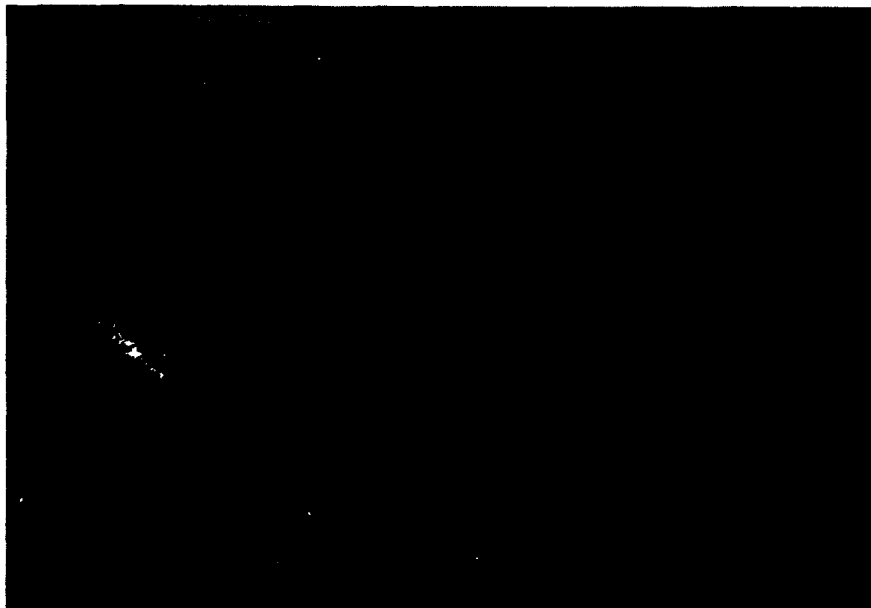


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COLD RECYCLING OF BITUMINOUS PAVEMENTS
BUCKSHUTEM ROAD, COUNTY ROUTE 670
CUMBERLAND COUNTY, NEW JERSEY



CONSTRUCTION AND FINAL
REPORT
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PREPARED BY

THE NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF TRANSPORTATION STRUCTURES RESEARCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

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16. Abstract <p>This report describes NJDOT's first experience using a Cold Recycling process for rehabilitation of a Bituminous roadway. In this process 2 - 3 inches of Bituminous material was milled along with 3 - 4 inches of base material. This material was then thoroughly mixed with an asphalt emulsion. The effectiveness of this process was gauged by a program of Visual Inspection, Benkelman Beam Measurements, and Resilient Modulus Testing.</p> <p>However, the process was discontinued after about 1½ miles were completed because of the overly ambitious approach taken. Major changes to the geometry of the original roadway were attempted with this process. These changes to line and grade were not possible with the equipment used on this project. Additionally, the material recycled with the surface course (mostly clays), required several days to set up necessitating closing of the roadway to all but local traffic.</p>					
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PART ONE: INTRODUCTION

1.1 Objective

This report documents the construction phase of a study designed to evaluate the effectiveness of a cold-mixed in-place recycling process for reusing existing bituminous pavement materials.

1.2 Background

Rehabilitation of our highway system is costly, time consuming, material and energy intensive. Within the last ten years, recycling of existing pavement material has emerged as a viable alternative to conventional rehabilitation techniques. The benefits of recycling include lower costs, conservation of aggregates, binders, and energy, and preservation of the existing roadway cross sections.

In New Jersey, asphalt pavements are currently recycled by cold milling the top few inches of roadway, taking the milled material to an asphalt plant, and mixing this material with virgin aggregate and asphalt creating a hot-mixed product. Under certain conditions, up to 50% of the aggregate in a bituminous mix can be recycled materials. While this method of recycling pavements provides cost advantages over using all virgin materials, transporting the material to a hot-mix plant and heating and mixing the recycled material diminishes the potential savings.

Another method of recycling asphalt pavements is through the use of a cold-mixed, in-place recycling operation. Although this process has not been used in New Jersey, reports from other states are promising. The available literature indicates that cold recycling may be a successful alternative for the reconstruction and rehabilitation of lower volume roads, and perhaps for shoulder rehabilitation of higher volume roadways.

In the cold recycling process under consideration, a three unit train which consists of a milling machine which pushes an emulsion tanker and pulls a conventional asphalt paver is used. The milling machine grinds off the existing bituminous pavement and a portion of the base material. This mixture is fed into a hopper where a asphalt emulsion is added from the tanker. After thorough mixing the material is conveyed to the paver, and laid in a normal paving operation. Following the paving operation, a vibratory roller is used for initial compaction, with a rubber tire roller used for finishing.

One of the claimed advantages of this process is that traffic can be permitted on the pavement immediately following proper compaction. The recycled material is then utilized as a base course with a relatively thin virgin aggregate hot-mixed layer (2-3 inches) placed on top as a wearing course.

1.3 Project Description

The cold recycling process selected for evaluation, was performed on Buckshutem Road, (county road 670) in Cumberland County, New Jersey. This six mile section of roadway begins at county route 625 (Hogbin Road) and ends at county road 638. (Figure 1)

This process, used successfully in other states, was tried in New Jersey primarily due to the enthusiasm of the Cumberland County Engineer and the interest from NJDOT personnel. The road chosen is lightly traveled, relatively straight, with no major obstructions like manholes or inlets, and little reconstruction was necessary to conform the road to current AASHTO geometric standards. Also the geographical location of Buckshutem road was such, that detours were very long (averaging 10 miles) and impractical. This process allowed the road to remain open to traffic during construction; a feat not possible using conventional methods. The experimental Cold Recycling section is located between stations 405+00 and 122+00. The control section, which was constructed conventionally and used in subsequent performance evaluations, is located between stations 122+00 and 133+00.

