EXPERIMENTAL USE OF COLD RECYCLED ASPHALT PAVEMENT ON VERMONT ROUTE 2A

INITIAL REPORT 82-5

March 1983

Reporting On
Category III Work Plan 81-R-5

St.George-Williston HMA 2108

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

T. EVSLIN, SECRETARY OF TRANSPORTATION
S. J. GAGE, P.E., DIRECTOR OF ENGINEERING & CONSTRUCTION
R. F. NICHOLSON, P.E., MATERIALS & RESEARCH ENGINEER

Prepared By
Paul E. Corti
RESEARCH SPECIALIST C

Reviewed By:

R.F. Nicholson, P.E., Materials & Research Eng.

Date: March 10, 1983

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Experimental Use of Cold Recycled Asphalt Pavement on Vermont Route 2A	March 1983
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Paul E. Corti	82-5
9. Performing Organization Name and Address Vermont Agency of Transportation Materials & Research Division 133 State St., State Administration Bldg. Montpelier, Vermont 05602	10. Work Unit No. DTFH 71-81-39-VT-02
	11. Contract or Grant No.
	13. Type of Report and Period Covered Initial Report Construction Phase
12. Sponsoring Agency Name and Address Federal Highway Administration Region 15 1000 Glebe Road Arlington, Virginia 22201	14. Sponsoring Agency Code

15. Supplementary Notes

FHWA Contract Manager, Mr. Douglas J. Brown

16. Abstract

Cold recycled bituminous mix was placed on 3.90 miles of Vt. 2A in the towns of St. George and Williston. The cold mix was made up of bituminous concrete and rubber slurry which was removed from I89, stockpiled, screened to remove oversize material and mixed in a portable pug mill with a CSS-2 emulsion at a rate of 5.5 gallons per ton.

Mix was placed an average of 1.6" deep with a conventional vibratory screed paver and compacted with a 10-14 ton dual axle tandom steel wheeled roller. The project was completed in six work days at a daily average rate of 8380 square yards and total usage of 3764 tons of cold recycled bituminous mix.

Forty days after completion of the project, the surface received a chip seal of CRS-2 emulsion and 3/8" stone. Total cost of the finished cold recycled bituminous/chip seal surface was $68,972 or $1.37 per square yard. Use of the experimental treatment in place of a standard 1 inch overlay resulted in an estimated savings of $21,633 or a 31% savings. Other savings obtained by using the cold mix in lieu of 1" of new bituminous concrete were 119.8 million Btu of energy, 2146 tons of virgin aggregate, and 76 tons of asphalt.

17. Key Words	18. Distribution Statement
Cold Recycled Bituminous mix, Pug Mill, Natural Resources, Cost and Energy Savings.	No Restrictions

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	24	

Form DOT F 1700.7 (8-69)

ACKNOWLEDGMENT

This project was performed in cooperation with the U. S. Department of Transportation, Federal Highway Administration, Region 15 in conjunction with Demonstration Project No. 39, Recycling Asphalt Pavements under Work Order No. DTFH 71-81-39-VT-02.

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation. Anyone, other than the Agency using this report, does so with awareness that the Agency does not guarantee the opinions, findings, or conclusions contained therein.

TABLE OF CONTENTS

INTRODUCTION

The State of Vermont uses varied pavement maintenance rehabilitation procedures. One commonly used is the placement of 1/2± inch leveling course and one to two inches of new bituminous concrete pavement. During the 1970's, this developed into a costly procedure, both monetarily and in the use of valuable resources and energy. Because of this, recycling of existing materials originally purchased at low prices has become a practical alternative.

Vermont has tried several recycling techniques, such as in place cold recycling of bituminous concrete, in place cold recycling of a bituminous concrete and a soil cement base, and the use of hot recycled bituminous concrete mix on a resurfacing project, using the batch plant heat transfer process.

Positive results from these projects, plus the desire to save money and natural resources, led to the decision to resurface a portion of Rte. 2A in Williston and St. George with a cold recycled bituminous concrete pavement. This report covers the construction phase of the project carried out under F.H.W.A. Demonstration Project No. 39, Recycling Asphalt Pavement.

