1989 WESTSIDE CHIP SEAL STUDY

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16. ABSTRACT

This report summarizes the results of reviews of chip sealing practices in the state of Washington. Background data is presented regarding the problems encountered in past chip sealing projects. Revised specifications are presented for the application of chip seals in both eastern and western Washington.

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1989 WESTSIDE CHIP SEAL STUDY

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April 1994

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TABLE OF CONTENTS

1989 WESTSIDE CHIP SEAL STUDY

I. BACKGROUND

Approximately 50 percent of the Washington State highway system has a bituminous surface treatment (BST) surface. The vast majority of this mileage is made up of the low volume roads in eastern Washington. The use of BSTs coincides with the 40 percent of the state system that has traffic volumes of 2000 ADT or less.

Although BSTs were widely used in both eastern and western Washington for many years, their use diminished markedly from the mid 1960s through the mid 1980s. During this period, BSTs were all but eliminated in western Washington and severely curtailed in some eastern districts. This was most likely due to improved funding for pavement rehabilitation and inherent problems with BSTs, such as rock[1] loss and windshield damage.

In the early 1980s, the use of chip seals was reconsidered in light of their favorable cost and good performance on low volume roads. At about the same time, a policy letter was issued which indicated that BST was to be considered the pavement surface of choice for all roads with ADTs less than 2000 vehicles per day.

With the renewed use of chip seals, construction problems increased due largely to the loss of experience and knowledge in the chip sealing process. In 1985, District 5 asked the Headquarters Paving and Materials offices to review their 1984 seal in light of the large number of problems encountered.

In response to this request, Newton Jackson and Dennis Jackson reviewed at length the 1984 and 1985 district-wide chip seals placed in Districts 2, 5, and 6. It soon became apparent that BST construction techniques and procedures differed from district to district and even project engineer to project

1. In this report the words "rocks" and "chips" are used interchangeably to refer to aggregates, normally 1/2"-1/4" for coarse aggregate and 1/4"-0 for choke.

engineer. The result was a wide range of quality on the roadway. Some of the most common problems were:

- Flushing
- Windshield damage
- Rock loss
- Excessive rock use

In other words, the reasons for failure ran the gamut from too much oil[2] and not enough rock to the reverse of too much rock and not enough oil.

The field reviews were followed by an extensive literature search and equally extensive discussions with other western states regarding basic chip sealing procedures. This review indicated a clear need to overhaul the BST specifications, push for statewide uniformity of construction inspection procedures, and focus on the following basic guidelines of chip sealing:

1. Use of clean single-sized chips - Our 1/2" to 1/4" rock works well.

2. Aggregate yields should be tightly controlled to minimize waste and windshield damage - The field review indicated rock rates of 35 to 60 pounds per square yard were used where 25 to 30 pounds per square yard is adequate.

3. Asphalt rates should be such that the chips embed about 50 to 70 percent into the asphalt film - For 1/2"-1/4" chips this rate is about .45 gallon per square yard over normal pavement. The field review indicated rates of .25 to .45 gallon per square yard were used with almost all of the lower rates losing aggregate.

4. A choke course of 1/4"-0 helps to complete the agregate matrix and lock down single sized chips when applied immediately after the initial rolling - The field review indicated that choke was used sporadically with mixed results.

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2. In this report the words "oil" and "asphalt" are used interchangeably to refer to emulsified asphalt, normally CRS-2.

5. When emulsified asphalts are used, rolling which embeds chips or lays them on their flat side must occur immediately after aggregate placement - The field review indicated very little information in this area. The Standard Specifications in effect at that time provided no time limit.

6. Brooming should be accomplished as soon as possible after the asphalt has set up - Brooming can usually be accomplished the morning after the shot. The existing specification called for final brooming after five days.

7. Where embedment is low and there are signs of chip loss after brooming, a fog seal of CSS 1 can be used to increase embedment and eliminate or reduce winter rock loss.

In the spring of 1986, these guidelines were reviewed with the project engineers and inspectors assigned to major chip seal projects that summer. Our direction was to implement these guidelines as much as practical on the existing projects. Embedment guidelines for asphalt application rates and pan tests for chip rates were also initiated. Surface treatment design formulas from The Asphalt Institute's Asphalt Emulsion Manual were tried on a few projects with limited success.

As a result of additional field reviews in 1986, discussions with front line inspectors and/or project engineers and a BST wrap-up meeting held in the fall of 1986, the BST specifications were completely revised in early 1987. The specifications changes of major impact are outlined below:

1. Section 5-02.3(3)

   a. Application Rates

      - Asphalt yields were increased.
      - Aggregate yields were decreased.
      - Class D aggregate was specified as 3/8" - #10.
      - A BST preseal was added.

b. Longitudinal joints were limited to:

- Center line of the roadway.
- Center of the driving lanes.
- Edge of the driving lanes.

c. In lieu of repairing joint defects, the engineer, at his option, could deduct $200 for each defective joint.

d. To mitigate asphalt undersprays and gaps, we required that a minimum of 100 gallons of material remain in the distributor at the end of each shot.

e. The maximum allowable time between the placement of asphalt and aggregate was reduced to three minutes.

2. Section 5-02.3(5)

a. All aggregate stockpiles must be watered down to provide uniformly damp material at the time of placement.

b. Rollers

- A minimum of three rollers are required.
- Two pneumatic tired rollers are required for the coarse aggregate.
- The third roller which provides the final rolling shall be a smooth steel wheel for Class A and a pneumatic for all other classes.
- Maximum roller speed was set at 5 mph.

c. The fine aggregate (choke) must be applied with spreading equipment immediately following the initial rolling of the coarse aggregate.

d. Brooming was required before 10 a.m. the following morning.

e. The five-day brooming requirement was deleted.