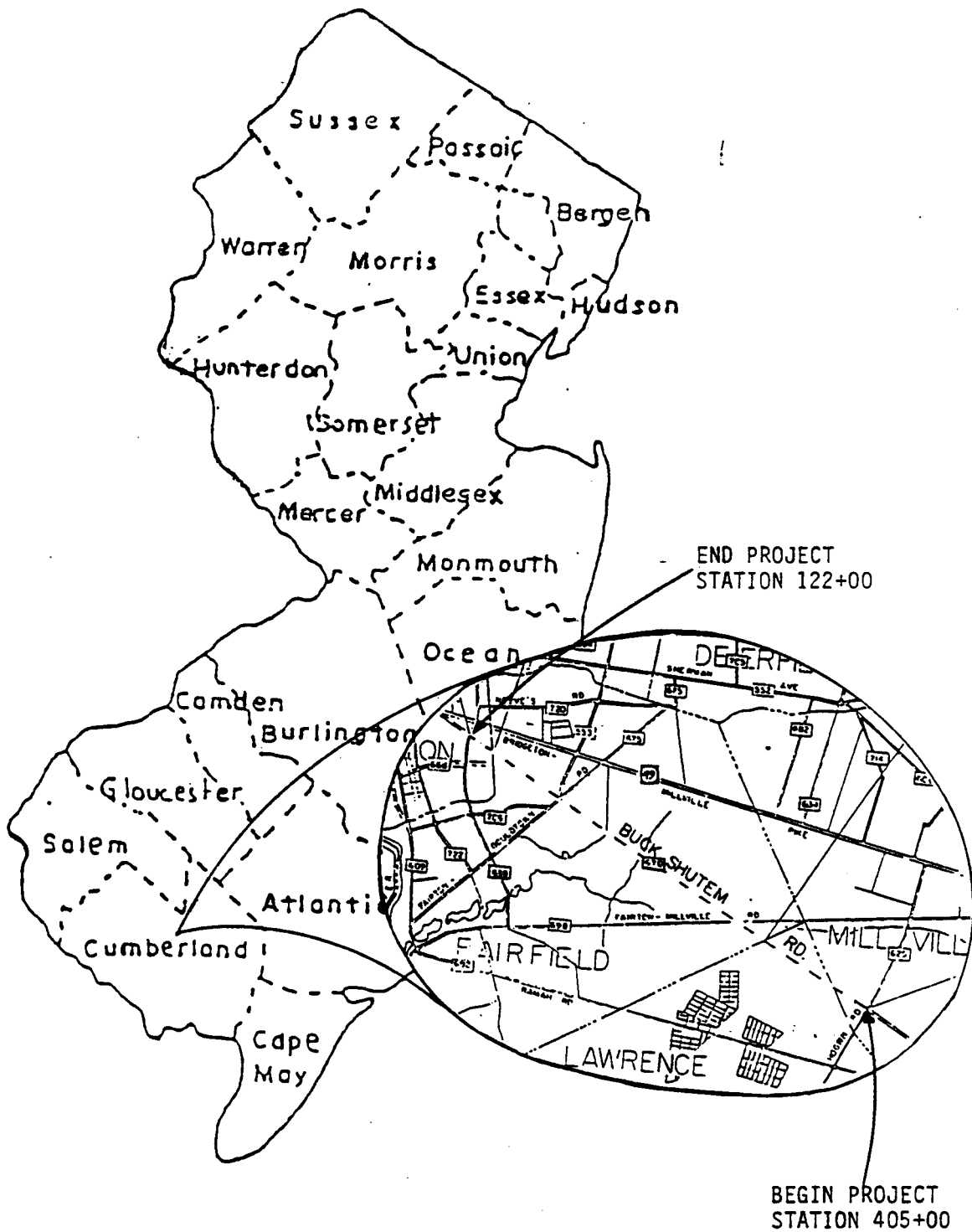


FIGURE-1 PROJECT LOCATION

PART TWO: PAVEMENT DESIGN

2.1 Climate

The climate in the vicinity of the project is relatively mild, being moderated by the Appalachian Mountains to the west and the Atlantic Ocean to the east.

Temperatures below 0 and above 100 degrees Fahrenheit are rare. The average temperature range in August is between 83 and 65 degrees Fahrenheit. In September, between 77 and 58 and in October between 66 and 44.

Average precipitation is about 4 inches in August, 2.5 inches in September, and 1.5 inches in October. Snowfall occurs infrequently and not before early November.

2.2 Design Traffic Data

The average daily traffic (two way ADT) used for the pavement design is as follows:

YEAR	VOLUME (VPD)
1984	1820
2004	2840

The anticipated truck volume is 3%

2.3 Roadway Geometry

The original roadway consisted of two 12 foot lanes and 5 to 6 foot gravel shoulders.



Photo #1 Original Condition of Roadway

The reconstructed roadway was designed to include a 12 foot lane in each direction with 8 foot outside shoulders. The cross-section shown in Figure 2 consists of a six inch cold recycled bituminous stabilized base course topped by a two inch bituminous concrete wearing course on a gravel base. The control section shown in Figure 3 consists of three inches of bituminous stabilized base course and a two inch bituminous concrete wearing course on a gravel base.