BACKGROUND AND PRECONSTRUCTION CONDITION

A 3.90 mile section of Vermont Route 2-A in the town of St. George and Williston was the experimental project location. (See Appendix A, Page 15). The section begins at the intersection of Vermont Route 116 and extends northerly towards I89 interchange #12 in Williston. Initial construction of the roadway as a surface treated gravel was carried out in 1946 in the town of St. George, and 1947 in the town of Williston. Between 1955 and 1965, the majority of the roadway received five blade mix treatments and one bituminous seal treatment. The surface was not treated again until 1971 - 1972, at which time the entire section was covered with a 3/4 inch bituminous concrete pavement which remained through the present period.

A study on the condition of the 22' wide roadway before the application of material revealed an overall average of 177' of cracking per 100 lineal feet of roadway. Approximately 93% of the cracking was of a longitudinal nature. The remaining 7% was transverse cracking. The width of the cracks varied between 1/8" and 1/2". Settlement or displacement of the material in the wheelpath resulted in rutting ranging from 1/16" to 1 11/16". The overall average rutting for all areas examined was 1/2". Mays meter roughness readings were 100"+.

The 1980 average daily traffic count for the experimental section of roadway was 2400, of which 15% was truck traffic. Of the 15% trucks, two-thirds were medium single unit and one-third were tractor semi-trailer heavy trucks.

The average friction value of the roadway prior to experimental work, as tested in 1980, was 41.2. All testing was done in accordance with ASTM E 274-79 test procedures at an operating speed of 40 miles per hour.

A few weeks prior to the start of treatment, a limited amount of the roadway was given a thin leveling course of Type IV bituminous concrete.

RECLAIMED PAVEMENT

The reclaimed material used for the recycle project was cold planed from Interstate 89 in the towns of Bolton and Richmond in the months of June and July, 1981. It was comprised of a three inch bituminous concrete pavement and 3/8"± rubber slurry interlayer placed in 1975. Cold planing was accomplished by the combined efforts of Barber Green and CMI planers.

Approximately 4000+ cubic yards of the reclaimed material was stockpiled at Richmond's old public dump site. In mid July, the material was screened through a portable screen to remove all material over one inch in size. The screen with operator was rented from Dennis Demers at a rate of $50/hr. It took 41½ hours to process all the material. An estimated 10-15% of the material was oversized. No special care was taken in stockpiling the screened material.

Typical Gradation of Screened Material

Samples of the screened reclaimed material were taken for gradation and asphalt content analysis. See Appendix B on Page 16 for results of test.

CONSTRUCTION

The project was started on the morning of July 23, 1981 and took six work days to complete the 3.90 miles of recycled paving (July 23, 24, 27, 28, 30, 31). Ambient temperatures during the period ranged from 60°F to 80°F with generally sunny conditions. No work was done on July 29 because of rain. For daily weather conditions, see Appendix C on Page 17.

A portable mixer owned and operated by Allstate Asphalt Inc. of Sunderland, MA. was set up at the reclaimed pavement stockpile. It took approximately 15 - 30 minutes to set up the mixer for production. The plant was a Midland Portable Mix Trailer, Model 201, which had a maximum production rate of 375 tons per hour. The trailer consists of a load hopper, feed gates, conveyor belt, pug mill, pumps, piping, diesel engine and control panel.

Midland Portable Mix Trailer

Before the actual mixing began, it was necessary to determine the production rate of the mixing plant using the reclaimed material. This was accomplished by timing how long it took to load a 5 cubic yard dump truck which had been weighed empty, then reweighing it loaded. The weight of the material loaded on the truck was calculated and this figure was divided by the time it took to load it, resulting in a production rate of 3.25 tons per two minutes of operation.

The emulsion used for the project was labeled as a CSS-2 with anti-strip additive, type and quantity unknown, a special blend manufactured and sold to Allstate Asphalt, Inc. by Bitumar, Inc. of Montreal, Quebec, Canada. Samples of the emulsion were taken from all tankers used in conjunction with the project. The samples were tested by the Materials and Research Division of the Vermont Agency of Transportation. Results of the tests indicate an average final Viscosity of 131 at 77°F, an average Residue by Distillation of 69%, and an average Penetration of 380+ at 77°F.