3. 5-02.3(7)

Provided for a CSS-1 fog seal if necessary. The field personnel were instructed to check the rock embedment into the asphalt and, if the embedment was less than 50 percent or there were signs of rock loss, the fog seal should be ordered.

Newton Jackson of the headquarters Materials Lab, Joe Mahoney from the University of Washington, and Dennis Jackson from the headquarters Paving Office again spent time in the summer of 1987 visiting BST projects throughout the state. The revised specifications were explained to the field people, both state and contractor, along with more emphasis on simple quality control checks like the "pan test" for predicting aggregate yields and embedment checks for monitoring aggregate retention. Another BST wrap-up meeting was held in the fall of 1987. The specifications were fine-tuned as outlined below:

1. Section 5-02.3(1)

Brooms must be motorized with a positive means of controlling vertical pressure.

2. Section 5-02.3(2)A

The need to loosen the upper half inch of material prior to prime coat application was limited to cutback asphalts only.

3. Section 5-02.3(3)

a. Some of the asphalt and aggregate application rate bands were broadened to more accurately reflect actual practice.

b. The maximum allowable time between the placement of asphalt and aggregate was reduced to one minute. However, the Engineer may increase this time if field conditions warrant.

4. Section 5-02.3(5)

a. A second spreader box was required to place fine aggregates.

b. Provides for remobilization of equipment to rebroom areas designated by the Engineer.

5. Section 5-02.3(7)

a. Asphalt for fog seal

- The application rate was decreased.

- Dilution with water is required at the rate of one part water to one part emulsified asphalt.

6. Section 5-02.5

An "Additional Brooming" item was added.

In 1988, the headquarters/district communication continued. Also a video on BST construction and inspection practices was produced and made a part of the Construction Inspection Training Program.

The recent specification changes and central office involvement in the BST process have positively affected the quality of our chip seals. We have also markedly reduced the rock loss and windshield damage on each project. For example, we now document somewhere between 2 and 10 windshield complaints per project. This is contrasted with earlier projects where the number of broken windshields exceeded 200.

II. STUDY ELEMENTS AND PLAN OF ACTION

A primary headquarters/University of Washington chip seal review team was made up of Dennis Jackson, Newt Jackson, and Joe Mahoney. Nine BST projects were targeted for review. These projects, two in District 1, two in District 3, and five in District 4, were constructed in 1987 and 1988. Appendix A contains:

- A map showing the study areas.
- A list of the projects studied.

We collected information three ways:

1. We met with each district staff to discuss their individual experiences with BST projects, both good and bad. The file notes from these meetings are found in Appendix B.

2. A questionnaire was sent to each project engineer involved with the work. The completed questionnaires provided information on shot rates, aggregate yields, equipment used, construction procedures, and all important performance data. Appendix C contains:

    - A copy of the questionnaire.
    - A graph showing aggregate and asphalt emulsion yields.
    - A spreadsheet breakdown of the questionnaire data.

3. In the spring of 1989, each project was field reviewed by at least one member of the study team. In most cases, district construction and/or maintenance people participated in the field reviews. A post construction evaluation form was completed for each project. The field reviews gave us an excellent opportunity to look at past work and think about the future direction of westside chip seals. Appendix D contains:

    - A list of the members of the field review teams.
    - A spreadsheet breakdown of the post construction evaluations.

III. FINDINGS AND CONCLUSIONS

Based on field reviews, discussions with the districts, and analyzing information received, we came to the following conclusions:

1. Flushing

Flushing or fat spots exist when either surplus asphalt migrates over the top of the seal coat aggregates or the aggregates are pushed into existing fatty pavements. In some cases, the seal coat aggregate ravels away from the asphalt, again leaving a flushed surface. Some of the causes of flushing are listed below:

a. Bleed throughs - Existing flushed pavements and cold mix patches have a strong tendency to migrate through chip seals, producing "reflective flushing."

b. Too much oil - If the asphalt application rates are too heavy or a fog seal is used when it is not needed, the seal will flush.

c. Improper construction of transverse joints - If building paper is not used at transverse joints, the joints will oftentimes receive a double application of asphalt, causing almost immediate flushing.

d. Allowing emulsions to break before applying aggregates - Once the emulsions break, aggregate retention is minimal, resulting in areas of uncovered oil and a flushed pavement.

e. Improper crack sealing techniques and/or materials - We saw evidence of previous crack sealed areas bleeding through the seal coats. "Band-aid" type crack seals (those with an excess of material on the pavement) almost always bleed through. Also crack sealing materials that do not meet the ASTM D-1190 requirements of Specifications for Concrete Joint Sealer, Hot Poured Elastic Type, have a tendency to bleed.

Flushing is inherent in the BST process and will never be completely eliminated. However, there are certain things that can be done to mitigate flushing:

a. Prepaving evaluations - By use of the video road logs or preferably field reviews, the existing roadway surface can be evaluated prior to constructing the seal coat. If areas of 1/4 mile or longer are either too rich or too dry, the asphalt shot rates should be adjusted to fit the field conditions. Smaller areas of dry pavement can be corrected by fog sealing prior to placing the normal chip seal.

b. Embedment checks - This simple process should be used several times a day to determine the depth of oil around the rock. We typically look for about 50 percent embedment after initial rolling and about 70 percent after two or more weeks of traffic. The asphalt shot rates should be adjusted to achieve proper embedment.

c. Judicious use of fog seals - The specifications provide for a fog seal if necessary to add additional oil to the system. If a fog seal is applied when not warranted, flushing will follow. Embedment checks should be made to determine the need for a fog seal.