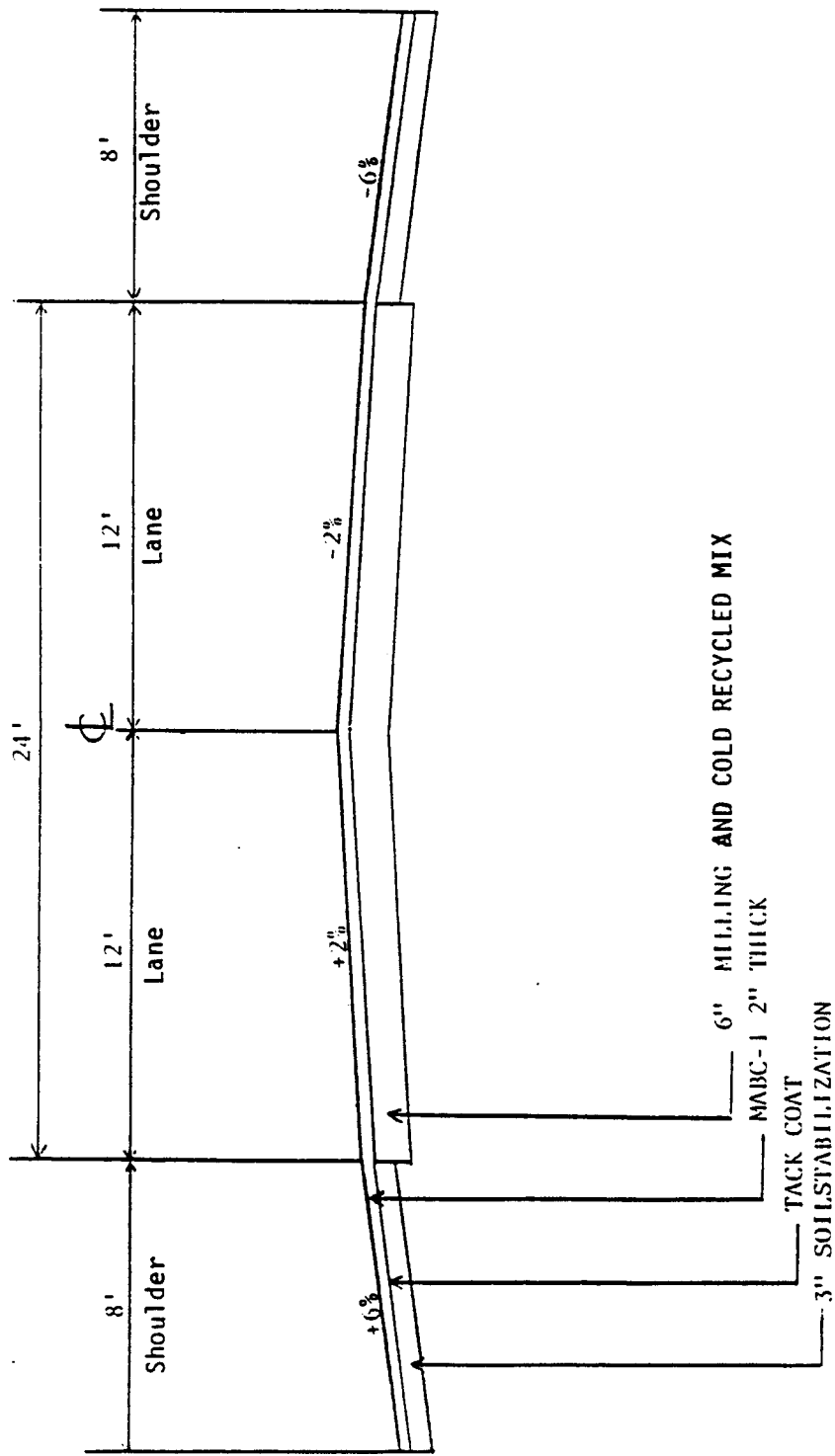


FIGURE-2

COLD RECYCLED SECTION

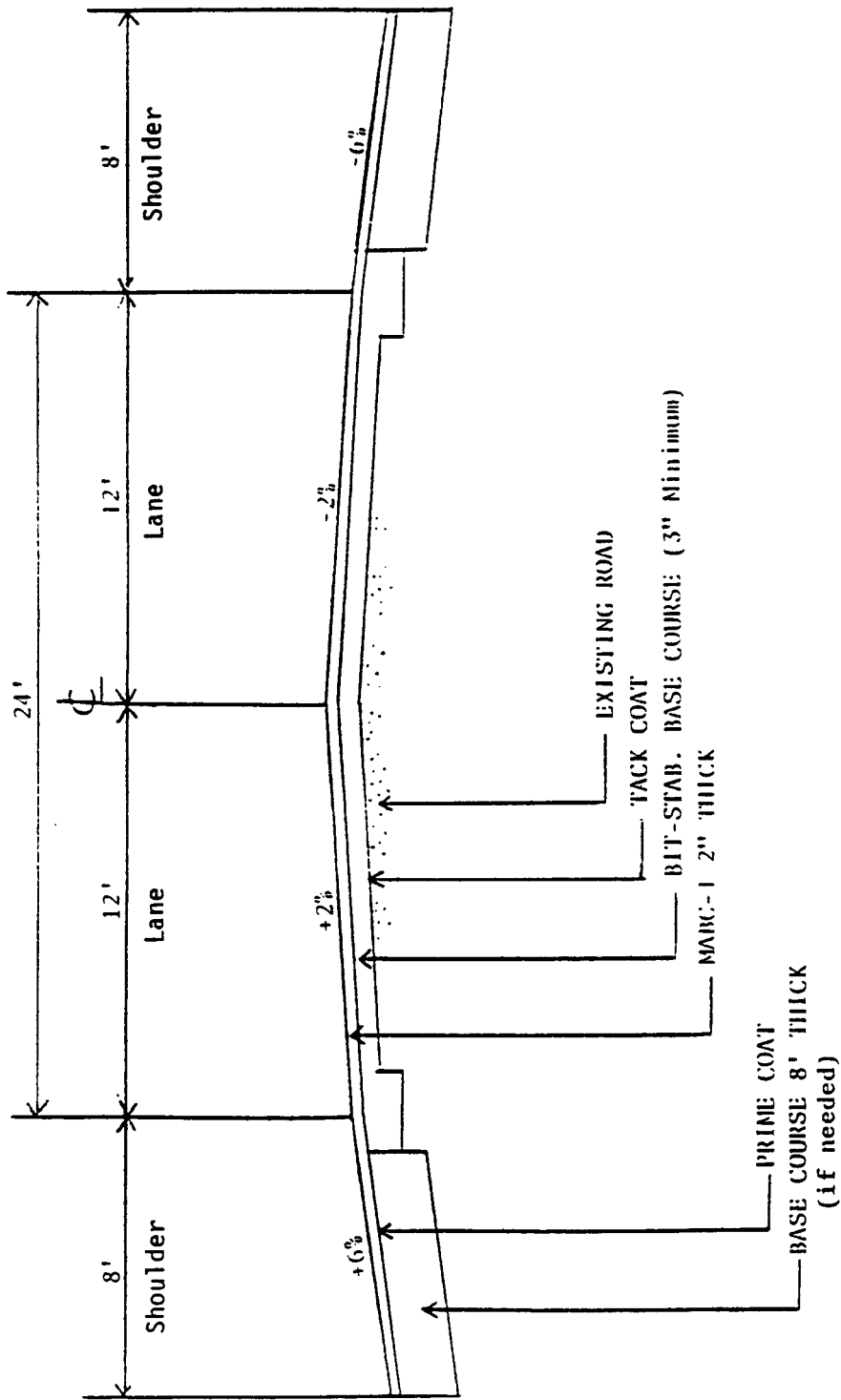


FIGURE 3
CONTROL CROSS-SECTION

2.4 Preliminary Investigation

The plans, specifications, and cost estimates for the project were prepared by the Cumberland County Engineer with technical assistance from the New Jersey Department of Transportation.

A condition survey was performed documenting the conditions of the roadway before recycling.



Photo #2 Alligator Cracking in Original Roadway

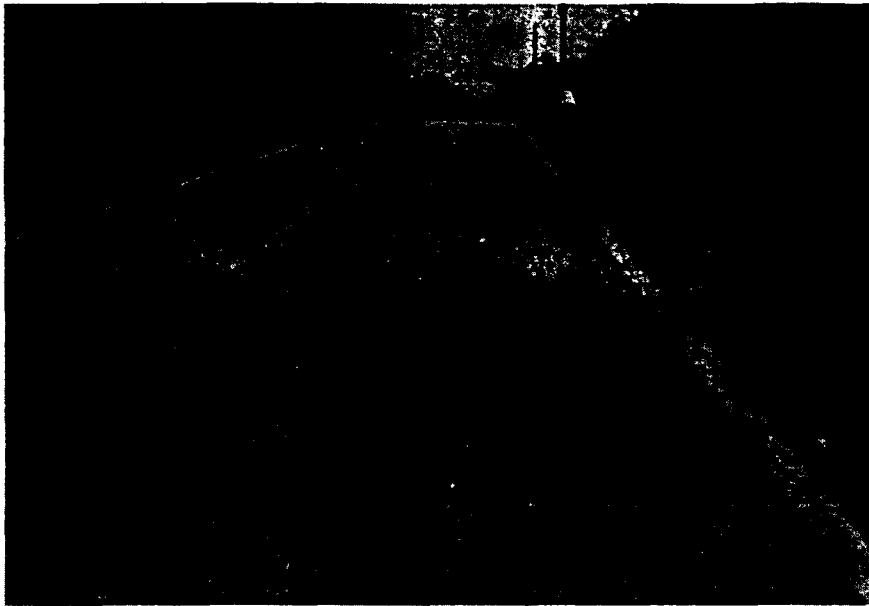


Photo #3 Alligator Cracking in Original Roadway

Photographs of the roadway surface were taken, the control section and the areas where non-destructive deflection measurements were made were identified. These measurements were taken by means of a Benkelmen Beam to compare with post construction data collected.

2.4.1 Mix Design Procedure

The mix design for the cold recycling of Buckshutem road was done by Asphalt Technology Inc. (a subsidiary of the asphalt supplier), and verified by the Materials and Research Divisions of the NJDOT. The original concept was to include a portion of the base material along with the bituminous surface course. According to the Recycling Sub-contractor, this combination was possible; therefore, the mix design included a portion of this material.

Cores were taken every mile by representatives of Asphalt Technology Inc. to obtain a cross-section of the material that existed throughout the project.

These cores were crushed, simulating field operations, and subjected to the following AASHTO standard tests:

- * T-27 Gradation
- * T-49 Penetration
- * T-99 Moisture Density relationship
- * T-170 Absorption Recovery
- * T-164 Extraction
- * T-202 Viscosity

To obtain a representative sample of the entire project, the crushed cores were grouped in three's and combined with 4% asphalt and 4% water. Marshall plugs were made from this mixture and tested for stability, flow, and air voids.

2.4.2 Initial Benkelmen Beam Data

Before the recycling began, Benkelmen Beam deflection measurements were taken along Buckshutem road, in order to obtain an estimate of existing pavement and subgrade strength. These deflection readings were taken so that comparison could be made with measurements taken after construction.