Temperature of the emulsion as used in the mix ranged from a low of 135°F to a high of 160°F, and the temperature of the reclaimed material ranged from 68°F to 78°F. Moisture content of the stockpile varied from 4.0% to 5.8%. For detailed temperature and moisture contents, see Appendix C on Page 17.

Bitumar, Inc. was also responsible for analyzing samples of the reclaimed material and determining the amount of emulsion required to produce a quality mix. Project personnel were informed by Bitumar that the introduction of approximately 5.5 gallons of emulsion per ton of screened grindings would produce a desirable mix. Using the given production rate of the mixer and the emulsion requirement, it was concluded that the emulsion would be introduced into the trailer at a rate of 23 gallons per minute. Once the portable plant was properly adjusted, mixing and loading of material began.

A front end loader was used to keep the hopper of the mixing trailer supplied with grindings. On the first day of operation, the loader operator experienced a small degree of difficulty loosening and digging into the stockpiled grindings, making it hard for him to keep up with the demand for material in the hopper. This problem was overcome by using a bulldozer to push material off the top of the stockpile, making a constant supply of free flowing material for the loader to introduce into the hopper.

Processing of material through the mixer took 15-20 seconds. Emulsion was introduced to the mix at the entrance of the pugmill. Actual mixing time of the material was 1-2 seconds. The resulting mix appeared to have good consistancy.

Portable Mixer In Operation

Recycled material was hauled to the project by Agency of Transportation forces. Haul distance from the stockpile to the project site was 8 miles. At the project, the recycled mix was dumped directly into a Cedar Rapids Vibratory

Screed paver rented from the F. W. Whitcomb Construction Corporation of N. Walpole, N. H. Placement of recycled mix began in the town of Williston on the southbound lane at milemarker location 1.95 and proceeded southerly towards the town of St. George. The mix was placed 11' wide and approximately 1½" deep. All paving was done in a southerly direction and paving was conducted so that at the end of a work day an entire section of roadway (both lanes) was complete.

During the hauling and dumping of mix into the hopper of the paver, it was noticed that the coarse material in the mix had a tendency to segregate to the sides of the truck and paver. This resulted in patches of coarse pavement at the stop and start points of each truck load of mix. It was especially noticeable if the flow of material from the trucks was interrupted and the paver completely emptied its hopper.

Another problem which plagued the project was the build-up of recycled mix on the vibrating screed. This caused numerous tears and drag marks in the pavement mat. There were several possible reasons for this

Drag Marks Caused by Build-Up of Material On Screed

happening. One of the reasons was that the mix would cling to and build up on areas of the screed. On occasions, it would get so bad the paver operator would have to pick up, move ahead, and physically scrape the material from the bottom of the screed. Some project personnel felt the build-up was caused by the rubber obtained with the reclaimed material. Another strong possibility for the build-up was the failure to apply heat to the screed. During the times when the pavers' burner was working, build-up on the screed and dragging of mix was minimized. Another possibility for the dragging was that the majority of the roadway's cross-section was considerably deformed and the 1½" paving depth was not adequate to allow for all these deformities. Crowned areas and/or the areas between wheel paths were high enough to cause the coarse material in the mix to be wedged between the roadway and the screed. Occasionally there were small areas which received no mix at all. Increasing the recycled pavement mat depth or adequately leveling the surface prior to paving could have eliminated this problem. Open areas were filled with shoveled mix from the paver by project personnel.

Filling Drag Marks

Once placed, the recycled mix was rolled with a 10-14 ton dual axle tandom steel wheeled roller. All areas of pavement received two passes of the roller. There was a slight amount of shoving and movement of the mix as the rolling operation was performed. On the fourth day of the project, it was felt the shoving was excessive, so a 3-5 ton and a 6-8 ton dual axle tandom steel wheeled roller were tried. Later in that day, it was decided to return to using the 10-14 ton roller. There were indentations in the new surface where the roller or trucks were stationary for any period of time.

During the first hours of placement of recycled mix, it was determined necessary to sand the pavement surface. Vehicles' tires traveling over freshly placed material without the sand adhered and pulled material from the new pavement mat, initiating areas of raveling. The sand prevented this and seemed to accelerate the initial curing of the mix.