2. Raveling

Raveling is the loss of chips from the seal coat. Chip loss can occur immediately after aggregate placement or, in some cases, months later by snow plow blades. One of the most undesirable effects of raveling is windshield damage. Some of the causes of raveling are listed below:

a. Dry or open pavements - These pavements absorb some of the oil intended for the new seal coat, leaving a shortage of asphalt on the surface to embed the new aggregate.

b. Hotmix patches - Recently laid hotmix patches also readily absorb oil in much the same manner as dry or open pavements.

c. Shaded areas - Rock loss appears to be greater in shaded areas, all other things being equal.

d. Too much aggregate - Aggregates placed more than one chip deep are wasted. Worse yet, most of the excess chips will leave the roadway taking some asphalt with them. Further, the excess chips break windshields.

e. Aggregate too wet or dirty - Aggregates containing either more than 1 percent 200 material or too much moisture will not be properly bound by the asphalt emulsion.

f. Allowing emulsions to break before applying aggregates - Once the emulsion breaks, aggregate retention is minimal, resulting in both excessive raveling and windshield damage.

g. Late season work - Any BST work performed after August 15 will have a strong potential for raveling and early failure. Late season work does not provide for adequate cure and embedment of the BST system. Our field reviews substantiated this. The projects with the lowest ratings were constructed after August 15.

The following steps can be taken to mitigate raveling:

a. Use of preseals - Preseals should be constructed prior to placement of the seal coat over existing pavements that are dry, cracked, open, or have had recent hotmix patches.

b. Embedment checks - See discussion under "Flushing."

c. Prepaving evaluations - See discussion under "Flushing." Also, the shot rates should be increased in heavily shaded areas.

d. Aggregate and asphalt rates - The initial aggregate yield can be determined by laying the aggregate one stone deep in a baking pan and calculating a pound per square yard yield. Field embedment checks should be used to verify and/or adjust asphalt application rates.

e. Judicious use of fog seals - See discussion under "Flushing."

f. Timely application of aggregate. The area covered by a spread of asphalt must be covered with aggregate before the emulsion breaks. The Standard Specifications now state, "within one minute."

g. Timing of contracts. BST work should be performed between May 15 and August 15. We have had poor success with late season work. Strong consideration should be given to establishing a cutoff date for advertising BST projects, something like "no later than March 1." This would accomplish the following:

- Provide lead time for crushing to ensure that all BST work is completed on August 15.

- Allow successful bidders to schedule their state and county work in a rational manner.

- Reduce the raveling and early failure problems that are often associated with late season work.

3. Political Pressure and Public Relations

The BST process, with its associated traffic delays, dust, flying rocks, windshield damage, flushing and raveling is an inconvenience to the traveling public which can become an administrative nightmare. Also, bicyclists have complained of the rough ride BST presents. It is interesting to note that of all the projects studied by the review team, the project which suffered the most negative public criticism, SR 532

near Stanwood, was one of the better constructed. We can improve the public image of BST projects by:

a. Cutting down on dust - A 3/8"-#10 material can be used for choke in lieu of the currently specified 1/4"-0. This clean material will virtually eliminate the dust problem.

b. Using Class D seals on routes with heavy bicycle traffic - Class D seals, which are constructed with 3/8"-#10 aggregate, provide a smoother, more uniform surface than the standard Class C seal. The result would be a more pleasant ride for bicyclists.

c. Use of polymers for better aggregate retention - We are now specifying polymers for all westside chip seal work and should continue to do so. Our experience to date shows polymers offer the following advantages over normal emulsions:

- Less windshield damage.
- Better aggregate adhesion.
- Less rock loss due to brooming.
- Open to traffic earlier.
- Seals alligatored areas.
- Fills and bonds thermal cracks.
- Tends to deice itself.

d. Enhancing traffic control - It is important to keep traffic flowing and disruptions to a minimum. Better enforcement (possibly hiring off-duty law enforcement people) will keep motorists from "running" the flagging stops. Also, the hours and days of work in areas of high peak hour traffic or weekend recreational use should be restricted by special provision.

4. Impacts of Traffic and Trucks

Generally, more construction quality, windshield damage, and public regulation problems were evident on the routes with high average daily

traffic counts (ADTs) and/or truck percentages. To make our BST program more cost effective and palatable to the traveling public, we should be considering other methods of system preservation when the ADT exceeds 5,000 and/or the truck percentage exceeds 15 without regard to the ADT level.

5. **Inspection Procedures**

Skilled and experienced inspectors are a key element in a quality BST program. Listed below are some things that can be done to keep the quality of our BST inspection at a high level:

- Consider using maintenance people who have extensive experience placing BST as inspectors on chip seal projects.
- Provide inexperienced project people with preconstruction training.
- Provide someone with extensive chip seal experience to work with the inexperienced crews the first day or two of chip seal construction.
- Continue with central office support and review of the BST program.
- Continue with the BST module in the Construction Inspection Training Program.
- Westside construction inspection trainers may need to gain more hands-on experience with chip seals.

IV. RECOMMENDATIONS

The conclusion of the chip seal review team is that BST construction is a cost effective, viable method of system preservation. The chip seal program should continue in western Washington at about its current level. We should

see improvements to both equipment and personnel training as the contractors gain more experience and the BST program continues on the westside. Also, WSDOT inspectors are becoming more proficient and are able to identify and correct substandard construction practices and equipment.