Deflections were determined from the weight of a dump truck loaded with 18,000 pounds on the rear axle at locations 0, 20, and 40 inches from the apparatus probe.

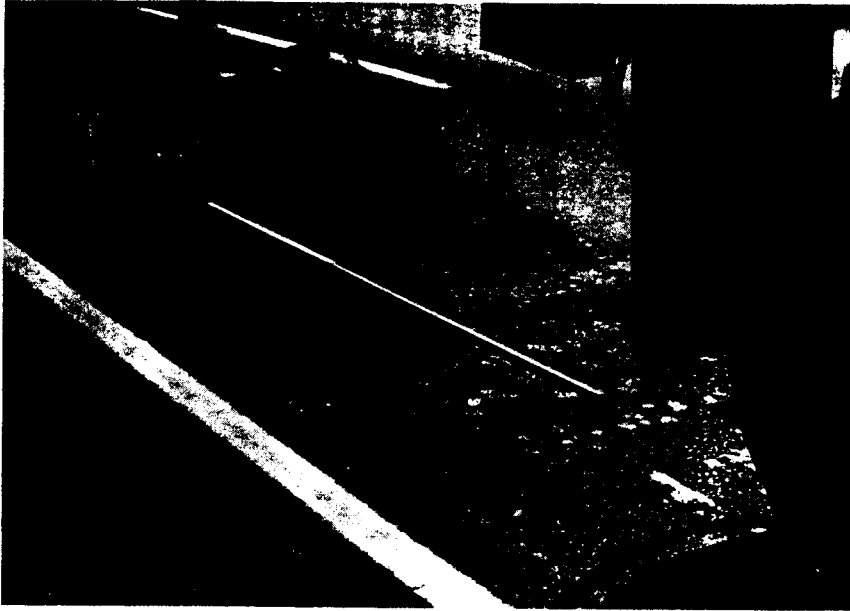


Photo #4 Benkelmen Beam Measurement

These readings established a representative deflection basin of the pavement and subgrade.

A total of 26 deflection readings were taken in each direction at 100 foot intervals between stations 108 and 133. The recycled section was located between stations 108 and 122 with the control section from stations 122 to 133.

A statistical analysis of the original deflection readings follow:

	Average ($\times 10^{-3}$ in.)	Standard Deviation	Range	
			high	low
d0	22.9	5.4	34	11.5
d20	6.8	2.6	14	2
d40	2.7	1.5	5	0

The analysis of this data indicates that the subgrade of Buckshutem road is strong and the pavement weak.

This characterization agrees with a visual inspection of the existing pavement, considering the strong gravel foundation soil, and the patched and cracked two inch asphalt pavement.

PART THREE: CONSTRUCTION

3.1 Background

The construction contract was awarded to South State Contracting Company Incorporated of Bridgeton, New Jersey, in April 1986. South State secured E. J. Breneman Incorporated of Sinking Spring, Pennsylvania, as a subcontractor to conduct the cold recycling process. The Asphalt Emulsion used in the cold recycling process was supplied by West Bank Oil Company Incorporated of Pennsauken, New Jersey.

The cold recycling process used a Barco 800 milling machine with a 12 foot cutting head.

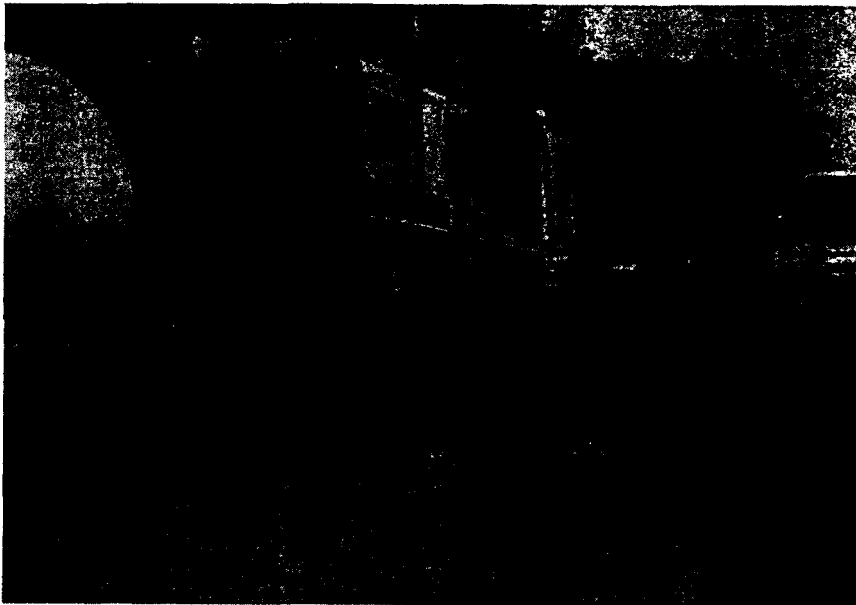


Photo #5 Milling Apparatus

This machine was self propelled with variable operating speeds and capable of removing the bituminous concrete and subbase up to a depth of eight inches. The machine was equipped with an automatic grade control which ran off a stringline, and was capable of controlling particle size of the milled bituminous concrete/base material to meet the gradation requirements.

The rejuvenating oil (Asphalt Emulsion CSS-1), which was kept in a tanker with a capacity of 4,000 gallons was added to the milled material.



Photo #6 Emulsion Storage Tanker in Recycling Train

The tanker had the capability of metering the emulsion up to a 5% deviation from the required specification. The recycled material was placed by a Blowknox paver and rolled with a Dynapac static/vibrating roller to 95% compaction.

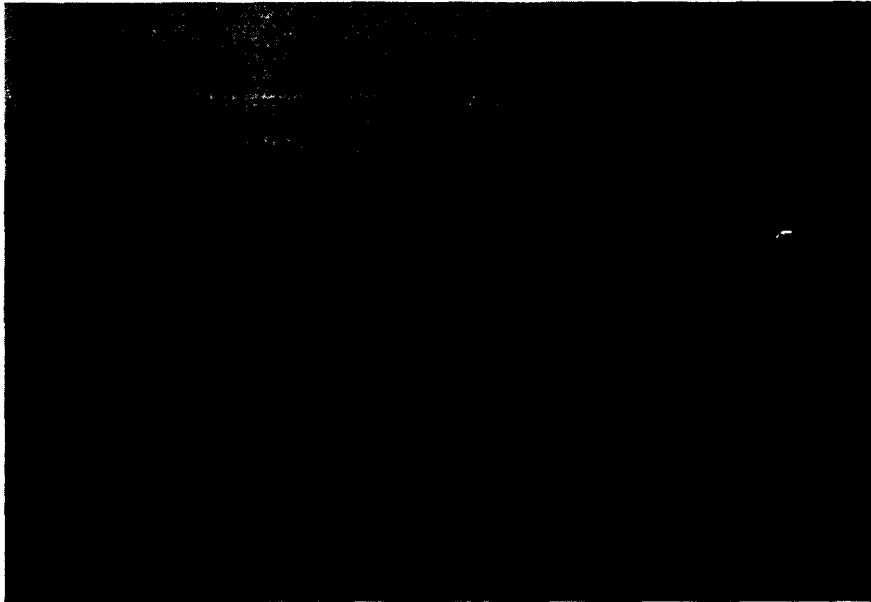


Photo #7 Breakdown Rolling

The equipment was coupled in a train configuration and proceeds by:

- * the milling machine cuts approximately six inches of the roadway material. The top 2-3 inches is bituminous concrete and the remainder base material.
- * the milled material is collected in the downcutting milling mandrel where it is blended with emulsified asphalt stored in the tank truck.