Sanding

Once sanded, traffic was immediately allowed to travel on the new surface, causing a slight amount of initial rutting in the wheel paths. It was most noticeable in areas where traffic had to brake hard or corner sharply.

Throughout the paving operation, samples of the recycled mix were taken and tested for gradation and asphalt content. For results of the testing, see Appendix D, Page 18.

The average daily placement of the recycled mix was 8380 square yards at an average depth of 1.6". This is equivalent to 3430 lineal feet of 22' width of roadway per day. A total of 20,820 gallons of CSS-2 emulsion were used to produce approximately 3764 tons of mix. For a breakdown of daily production rates, see Appendix C on Page 17.

An additional section of roadway on the north end of the project was treated with a 1 inch wearing coarse of Type III bituminous concrete pavement and was considered as a possible control for comparison with the recycled pavement. Due to the fact that the control portion of roadway was reconstructed recently and in better condition than the recycled portion of roadway it was determined that the recycled mix would be judged mainly on its own performance.

SEAL COAT

An emulsion seal was applied to the recycled cold mix surface on September 9th and 10th, 1981, 40 days after placement of recycled mix. A CRS-2 emulsion was applied as a rate of 0.35 gallons per square yard by Gorman Bros., Inc. of Albany, New York. Emulsion used the first day was manufactured by Mohawk Asphalt, Amsterdam, New York and the second day's emulsion was produced by Chevron Asphalt, Albany, New York. The 3/4" cover stone used for the seal coat was from F. W. Whitcomb quarry in

Colchester, Vermont. Cover stone was applied at an average rate of 20 pounds per square yard.

Application of the seal started on the north end of the project in the town of Williston. A total of 1.77 miles of roadway were completed on the first day. Weather during the first day of sealing was cool (50°F-60°F) and damp. The roadway had numerous wet areas. The aggregate averaged 3% moisture content. Temperatures during the second day were cold (40°F-50°F) and it was very windy. Moisture content of the aggregate averaged 1.5%. The emulsion was applied at temperatures ranging from 145° to 165°F during application. SAmples were taken of both the emulsion and the cover aggregate. For the results and type of tests run on these items, see Appendix E on Page 19.

Frequently the application of stone and rolling of the treatment lagged a considerable distance behind the asphalt distributor truck. Traffic was allowed to travel on the freshly completed surface treatment. On the second day of application, stones were observed being dislodged by traffic.

The last 1,000 feet of recycled pavement on the south end of the project was not treated. A total of 3.71 miles of roadway was treated, requiring the use of 16,005 gallons of emulsion and 476.3 tons of aggregate.

POST CONSTRUCTION OBSERVATIONS

Observations made during the days following placement of the recycled mix indicated that the stability developed slowly. It took two to four days to obtain stability enough so the mix would not compress or shove under heel pressure. This did not appear to have a detrimental effect on the roadway surface other than a slight amount of rutting in the wheel paths. There was no indication of raveling of material other than a few small areas on the edge of the pavement which were the result of traffic travel on the recycled mix just after placement.

Prior to application of the chip seal, the roadway surface was examined for cracking, rutting and friction value. There was no cracking but there was a slight amount of rutting in the wheel paths ranging from 0-1/4". Friction testing done at 40 mph in accordance with ASTM test method E274-79 resulted in an average SN 40 value of 42.2, a value similar to that obtained on typical new dense graded bituminous concrete pavements.

COST ANALYSIS

The cost of placing the cold mix was $47,158 or $0.94 per square yard, which includes the cost for screening reclaimed material, producing mix, placing, labor, hauling, rolling, and sanding. The chip seal, with all cost incurred, added $21,814 or $0.43 per square yard to the cost. The total cost of the finished surface treatment was $68,972 or $1.37 per square yard.

In lieu of the experimental cold mix, a new layer of 1" bituminous concrete most likely would have been used. Estimated total cost of such a treatment, at the time the project was done, was $90,604 or $1.80 per square yard. This would have increased cost by $21,632 or 31.4%. For a breakdown of cost, see Appendix F, Page 20.