As part of our ongoing effort to improve the quality of the BST product, we present the following recommendations:

1. Continue using polymerized emulsions for all westside seal coat work.

2. Continue strong central office support and review of the BST program.

3. Consider using maintenance people with strong BST experience as chip seal inspectors.

4. Consider establishing March 1 as cut-off date for advertising BST projects.

5. Consider using a clean 3/8"-#10 aggregate for choke in areas where dust will be a problem.

6. Consider using Class D seals in areas of heavy bicycle traffic to provide a smoother, more uniform surface.

7. Consider using system preservation methods other than BST on sections that can be considered high risk from a traffic standpoint, particularly where there is no diversion route. High risk level seems to be ADTs in excess of 5,000 and/or truck percentages greater than 15 percent without regard to the ADT level. WSDOT, in concert with the asphalt cement and asphalt paving industries, is working on an intermediate treatment (somewhere between ACP Class G and BST) which uses softer base asphalts with polymers and is placed with conventional paving equipment. This innovative thinking should be encouraged.

8. The following revisions will be made to Section 5-02 of the Standard Specifications:

a. Section 5-02.3(2)B Treated Surfaces

Use Force Account to pay for patching potholes and repairing edge breaks, with premixed BST. The existing method of paying unit contract prices for oil and aggregate does not come close to compensating the contractor for actual costs.

b. Section 5-02.3(5), paragraph six, Application Method of Aggregate.

Change the time between initial rolling and application of choke from "immediately" to five minutes.

c. Section 5-02.3(8) Progress of Work

Eliminate the minimum daily mileage requirement. Temperature and weather conditions effectively control the daily progress of work. Slow contractor progress is no longer a problem.

Based on

- The performance to date of the nine chip seal projects studied
  and
- The anticipated improvements to BST quality that will be brought about by implementation of these recommendations,

we can reasonably predict that chip seals will provide a performance period of at least five years. The seals should therefore be eligible for Federal Aid financing in accordance with the current FHWA Pavement Management and Design Policy (FHPM 6-2-4-1).