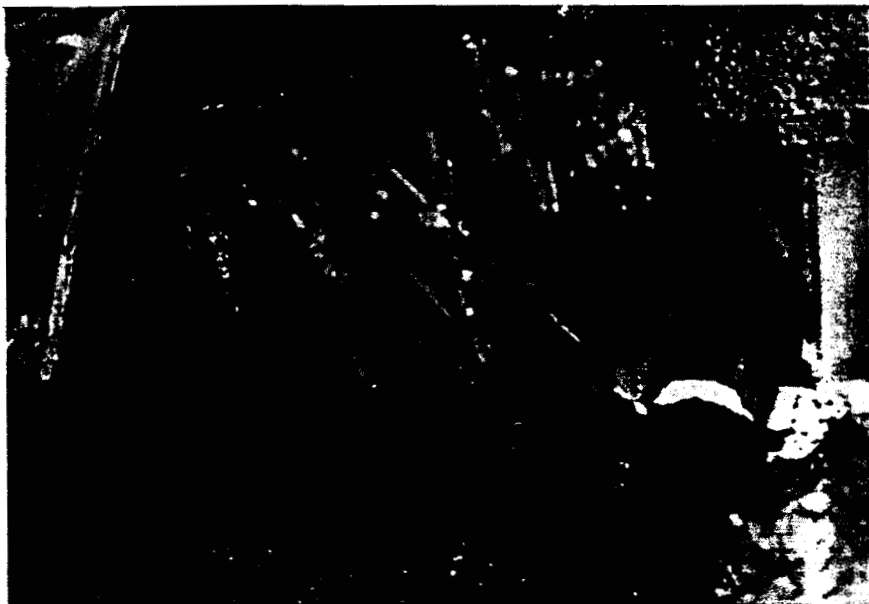


Photo #8 Down Cutting Milling Mandrel

- * the mixed material then travels by means of a conveyer to the paver where it is laid back to its original position.



Photo #9 Conveying Blended Material to Paver



Photo #10 Paving with the Recycled Material

- * a vibratory roller which makes the passes necessary to achieve 95% compaction immediately follows.



Photo #11 Compaction with Vibrating Roller

* a two inch wearing course is conventionally applied when the recycled portion is properly cured.

A test strip of about 500 square yards was constructed on August 25 1986. This strip was used to determine the machine and drum speeds of operation which produced the proper surface texture to determine the cutting depth required to remove ruts and transverse corrugations. The milling operation began when the above criteria were established and approved. The entire operation was conducted by four people. One operator each for the milling machine, compactor, and paver, and a foreman coordinating the operation.

3.2 Weather Data

The cold recycling process began on August 25th and continued until September 5, 1986. During these two weeks the weather conditions were not typical of late Summer in southern New Jersey. Instead of warm sunny conditions, the period consisted of below average temperatures with high relative humidities. Rain was light to heavy, and sky conditions were predominantly cloudy with little sunshine. The average temperatures during the operation ranged from a high of 76 to a low of 58 degrees Fahrenheit with humidities ranging from a high of 88 to a low of 50%. A complete description of the weather conditions during this period is located in Appendix A.

3.3 Quality Control

As noted the recycling operation began on Monday August 25, 1986 with a test strip approximately 12 feet wide and 400 feet long. Its function was to determine the machine drum speeds needed to produce the proper surface texture and the cutting depth required to remove ruts and transverse corrugations.

Nuclear density measurements were made using a Troxler thin lift gauge following AASHTO T-238 method B. These tests were made after each pass of the compaction equipment until no appreciable increase in density was obtained by additional passes.

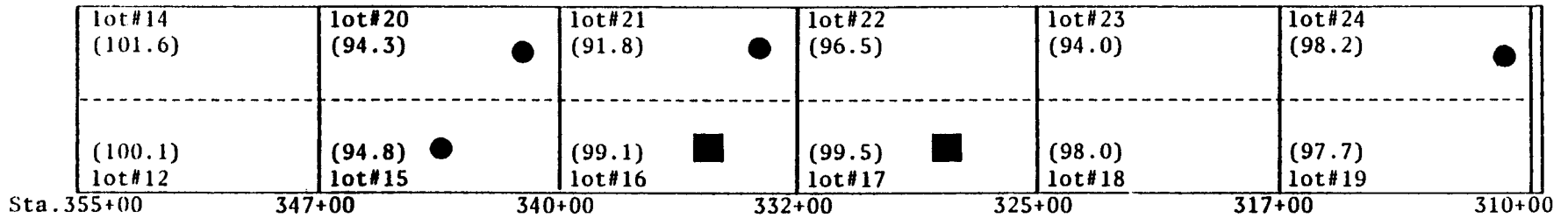
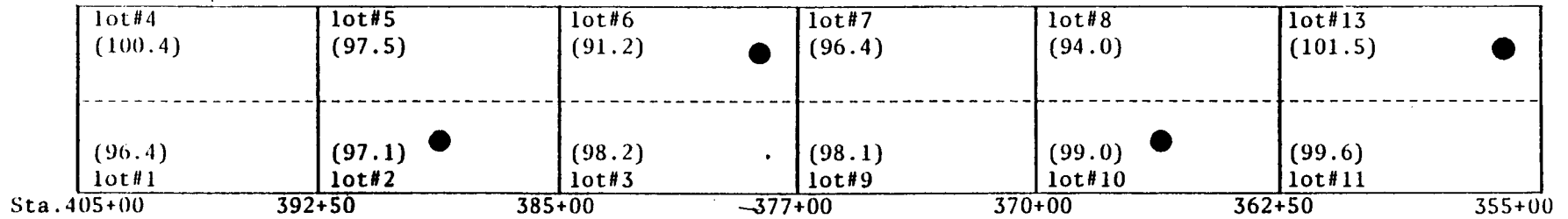


Photo # 12 Nuclear Density Measurement

Upon completion of the operation, ten tests were made at random locations to determine an average in-place density of the test strip. The subsequent construction of the recycled pavement was to be compacted to at least 96% of the average value obtained from the test strip. Samples of the emulsion (CSS-1) were taken and the Saybolt Viscosity at 77 degrees Fahrenheit was determined in the laboratory. Finally, during the operation, the amount of the emulsion added to the material was measured and adjusted to obtain the proper mix consistency.

3.4 Laboratory Analysis of the Recycled Material

The Cold Recycled material was sampled at various intervals and taken to the laboratory for analysis. The locations of the testing throughout the project was determined by setting up lots of 1000 square yards and taking one sample every third lot. A diagram of the testing plan with densities of each lot and locations of the samples taken are shown in Figure 4. This sampling was adhered to with the exception of lot #18 which was not sampled due to the rainy weather and lot #20 where an additional sample was taken. The samples obtained were subjected to the following tests.



● Sample Taken for Extraction and Marshall Plugs

■ Sample Taken for Extraction Only

|| End of Construction

Densities of each lot in Parenthesis

FIGURE 4 - SAMPLE LOCATION DIAGRAM

- * Gradation T-27
- * Moisture Density T-99
- * Marshall Stability and Flow T-245
- * Percent Air Voids D-3203
- * Extraction T-164
- * Absorption Recovery T-170
- * Viscosity T-202
- * Penetration T-49
- * Resilient Modulus
- * Split Tensile

In addition two extra samples were taken for extractions only (Figure 4). An average was computed of the eight regular samples. Two of these eight samples (Lot #15 & 20) were from excavation areas (areas where no recycled asphalt pavement material was mixed with base material).