CONSERVATION OF ENERGY AND NATURAL RESOURCES

The amount of energy used for the production and placement of the finished cold mix-chip seal surface was considerably less than that required to produce and place 1" of conventional bituminous concrete. It was estimated that a 1" bituminous surface would have used 2380 additional Btu per square yard, or a total of 119 million Btu over the treatment used. The majority of energy saved would have been used in the production of virgin aggregates, increased asphalt usage and heating of materials to higher temperatures. For energy figures, see Appendix G, Page 21.

Not only did the use of the cold recycled mix save large amounts of energy, but it also conserved sizeable quantities of natural resources (2146 tons of virgin aggregate and 76 tons of new asphalt).

SUMMARY

A 3.90 mile section of Vermont 2A in the towns of St. George and Williston was paved with a cold recycled bituminous mix. The surface prior to treatment, had an average of 177' of cracking per 100 feet of roadway, rutting as much as 1 11/16 inches, and roughness numbers well over 100 inches. The roadway's ADT was 2400, of which 14.8% was truck traffic.

The surface was covered with 1.6 inches of cold recycled bituminous mixture. The mix consisted of a five year old bituminous concrete and rubber slurry removed from Interstate 89, screened and then blended in a portable pug mill with a CSS-2 emulsion at a rate of 5.5 gallons per ton.

Placement of the cold mix onto the roadway was done with a conventional vibratory screed paver, followed by a 10-14 ton dual axle tandom steel wheeled roller. It took six work days, at an average daily rate of 8380 square yards per day, and a total of 3764 tons of cold mix, to pave the 3.90 mile section of roadway. The paving operation experienced problems with rubber material or cold mix sticking to the screed of the paver, causing drag marks in the pavement.

Some 40 days after placement of the recycled mix, the surface was sealed, using a CRS-2 emulsion applied at a rate of 0.35 gallons per square yard and covered with a 3/8" stone. There was adverse weather conditions during the second day of chip seal application. Total cost for the cold mix and the chip seal was $68,972 or $1.37 per square yard.

Energy saved by using the cold mix and chip seal in lieu of a 1 inch bituminous concrete surface was 119 million Btu and natural resources conserved were in the form of 2146 tons of virgin aggregate and 76 tons of asphalt. Estimates indicate that new material would have cost $21,633 or 31.4% more.

RECOMMENDATIONS

Based upon the present results of this project, the use of cold recycled bituminous mix should be used whenever practical. The following items should be taken into consideration with the undertaking of another project:

The road to be treated should not have too high an A.D.T. or percentage truck traffic.

Time period between placement of recycled cold mix and application of chip seal should be lengthy enough to insure proper curing of cold mix.

Consider the use of a traveling pug mill-paver in place of the separate pug mill and paver units for possible time, labor and cost savings.

FOLLOW-UP

Surveillance will continue on this experimental project. Follow-ups to this report will be in the form of addendums and/or a final report which shall include recommendations for use in developing future recycling projects of this type.