Respectfully submitted,

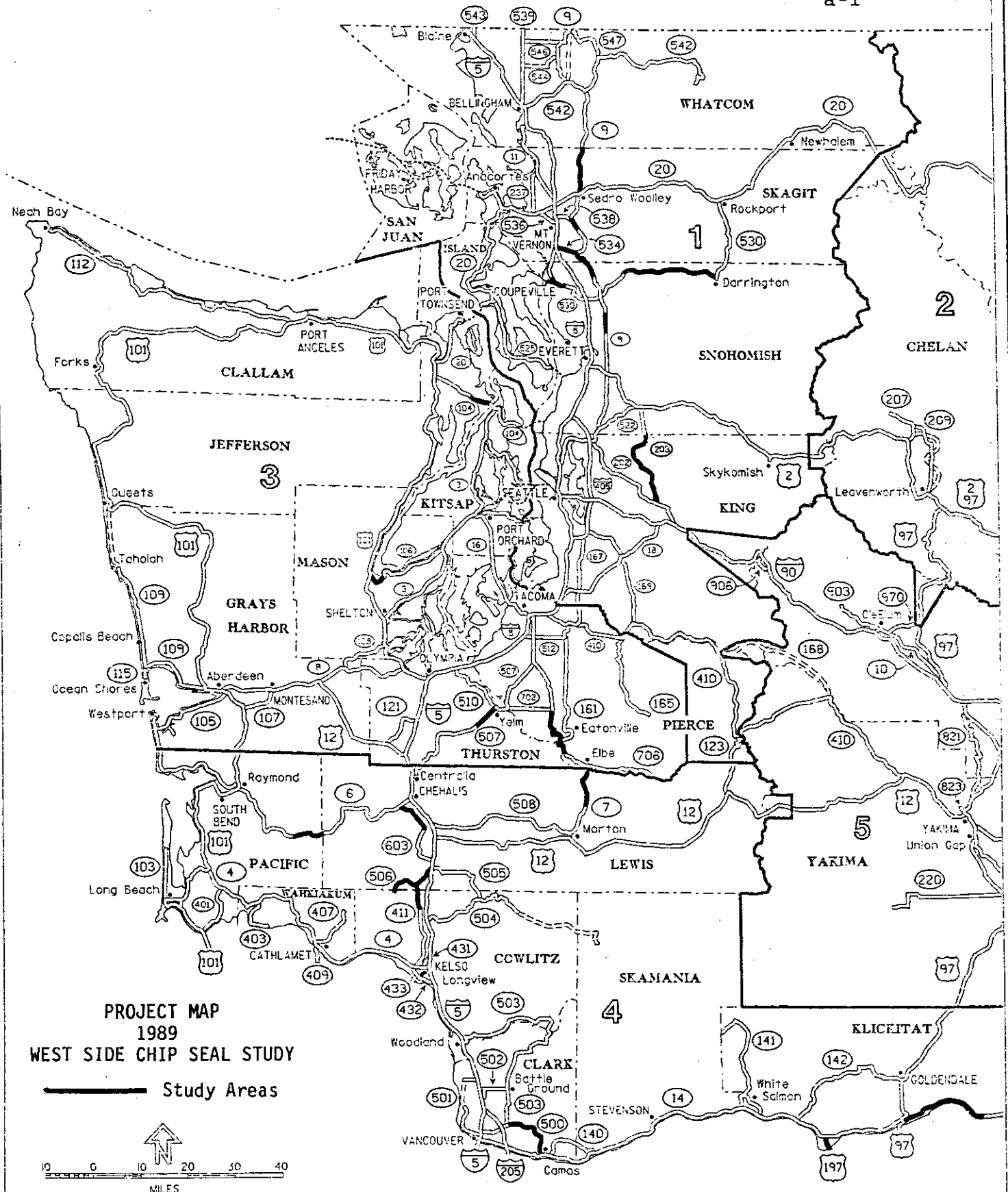
Dennis C. Jackson

Newton Jackson

Joe P. Mahoney

1:PD-43

APPENDICES



PROJECT MAP
1989
WEST SIDE CHIP SEAL STUDY

Study Areas

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
PLANNING, RESEARCH AND PUBLIC TRANSPORTATION
CARTOGRAPHIC SECTION

COMPUTER GENERATED

1989 WESTSIDE CHIP SEAL STUDY

PROJECT LIST

District 1

Contract 3249 SR 532 et al
District 1 Wide Seal - North

Contract 3415 SR 9, 203 and 534
District 1 Chip Seal - 1988

District 3

Contract 3205 SR 106
Skokomish River Bridge 106/2

Contract 3308 SR 101 and 104
SR 101 to Hood Canal Bridge

District 4

Contract 3122 SR 6
Frances to Rock Creek Bridge

Contract 3235 SR 7
MP 6.24 to Pleasant Valley Road

* Contract 3318 SR 7 and 507
Rainier to Yelm and Alder to SR 702

Contract 3444 SR 411 and 506
District 4 Chip Seal North - 1988

Contract 3459 SR 500 et al
District 4 Chip Seal South - 1988

* Contract administered for District 3 by District 4

Washington State Department of Transportation

INTRA-DEPARTMENTAL COMMUNICATION

DATE: March 6, 1989

FROM: D. C. Jackson
PHONE: 234-6006

SUBJECT: 1989 Chip Seal Study

TO: File

A meeting was held in Mr. Bockstruck's office at 9:00 a.m. Thursday, February 16, 1989 to discuss the 1988 Chip Seal Projects in District 1 and give us some points to ponder as we embark upon our study.

The following people were in attendance:

John Stephenson, Dist. 1
Jim Kaska, Dist 1
Gerry Smith, Dist. 1
Tom Brown, Dist. 1
Del Reynolds, Dist 1
Miguel Gavino, Dist 1
Dennis Jackson, HQ
Newt Jackson, HQ

We discussed the following:

1) SR 530 (Contract 3249)

In August and September 1988 (one year after construction) the District began receiving calls complaining of flushing conditions.

Maintenance burned some choke into the areas of bleeding during the month of November 1988. Approximately $60,000 in M-2 monies were spent doing this work.

Condition of roadway before chip seal:

- Rutting in wheel paths.
- Some rich areas, possibly the same spots that flushed.

2) SR 203 (Contract 3415)

Complaints from bicyclists regarding surface texture and narrow width of striped shoulder.

Drivers complained about high noise level.

During the recent snow, a rubber tipped plow blade was worn down after five miles of plowing. (This speaks well for the tenacity of the chip seal.)

3) Things to Consider:

Different shoulder treatment for routes that have shoulder bicycle traffic. It might be possible to consider some sort of post BST Sand Seal.

Better enforcement of traffic control to eliminate motorists going around flaggers. Consider hiring local law enforcement people.

Restrict by special provision the hours and days of work in areas of high recreational use.

Intermediate treatments (somewhere between ACP Class G and BST) in areas of higher ADT. Take a look at AC-5 with polymers.

Maintenance strategies for areas of flushing on SR 530. We should field review the project with Tom Brown of District Maintenance.

Going with a washed 1/4" - #10 aggregate for choke in lieu of the conventional 1/4"-O with 10 percent #200. Also, look at specifying the same 1/4" - #10 material for preseals.

4) Immediate Action Taken:

SR 9 XL - 0013
SR 546 to Johnson Creek Bridge

Because of heavy truck traffic, the surface treatment will be changed from a Class C BST to a modified ACP Class G overlay.

SR 9, et al XL - 0020
District 1 Chip Seal
To cut down on dust, the 1/4"-0 material will be deleted from this project and replaced with 1/4" - #10 material meeting the following spec.:

Passing Sign	Percent Passing
3/8"	100
1/4"	80-100
#10	30-60
#40	0-2
#100	0-1

The meeting was adjourned at 10:15 a.m.

DCJ:tc

cc: Attendees
Joe Mahoney, U of W

Washington State Department of Transportation

INTRA-DEPARTMENTAL COMMUNICATION

DATE: April 10, 1989

FROM: D. C. Jackson
PHONE: 234-6006

SUBJECT: 1989 Chip Seal Study

TO: File

A meeting held in the Chehalis Project Engineer's office at 9:30 a.m. Thursday, April 6, 1989 to discuss the 1987 and 1988 Chip Seal projects in District 4 and give us things to think about as we continue with our study.

The following people were in attendance:

Gerry Edwards, Dist. 4	Jerry Danielson, Dist 4
Frank Boyd, Dist. 4	Dennis Jackson, HQ
Troy Crews, Dist. 4	Newt Jackson, HQ
Royce Walls, Dist. 4	Mark Sehr, FHWA

We discussed the following:

1) Polymers allow earlier brooming, possibly as soon as 6:00 p.m. the day of construction.