The results of the laboratory analysis performed on the samples taken in the field indicated no problems with the mix. All samples were well graded and produced acceptable stabilities (Appendix B). However, during construction the weather was damp and overcast with rain, which did not provide the necessary conditions for curing of the recycled material. Therefore the necessary vehicle support strength was not achieved and rutting and raveling of the material occurred.

PART FOUR: POST CONSTRUCTION EVALUATION

4.1 Benkelmen Beam Data

Construction was halted on September 5 1986, after approximately 1.5 miles had been completed due to the following problems:

- * The recycling operation was not able to provide the required transverse profiles. (2% mainline, 6% shoulders, plus or minus a quarter inch)
- * The cold recycled material did not achieve the necessary vehicle support strength for days necessitating closing the road to all but local traffic. Photo #13 shows tire impressions in the completed material and photo #14 shows alligator cracking and raveling which was an indication of the variability of the material.

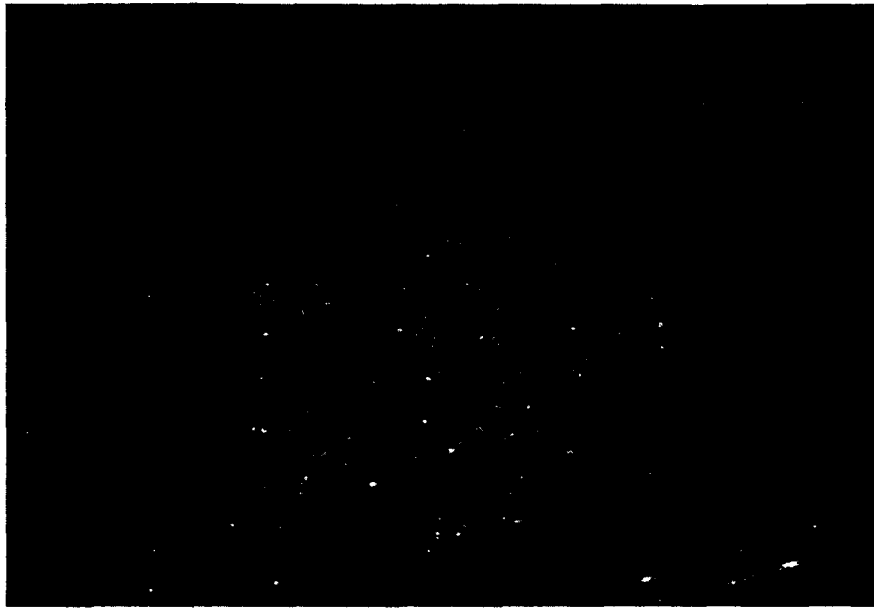


Photo #13 Tire Impressions in Uncured Recycled Material



Photo #14 Raveling and Alligator Cracking of Recycled Material

Benkelmen beam measurements were made and compared to pre-construction measurements taken before the project began. The average maximum measured deflection before construction was 19 mils. After construction, with 4 inches of hot Bituminous surface course on top of the recycled material, the average maximum measured deflection was 20 mils.

These results, summarized in tables 1 and 2, show a decrease in strength of the recycled section, and the variability of the material.

TABLE 1
BENKELMEN BEAM MEASUREMENTS

Pre-Construction

Dates 11-19-85 and 8-13-86

D = 19

T = 3.9

N = 52

D = The average maximum measured deflection
in 1000 ths of an inch
T = Standard Deviation
N = Readings Taken

TABLE 2
 BENKELMEN BEAM MEASUREMENTS

Post-Construction

Station 395 to 400

Date	10-16-86 *	6-11-87 **
Eastbound	D = 17 T = 1.9 N = 6	D = 21 T = 1.5 N = 6
Westbound	D = 15.5 T = 4.4 N = 6	D = 15.5 T = 2.5 N = 6

Station 327 to 331

Eastbound	D = 14.3 T = 4.6 N = 5	D = 21.5 T = 4.0 N = 5
Westbound	D = 11.7 T = 5.4 N = 5	D = 21 T = 2.5 N = 5

Station 300 to 310

Eastbound	D = 23 T = 3.0 N = 8	D = 20 T = 3.0 N = 11
Westbound	D = 23 T = 3.5 N = 10	D = 19 T = 5.0 N = 11

* Measurements made on Cold Recycled Material

** Measurements made with 4 inches of Hot Bituminous Surface Course on top of Recycled Material

D = The average maximum measured deflection
 in 1000 lbs of an inch

T = Standard Deviation

N = Readings Taken

4.2 Resilient Modulus Data

The Resilient Modulus test is a non-destructive test which measures the deformation/resiliency of a specimen. The operating principle consists of loading a cylindrical sample (2 1/2 inch thick by 4 inch diameter) across its vertical diametral axis, and measuring the subsequent deformation across its horizontal diametral axis. The loading is measured in pounds and the deformation in inches. The results are then correlated using the following equation, to yield a number which is the resilient modulus number of that sample.

$$MR \text{ (psi)} = \frac{f \times k}{h}$$

where h = deformation (microinch)
k = $M + 0.2734/\text{thickness}$
f = load (lbs)
M = Poissons Ratio

The higher the resilient modulus number the stiffer or less resilient the mix, and the lower the resilient modulus number the softer or more resilient.

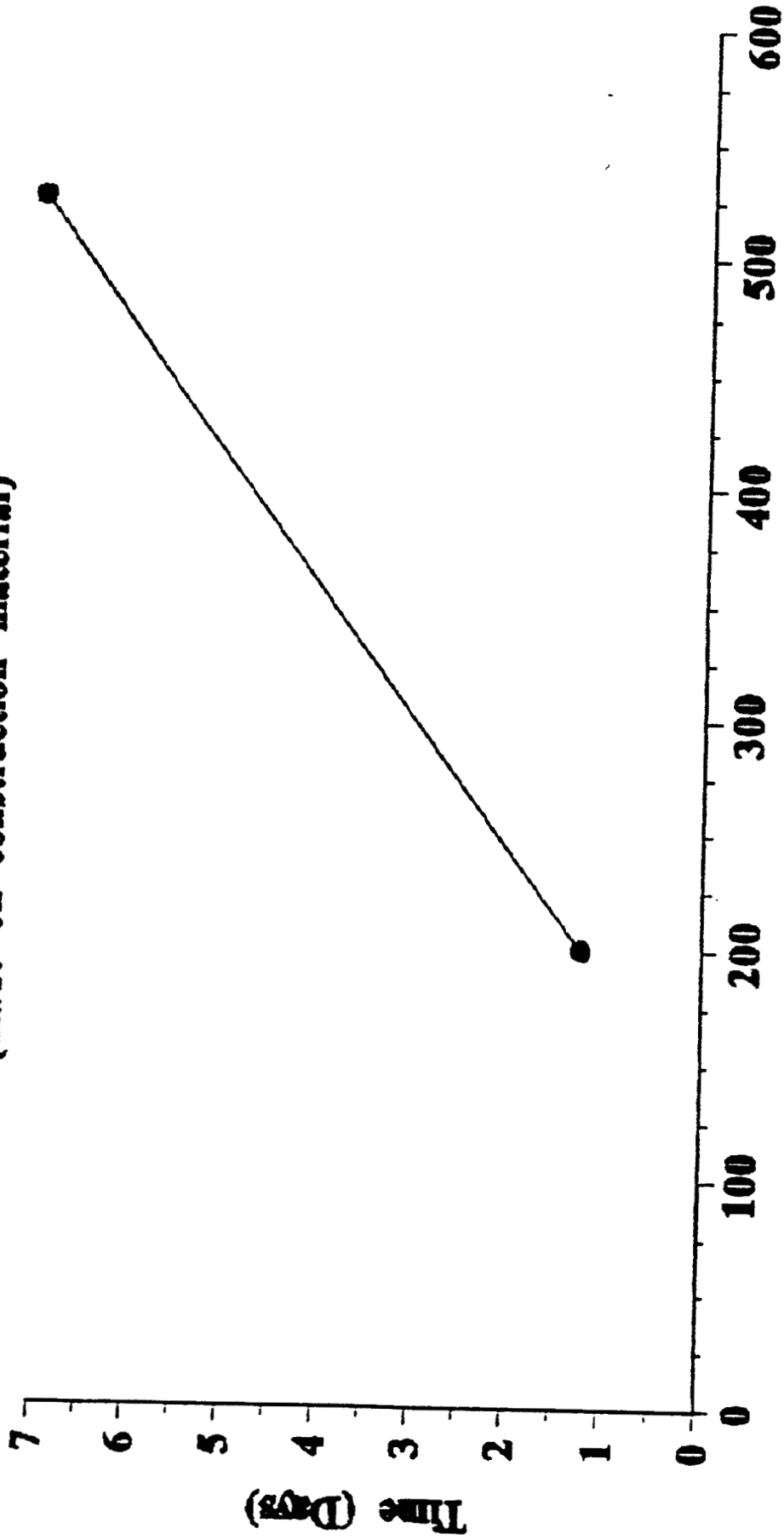
This type of testing done on Buckshutem Road was performed on;