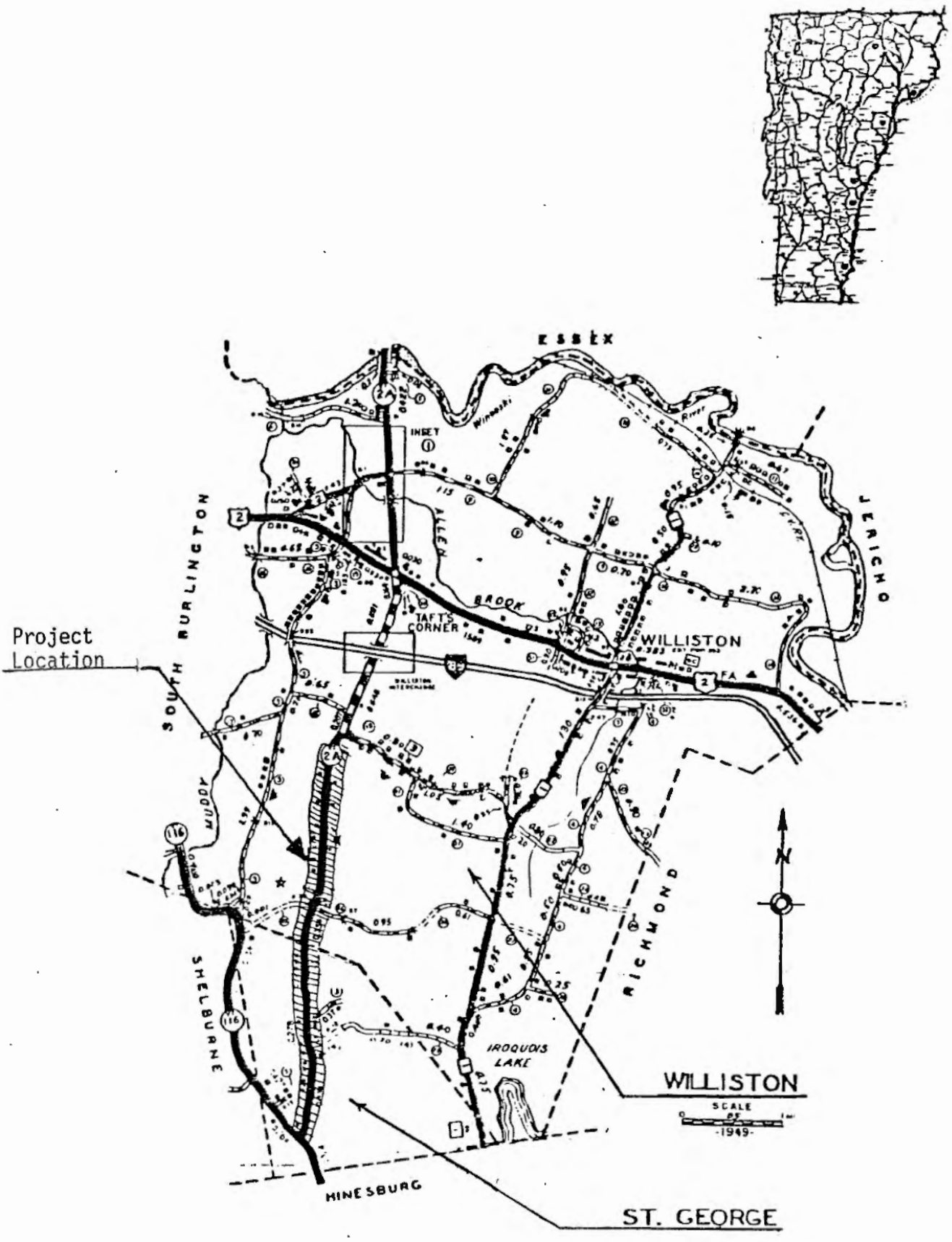

Figure I

Project Location - Vt. Rte. 2A in Chittenden County

RECLAIMED MATERIAL
GRADATION & ASPHALT CONTENT

GRADATION % PASSING							
Sample		PRELIMINARY 1	PRELIMINARY 2	JOB SAMPLES 1	JOB SAMPLES 2	JOB SAMPLES 3	
Date Sampled		7/17/81	7/20/81	7/24/81	7/30/81	7/31/81	Avg.
	3/4			100	100		100
	1/2	100	100	99	99	100	99.6
	3/8	90	93	89	91	96	91.8
	4	75	83	64	71	80	74.6
	8	48	62	48	56	63	55.4
	16	26	38	37	43	48	38.4
	30	12	18	29	32	36	25.4
	50	5	7	20	23	25	16.0
	200	2	3	8	9	10	6.4

Asphalt Content %	-	6.8	5.4	5.5	5.9

Penetration Value of Recovered Asphalt	-	51	45	32	43

TEMPERATURES

Date	Ambient	Reclaimed Material Stockpile	Emulsion	Bituminous Mix	Moisture Content of Stockpile, %
July 23	60°-80°	75°	160°	76°-78°	4.6
July 24	58°-82°	78°	155°	80°	4.5
July 27	77°-80°	75°	144°	78°	4.4
July 28	65°-75°	77°	138°	79°	4.0
July 30	65°-80°	68°	152°	73°	5.8*
July 31	60°-75°	70°	135°	72°	4.6

*Stockpile was subject to heavy rain on preceeding day.