2) Brooming after 10:00 a.m. doesn't work in hot weather because of the potential for pick-up and rock turning.

3) Recent changes to section 5-02 and specified asphalts that have positively impacted BST quality:
   - Use of polymers
   - Cutting back aggregate yields
   - Fog sealing as necessary
   - Embedment checks during construction

4) The Contractor's equipment quality and manpower expertise are much less on the westside than the eastside.

   We should see improvements to both equipment and personnel training as the Contractor's gain more experience and the BST program continues on the westside. Also, WSDOT inspectors are becoming more proficient and are able to identify and correct substandard construction practices and equipment.

5) SR 603 (Contract 3444)

The roadway is so narrow in certain areas that the edge striping is sometimes on the unpaved shoulder.

6) SR 7 (Contract 3235)

District Maintenance didn't have enough lead time to repair distressed areas or do any profiling before the Contractor began his Chip Seal operations.

Things to consider:

1) Don't construct BST in urban areas.

2) Section 5-02.3(5), paragraph six, Application Method of Aggregate.

Change the time between initial rolling and application of choke from "Immediately" to a definite time period, say five minutes.

3) Section 5-02.3(8) Progress of Work

Eliminate the minimum daily mileage requirement. Temperature and weather conditions effectively control the daily progress of work. Slow contractor progress is no longer a problem.

4) Keep the total length of westside seal projects shorter than the 100 to 120 mile projects that are commonplace on the eastside. The shorter westside chip seal season should be considered when programming projects. Long projects could be divided into two shorter projects.

5) Section 5-02.3(2)B Treated Surfaces

Considering using Force Account to pay for patching potholes, repairing edge breaks and pre-filling with BST. The existing method of paying with contract prices for oil and aggregate does not come close to compensating the Contractor for actual costs.

6) Strong consideration should be given to establishing cut off dates for advertising BST projects, something like, "No Later Than March 1". This would accomplish the following:
   - Provide lead time for crushing to ensure that all BST work is completed by August 15.
   - Allow the successful bidders to schedule their State and County work in a rational manner.
   - Reduce the aggregate loss and early failure problems that are often associated with late season work.

The meeting was adjourned at 11:15 a.m.

Following the meeting, Newt Jackson, Mark Sehr and I made post construction evaluations of two District 4 projects.

Contract 3122 SR 6
Frances of Rock Creek Bridge

Contract 3444 SR 411, 506 and 603
District 4 Chip Seal North - 1988

Copies of the post construction evaluation reports are attached.

DCJ:tc
Attachment

cc: Attendees
Joe Mahoney, U of W

Washington State Department of Transportation

INTRA-DEPARTMENTAL COMMUNICATION

DATE: April 18, 1989

FROM: D. C. Jackson
PHONE: 234-6006

SUBJECT: 1989 Chip Seal Study

TO: File

A meeting was held in Mr. Darnell's office at 8:00 a.m. Wednesday, April 12, 1989 to discuss the 1987 and 1988 chip seal projects in District 3. This was our final meeting with the westside Districts. District 1 and 4 have already been visited.

The following people were in attendance:

Rich Darnell, Dist. 3	Ned Williams, Dist. 3
Bob Dugan, Dist. 3	Dennis Jackson, HQ
Tom Nelson, Dist. 3	Newt Jackson, HQ

We discussed the following:

1) Chip seals perform well in frosty conditions, requiring less sanding than adjacent hot mix overlays.

2) Thin lifts of ACP Class G over areas of flushing BST will probably show signs of migratory flushing within one year.

3) Chip seals perform much better than ACP Class G over pavements that are starting to show fatigue. Newt is looking at lighter paving grade asphalts such as AC-5 with 2% Alvac. This could give us the best of both worlds. The riding qualities of a machine placed mix, coupled with the performance characteristics of a chip seal.

4) The District had good success with a double shot 1/2" - 1/4" project on SR 112, Joyce to Twin. The project was constructed several years ago.

5) District maintenance uses a double washed 3/8" - #4 aggregate. They have had excellent success with this.

6) The current specs for Bituminous Surface Treatment, section 5-02, work well when followed.

7) SR 7 (Contract 3318)

The long wait between application of oil and placing of aggregate, up to 15 minutes in some cases, caused the oil to run into existing wheel ruts. This in turn was the reason for the majority of the flushing on the project.

8) SR 106 (Contract 3205)

Most of the rock shed on this project was attributed to not presealing the hot mix preleveled areas prior to constructing the chip seal.

Things to consider:

1) Continue specifying polymers in Western Washington.

2) Consider using Maintenance people who have experience placing BST as inspectors on chip seal contracts.

3) Take a look at specifying the following material for choke.

Passing Sieve	Percent Passing
3/8"	100
1/4"	80 - 100
#10	30 - 60
#40	0 - 2
#100	0 - 1

This cleaner material will cut down on dust and associated motorist complaints.

4) Provide inexperienced project offices with pre-construction training and maybe someone with extensive chip seal experience to work with the crew the first day or two of chip seal construction.

5) There have been recent problems with overloaded logging trucks bypassing the WSP scales on SR 101 by diverting onto SR 112. This is playing havoc with the structural integrity of SR 112. Tom Nelson will ask WSP to step up load enforcement on SR 112.

The meeting was adjourned at 9:45 a.m.

Following the meeting, Newt Jackson, Ned Williams and I made post construction evaluations of one District 3 and one District 4 project respectively.

