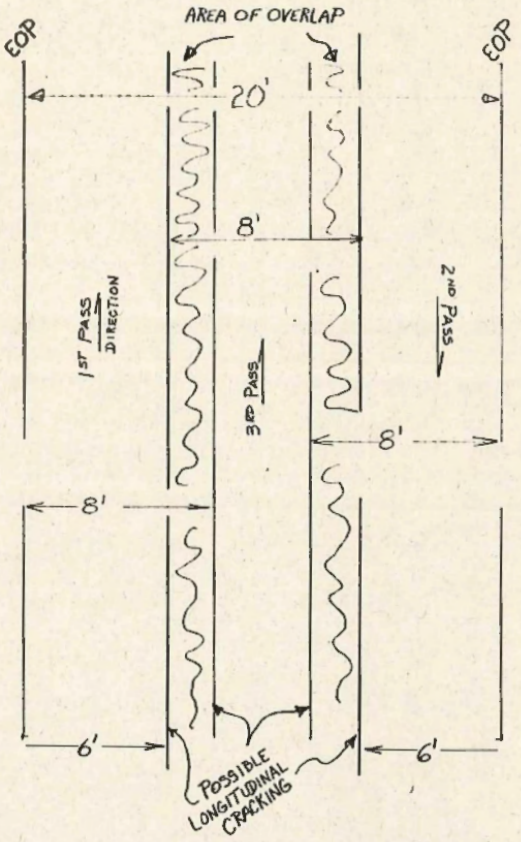


FIGURE 1
(3) 8' BOMAG PASSES



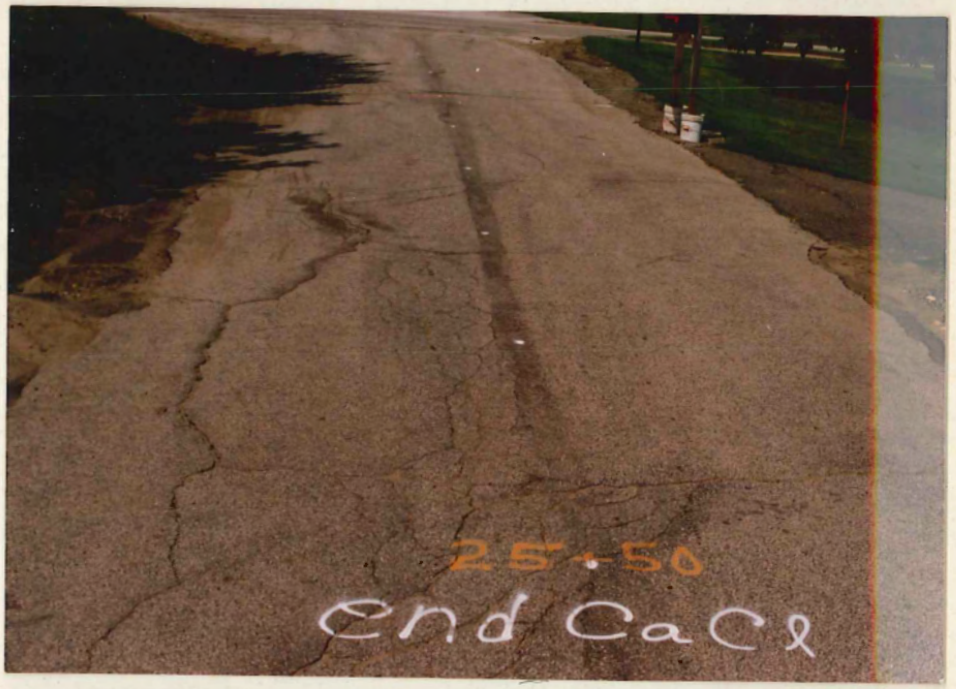
SKETCH SHOWING AREA OF OVERLAP
DURING RECLAIMING PROCESS

STATION 25+00 BEFORE THIRD PASS OF RECLAIMER

VT AOT
MATS & RES

Calcium Chloride Stabilization
Colonial Drive, Montpelier

Calcium Chloride Test Section 2



Control Test Section 7

Pavement and subbase reclaimed
10 inches deep

Calcium Chloride Stabilization
Colonial Drive, Montpelier

Test Section 6 & 7
Partially Reclaimed

Applying the Calcium
Chloride Solution

Working in the Calcium Chloride