PRODUCTION RATES & MATERIAL USAGE

Date	Sq. Yds. Paved	Mile Marker Locations EB Lane	WB Lane	Gals. Emulsion Used	Tons of Mix	Thickness Paved (Depth)
7/23	7100	0192-0137	0192-0137	2075	377	1.5
7/24	8775	0137-0072	0137-0066	3240	589	1.4
7/27	7230	0072-0013	0066-0013	3180	578	1.6
7/28	7842	0013-0143	0013-0158	3970	700	1.8
7/30	10841	0143-0058	0158-0075	4635	843	1.6
7/31	8583	0058-0000	0075-0000	3720	677	1.6

COLD RECYCLED MIX

GRADATION % PASSING							
Sample #		1	2	3	4	5	
Date Sampled		7/23/81	7/24/81	7/27/81	7/28/81	8/4/81	Avg.
Sieve Size	3/4	100	100	100	100		100
	1/2	98.5	98.7	96.6	100	100	98.8
	3/8	93.1	90.5	80.3	90.3	93.1	89.5
	4	75.0	69.2	55.4	64.7	72.4	67.3
	8	57.7	52.6	43.8	49.4	53.7	51.4
	16	43.6	40.1	34.9	38.5	40.4	39.5
	30	32.9	30.5	27.0	29.5	30.8	30.1
	50	23.1	21.6	18.8	20.4	21.7	21.1
	200	8.5	8.2	7.0	7.1	7.8	7.7
Asphalt Content %		7.4	8.2	6.9	6.9	8.2	7.5

CHIP SEAL EMULSION AND COVER STONE TEST

CRS-2 EMULSION

Sample	Sample From	Saybolt-Furol Viscosity @ 122°F (50°C)	% Residue By Distillation	Penetration of Residue
1	Distributor Truck #1 Chevron	119	73	131
2	Tanker - Chevron	149	72	160
3	Tanker - Mohawk	122	73	122
4	Distributor Truck #2 Mohawk	*61	72	116

*Failed to meet minimum Saybolt Furol Viscosity of 100.

3/8 COVER STONE

Sieve Size	Percent Passing	
	Sample #1 9/9	Sample #2 9/10
1/2	-	100
3/8	100	99.7
4	24.1	21.6
8	0.3	0.6
Moisture Content	3%	1.5%

COST COMPARISON

COLD MIX

SCREENING @ $1.55/ton X 3784 TON		$ 5,865
CSS-2 EMULSION, 20826 GALS @ $1.182/GAL. AVG. (INCLUDES USE OF PORTABLE MIXING PLANT & OPERATOR)	=	$24,616
SAND, TRUCKING COST, PAVER RENTAL, LABOR, ROLLERS, BULLDOZER, LOADER, MISC.	=	$16,678
TOTAL FOR COLD MIX		$47,158

CHIP SEAL

		$0.94/sy
CRS-2 EMULSION 16005 GAL. @ $1.0975/GAL.	=	$17,566
STONE 476.3 TONS @ $4.60/TON	=	$ 2,194
LABOR COST FOR CHIP SEAL	=	$ 2,054
		$21,814
		$0.43/sy
TOTAL COST FOR SURFACE	=	$68,972
or		$1.37/sy

STANDARD TREATMENT (1" BITUMINOUS CONCRETE)

726 TONS/MILE X(3.90 MILES) X $32.00/TON PLACED*	=	$90,605
or		$1.80/sy

*INCLUDES LABOR, TRUCKING, ROLLING, AND MISC.

ENERGY USAGE

*COLD MIX		Btu/ton
EMULSION	5.5 GALS./TON (1980/gal.)	10,890
PORTABLE MIXER & OPERATIONS		6,630
SCREEN GRINDINGS		15,000
		32,520 Btu/ton

3784 ton cold mix used X 32,520 Btu/ton = 1.2305568×10^8 Btu

			Btu/sy
EMULSION	.35 GA.S/sy X 2100 Btu/gal.	=	735
STONE	0.01 ton X 70,000 Btu/ton.	=	700
HAUL	0.01 ton X 18 miles X 3800 Btu/ton	=	684
DISTRIBUTOR	144 Btu/gal. X .35 gal/sy	=	50
SPREAD & ROLL COVER STONE		=	99
			2268 Btu/ton