Contract 3318 SR 507 and SR 7
Rainier to Yelm and Alder to SR 702

Contract 3235 SR 7
MP 6.42 to Pleasant Valley Road

On April 13, Newt Jackson and I made a post construction evaluation of the following District 3 project:

Contract 3205 SR 106
Skokomish River Bridge 106/2

Newt Jackson had previously reviewed this District 3 project:

Contract 3308 SR 101 and 104
SR 101 to Hood Canal Bridge

Copies of the post construction evaluation reports are attached.

DCJ:tc
Attachment

cc: Attendees
Joe Mahoney, U of W

Washington State Department of Transportation

INTRA-DEPARTMENTAL COMMUNICATION

DATE: February 17, 1989

FROM: D. C. Jackson
PHONE:

SUBJECT: Chip Seal Study

TO: Del Reynolds, District 1 (MS: 53)
Roger Horton, District 3
Brian Ziegler, District 3
Frank Boyd, District 4
Troy Crews, District 4
Duane Miller, District 4

Newt Jackson, Joe Mahoney, and I are in the process of reviewing the chip seals constructed in Western Washington during the 1987 and 1988 construction seasons. The process will consist of field reviews of each project with you and/or your project inspector, discussions with you and your district staffs, and a recap of the project records. To that end, I have listed some information I would like you to complete. It would help me out if you could take a few minutes to answer these questions.

I. PROJECT INFORMATION

Contract No. _____ SR No(s). ____ ____ ____ ____

Description _____

_____

Sections: (1) _____

(2) _____

(3) _____

(4) _____

Type(s) and Supplier of Oil

(1) _____

(2) _____

(3) _____

(4) _____

Cost of Oil ($/Ton)

(1) _____ (2) _____ (3) _____ (4) _____

Oil Yield (Gal/Sq Yd)

(1) _____ (2) _____ (3) _____ (4) _____

Size of Aggregate

(1) _____ (2) _____ (3) _____

Cost of Aggregate ($/Cy Yd)

(1) _____ (2) _____ (3) _____

Aggregate Yield (Lb/Sq Yd)

(1) _____ (2) _____ (3) _____

Traffic Data

(1) SR _____ ADT _____ % Trucks _____

(2) SR _____ ADT _____ % Trucks _____

(3) SR _____ ADT _____ % Trucks _____

(4) SR _____ ADT _____ % Trucks _____

II. CONSTRUCTION INFORMATION

A. Equipment Used

Distributor(s)

(1) _____

(2) _____

Spreader Boxes

(1) _____

(2) _____

Rollers

(1) _____

(2) _____

(3) _____

B. Was Choke Used? Yes _____ No _____

If yes,

(1) How was it placed? _____

(2) How much time elapsed from placement of aggregate to placement of choke?

_____

(3) Was aggregate rolled before placement of choke?

Yes _____ No _____

C. What was the maximum time lapse between oil and aggregate placement?

_____

D. Weather Conditions

First Construction Season:

From _____ _____ _____ To _____ _____ _____
(Month) (Day) (Year) (Month) (Day) (Year)

Maximum air temp during construction _____ Minimum temp _____

Did it rain within 24 hours of construction?

Yes _____ No _____

If yes, where?

SR _____: MP _____ to MP _____

SR _____: MP _____ to MP _____

SR _____: MP _____ to MP _____

Second Construction Season (if applicable):

From _____ _____ _____ To _____ _____ _____
(Month) (Day) (Year) (Month) (Day) (Year)

Maximum air temp during construction _____ Minimum temp _____

Did it rain within 24 hours of construction?

Yes _____ No _____

If yes, where?

SR _____: MP _____ to MP _____

SR _____: MP _____ to MP _____

SR _____: MP _____ to MP _____

E. Was a fog seal placed? Yes _____ No _____

F. Were any problems encountered during construction?

Yes _____ No _____

If yes, please explain:

_____

_____

_____

_____

_____

G. Were oil and rock application rates adjusted to fit field conditions?

Yes _____ No _____

If yes, how?

___ Review of video logs

___ Field review of pavement conditions

___ Other (please specify) _____

_____

H. Did you run the "pan test" for aggregate yield prior to start?

Yes _____ No _____

I. Did you check aggregate embedment and adjust oil shot rates accordingly?

Yes _____ No _____

If yes, how often? _____

J. How long did you pilot traffic? _____ hours

K. When did you sweep?

_____

_____

III. PERFORMANCE

A. Windshield Damage

- Approximately how many complaints did you have? _____
- Is this greater _____ or fewer _____ than recent years?

  How much? _____

B. Law Enforcement Concerns During Construction

- Were there any? Yes _____ No _____

  If yes, what were the concerns?

  _____

  _____

C. Citizen Concerns

- What type of negative citizen input did you have during construction?

  (1) _____

  (2) _____

  (3) _____

- What type of citizen input (positive and negative) have you had relating to long-term performance?

  (1) _____

  (2) _____

  (3) _____

D. Maintenance Costs

Please list any maintenance repairs by MP, type of repair, and estimated cost. If possible, please include reasons for chip seal failure.

(1) _____

_____

_____

(2) _____

_____

_____

(3) _____

_____

_____

E. We have recently begun specifying polymer additives to our seal coat emulsions. Have you used polymers?

Yes _____ No _____

If yes, please continue answering questions. If no, please skip to Question V.