- * the Marshall samples made with the cold recycled material during construction (see sec.3.4).
- * the cores taken of the roadway at the completion of construction.
- * the cores taken of the roadway 10 months after construction ended.
- * the cores taken of the roadway one and one-half years after construction ended.

The average values obtained on the Marshall plugs made during construction were 200,000 PSI in one day and 525,000 PSI in 7 days. (Typical MR value for Bituminous Concrete is 350,000 to 400,000 psi).

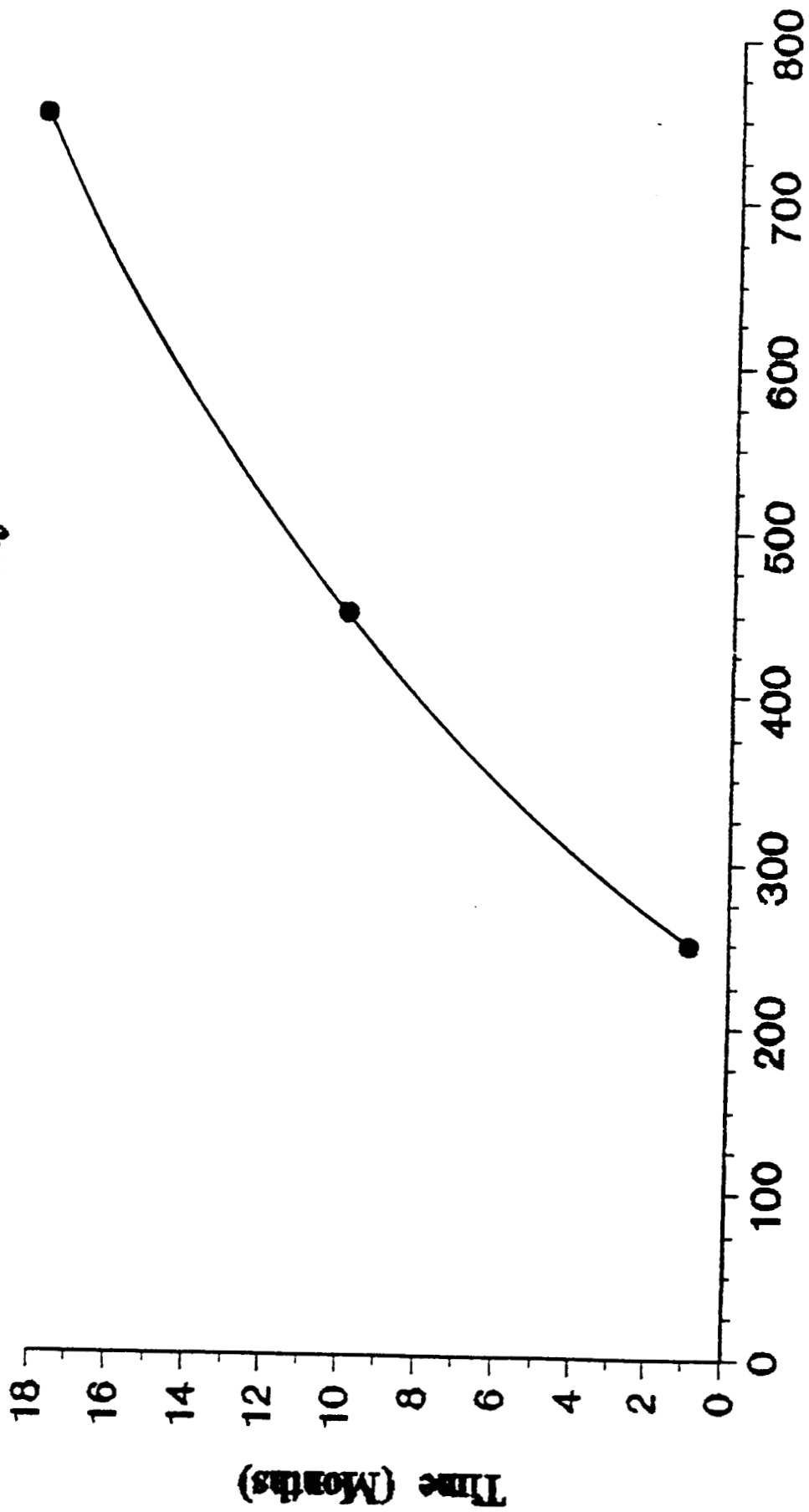
Approximately one month after construction the six cores taken yielded an average 250,000 PSI, at ten months averaged 457,000 PSI, and at one and one-half years averaged 777,000 PSI. These results were averaged and are graphically depicted in Figure 5 which shows the Marshall plugs and Figure 6 which shows the core data.

Marshall Plugs (made on construction material)



MR. (in thousands)
Figure 5

Cores of Roadway



MR. (In Thousands)

Figure 6

PART FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The cold recycling process used on Buckshutem road in Cumberland County, New Jersey was stopped on September 5th, 1986 when the desired effects could not be achieved. The following conclusions are offered:

- 1) The recycling work attempted on this project was overly ambitious and optimistic. During the development of the plans and specifications for the cold recycling installation, the recycling contractor indicated that his equipment was capable of making major changes to the cross sections and profiles (i.e. Changes up to 2 or 3 inches) were possible. In actuality, this type of reconstruction was not possible and the equipment provided would only make very minor changes in cross section.
- 2) The project required that the existing asphalt surface (about 2 inches) be mixed with approximately four inches of the existing gravel base and emulsion. This combination was tested and a mix design prepared. However, in many areas of the project significant cuts were required which exposed more and different materials (mostly clays). These did not mix well with the emulsified asphalt.