50336 sy X 2268 Btu/ton = 1.1416204×10^8 Btu

TOTAL FOR TREATMENT = 2.3721772×10^8 Btu

OR 4712 Btu/sy

*STANDARD TREATMENT

*126090 Btu/ton X 3.90 miles X 726 ton/mile =

TOTAL FOR TREATMENT = 3.5701122×10^8 Btu

OR 7092 Btu/sy

*HAUL AND PLACEMENT ENERGY USEAGE CONSIDERED EQUAL FOR COLD MIX AND STANDARD TREATMENT

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

WORK PLAN FOR
CATEGORY III EXPERIMENTAL PROJECT

RECYCLING ASPHALT PAVEMENTS
(REGION 15-DEMONSTRATION PROJECT NO. 39)
WORK PLAN 81-R-5

OBJECTIVE OF EXPERIMENT

To utilize 2000 cubic yards of existing bituminous pavement as an emulsion cold mix pavement course and to compare the performance, cost, and energy requirements of this recycling method with that of a standard pavement overlay.

PROJECT

St. George - Williston HMA 2108

PROJECT LOCATION

On Vermont Rte 2-A beginning at the intersection of Vermont Rte 16 in St. George and extending northerly 4.83 miles to the I89 Interchange in Williston.

CONSTRUCTION PROCEDURE TO BE USED

The construction procedure shall include the following steps:

1. The stockpiled bituminous pavement shall be sized as necessary to produce a gradation with a maximum size of one inch.
2. The moisture content of the sized material shall be brought within the desired level.
3. The material shall be passed through a pug mill which will add a specified type and amount of emulsified asphalt.
4. The cold bituminous mix shall be hauled to the project location and placed with a standard paver.
5. The course of recycled cold mix shall be overlaid with a thin course of bituminous pavement or an emulsion chip seal.

INVESTIGATION PROCEDURE

The investigation will include the following steps:

1. Analyze samples of the pavement to be utilized to determine the properties of the recovered materials.
2. Determine the type and amount of asphalt emulsion and moisture required to produce a satisfactory cold mix pavement.
3. Visually inspect and document the conditions of the pavement to be overlaid.
4. Observe the recycling process and document pertinent information on the equipment used, production rates, problems which occur, compaction effort required and achieved, weather conditions, and other related information.
5. Document field tests taken during the construction of the project and obtain core samples of the recycled pavement for lab analysis.
6. Determine if the recycling process provides significant environmental benefits such as elimination of disposal problems, conservation of quality aggregates, etc.
7. Compare differences in energy consumption between the recycle procedure and that of a standard pavement overlay.
8. Compare the cost of the recycled pavement with that of the standard pavement overlay section.
9. Compare the performance of the recycled pavement with that of the standard pavement overlay section.

CONTROL SECTION

A portion of roadway approximately 0.5 mile in length shall be included as a control section. The control treatment shall include a 1/2 inch leveling course and a 1 inch wearing course. Sufficient data will be gathered on the control section to make the desired comparisons with the recycled pavement section.

COST

The estimated cost for the experimental treatment is $24.60 per ton in place. The cost includes all labor, equipment and materials required to crush the old pavement, add emulsion, haul, and place the recycled cold mix.

The estimated cost for the standard overlay to be placed on the control section is $32.10 per ton in place.

DATE OF CONSTRUCTION

The experimental project shall be completed prior to October 1, 1981.

DURATION OF STUDY

The experimental project will be evaluated for a minimum of three years following completion of construction.

SURVEILLANCE

The experimental and control treatments shall be monitored during construction and at least once each winter and spring for the duration of the study. Evaluations shall include documentation of the condition of both experimental and control treatments.

REPORTS

An initial report covering the basic data collected, construction experiences, test results and initial observations shall be submitted within 90 days after project completion. Interim reports shall be made on an annual basis. A final report shall include recommendations for use in developing future recycling projects of this type.

Materials & Research Division
Agency of Transportation
March 20, 1981

Reviewed by:

R. F. Nicholson

R. F. Nicholson, P.E.
Materials & Research Engineer

Date: March 20, 1981