- 3) The emulsified asphalt used (CSS-1) did not break and set up for days due to the wet conditions present during the entire construction sequence. This necessitated closing the road to traffic for several weeks.

5.2 Recommendations

Cold recycling of Bituminous pavements has worked successful in other states. During dry weather, where there is a straight run without the interference from manholes and inlets, cold recycling can provide a cost effective alternative to conventional methods of rehabilitation. Based on the experience gained on this project the following recommendations are offered.

- 1) Altering the line and grade significantly during the recycling operation should not be attempted because of the equipment limitations.
- 2) If the soil aggregate base is to be mixed with the asphalt surface, testing should be performed to ensure that this material is relatively uniform and of sufficient depth, so that during construction no other material is encountered which will alter the mix.
- 3) Cold recycling with asphalt emulsion should be limited to work which can be performed during the drier summer months, and to areas where the material can be allowed to remain uncovered long enough for the emulsion to break.

- 4) Many states are using the cold recycling process to rehabilitate the upper 2 or 3 inches of bituminous road surface, which is then overlaid with about one inch of hot mix. Literature indicates that this is a cost effective technique that should be investigated for use on a low volume roadway rehabilitation project in New Jersey.
- 5) Additional research should be performed on another project utilizing the information gathered from the Buckshutem Road study. The project should not require grade changes, deep stabilization, or be performed on areas which must be kept open to traffic. A shoulder rehabilitation project would lend itself nicely to this type of work.

APPENDIX A

WEATHER DATA

DATE	TEMPERATURE		HUMIDITY		RAIN (in)	SKY CONDITIONS	
	HIGH	LOW	HIGH	LOW		CLOUDY	SUNNY
8-24	78	62	87	23	trace	10%	90%
8-25	77	51	80	35	0	23%	77%
8-26	84	62	82	34	0	40%	60%
8-27	85	71	87	63	.03	83%	17%
8-28	71	51	93	40	.38	66%	34%
8-29	68	44	80	38	0	9%	91%
8-30	74	47	86	35	0	0%	100%
8-31	77	56	81	43	0	47%	53%
9-1	77	56	75	57	trace	47%	53%
9-2	68	62	97	81	.21	100%	0%
9-3	77	65	99	71	trace	90%	10%
9-4	80	64	93	71	trace	83%	17%
9-5	77	67	97	72	.23	98%	2%
9-6	81	64	100	44	.51	18%	82%
9-7	76	57	87	48	trace	37%	63%

APPENDIX B

Buckshutem Road

New Jersey Department of Transportation

ANALYSIS OF SPECIAL MATERIALS AND RESEARCH

Material: Cold Recycled Base Course

Station	341+00EB	332+52EB	310+30EB	335+50WB	329+00WB	
I.D. #	Lot-20	Lot-21	Lot-24	Lot-16	Sand Cone	Avg.

% Passing

Sieve Size						
2"	100	100	100	100	100	100
1 1/2"	100	100	100	100	100	100
1"	100	100	100	97	100	99
3/4"	98	100	96	90	98	96
1/2"	94	98	94	85	94	93
3/8"	89	95	91	82	90	89
4	74	84	77	76	78	78
8	58.0	72.0	66.0	67.5	63.5	65.4
16	40	54	54	55	47	50
30	27	37	38	45	33	36
50	12.5	15.0	17.0	22.5	12.5	15.9
100	6	8	8	15	6	9
200	3.7	5.1	5.6	11.8	3.6	5.9
AC	3.25	4.00	4.85	2.25	3.60	3.59
Solvent Immersion	2.506	2.488	2.463	2.505	2.508	2.494
Moisture%	8.6	6.9	5.4	6.6	6.1	6.7

Buckshutem Road
 New Jersey Department of Transportation
 ANALYSIS OF SPECIAL MATERIALS AND RESEARCH

Material: Cold Recycled Base Course

Station	391+79EB	379+30EB	366+02EB	357+34EB	345+84WB	
I.D. #	Lot-2	Lot-6	Lot-10	Lot-13	Lot-15	Avg.

% Passing

Sieve Size						
2"	100	100	100	100	100	100
1 1/2"	100	100	100	100	100	100
1"	100	100	100	100	100	100
3/4"	100	99	98	96	99	98
1/2"	98	93	97	94	95	95
3/8"	95	87	93	91	91	91
4	79	73	78	78	84	78
8	66.0	61.0	65.0	66.0	75.5	67
16	54	48	51	52	56	52
30	38	34	37	37	36	36
50	17.0	13.5	15.0	15.5	12.0	14.6
100	9	7	8	8	6	8
200	6.0	4.6	5.4	5.0	3.9	5.0
AC	5.05	4.45	5.55	4.55	3.75	4.67
Solvent Immersion	2.477	2.488	2.438	2.472	2.445	2.464
Moisture%	5.4	5.9	4.9	6.5	8.6	6.3

BUCKSHUTEM ROAD

SAMPLE	A						B						C						D						
	1 - DAY						1 - DAY						7 - DAY						7 - DAY						
	140°F WATER			140°F OVEN			140°F WATER			140°F OVEN			140°F WATER			140°F OVEN			140°F WATER			140°F OVEN			
STATION	LOT NO.	BULK SP. GR.	% VOIDS	STAB.	FLOW	BULK SP. GR.	% VOIDS	STAB.	FLOW	BULK SP. GR.	% VOIDS	STAB.	FLOW	BULK SP. GR.	% VOIDS	STAB.	FLOW	BULK SP. GR.	% VOIDS	STAB.	FLOW	BULK SP. GR.	% VOIDS	STAB.	FLOW
391+79EB	2	2.191	11.5	870	14	2.201	11.1	1490	15	2.180	12.0	1000	13	2.177	12.1	2190	15	2.177	12.1	2190	15	2.177	12.1	2190	15
379+30EB	6	2.222	10.7	650	12	2.224	10.6	1490	14	2.174	12.6	1240	11	2.180	12.4	2720	12	2.180	12.4	2720	12	2.180	12.4	2720	12
366+02WB	10	2.211	9.3	430	11	2.215	9.1	1030	14	2.179	10.6	1020	13	2.182	10.5	2180	12	2.182	10.5	2180	12	2.182	10.5	2180	12
357+34EB	13	2.231	9.7	400	14	2.226	10.0	900	14	2.129	13.9	1300	13	2.150	13.0	2570	13	2.150	13.0	2570	13	2.150	13.0	2570	13
345+84WB	15	2.118	13.4	530	14	2.143	12.4	1500	15	2.032	16.9	1350	13	2.028	17.0	2710	13	2.028	17.0	2710	13	2.028	17.0	2710	13
341+00EB	20	2.196	12.4	550	13	2.175	13.2	1150	19	2.121	15.4	1820	12	2.101	16.2	3220	18	2.101	16.2	3220	18	2.101	16.2	3220	18
332+52EB	21	2.193	11.8	600	11	2.208	11.2	1460	11	2.128	14.5	1420	12	2.136	14.1	3140	15	2.136	14.1	3140	15	2.136	14.1	3140	15
310+30EB	24	2.190	11.1	610	13	2.183	11.4	1500	13	2.159	12.3	1000	11	2.159	12.3	2540	14	2.159	12.3	2540	14	2.159	12.3	2540	14
AVERAGE:		2.194	11.2	580	13	2.197	11.1	1320	14	2.138	13.5	1270	12	2.139	13.4	2660	14	2.139	13.4	2660	14	2.139	13.4	2660	14