F. Please discuss the immediate advantages of polymers (i.e., better stick, less rock movement, etc.).

_____

_____

_____

G. Please discuss any immediate disadvantages of polymers.

_____

_____

_____

H. Do you feel that polymers enable you to open the road to traffic sooner, thus saving pilot car and/or flagging costs?

Yes _____ No _____

If yes, how soon did you open to traffic? _____ hours

How much time did you save? _____ hours

I. How long has your polymer seal been down? _____

J. How would you rate the long-term performance of polymers?

Excellent _____ Good _____ Fair _____ Poor _____

IV. Please complete the following matrix. Add any additional elements you feel are appropriate (5 is high, 1 is low).

	Polymer	Normal Emulsion
Ease of Construction	5 4 3 2 1	5 4 3 2 1
Initial Stick	5 4 3 2 1	5 4 3 2 1
Need for Pilot Car or Flagging	5 4 3 2 1	5 4 3 2 1
Rock Embedment	5 4 3 2 1	5 4 3 2 1
Propensity to Flush	5 4 3 2 1	5 4 3 2 1
Susceptibility to Snow Plow Damage	5 4 3 2 1	5 4 3 2 1
Performance After 1 Year	5 4 3 2 1	5 4 3 2 1
Performance After _____ Years	5 4 3 2 1	5 4 3 2 1
Benefit/Cost	5 4 3 2 1	5 4 3 2 1
_____	5 4 3 2 1	5 4 3 2 1
_____	5 4 3 2 1	5 4 3 2 1
_____	5 4 3 2 1	5 4 3 2 1

V. TRAINING

A. Could your crew use more training before constructing another chip seal?

Yes _____ No _____

B. Would it be helpful to have someone with extensive chip seal experience work with your crew the first day or two of chip seal construction?

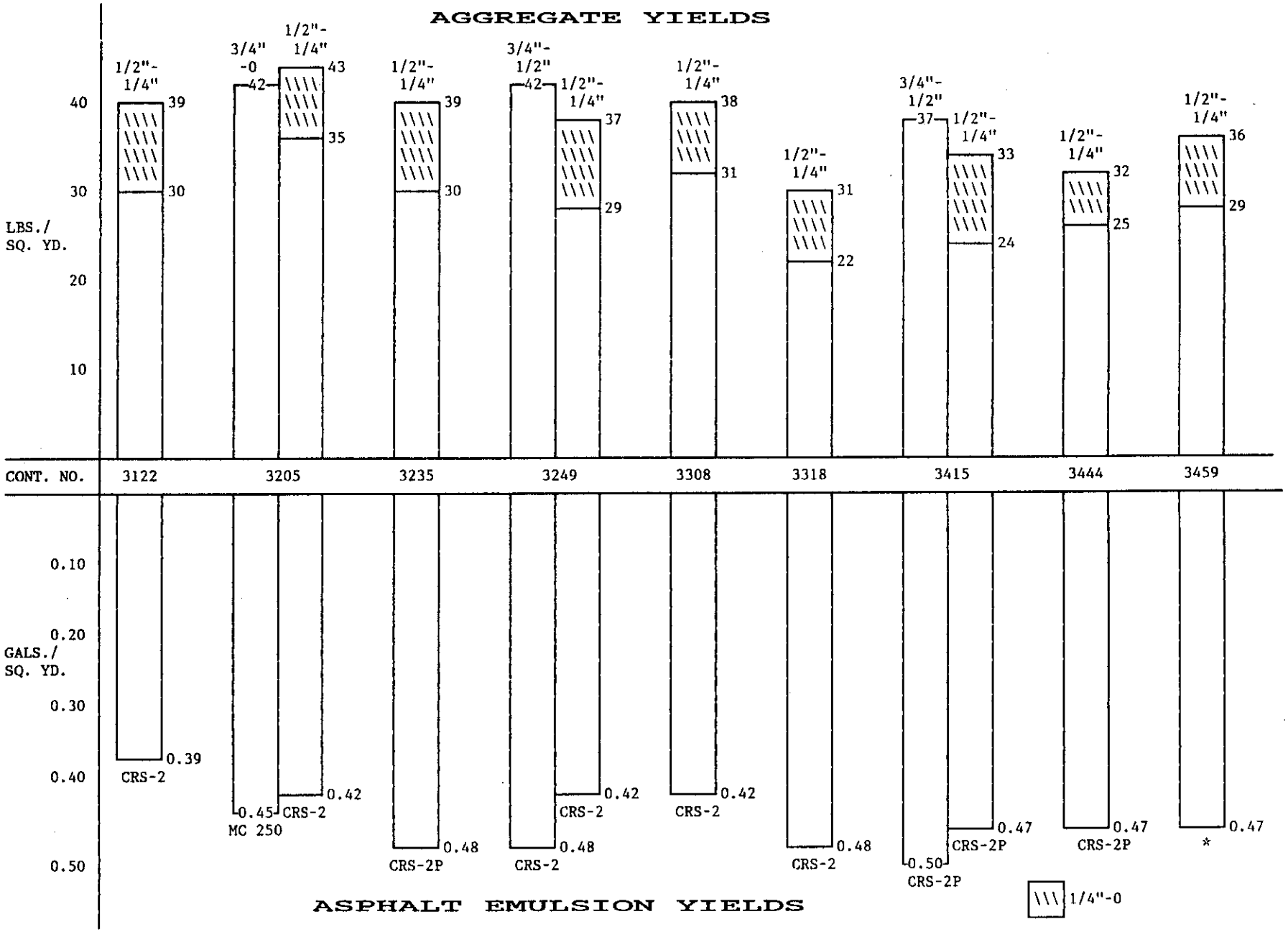
Yes _____ No _____

Thanks for your help. After we complete our review, we will make recommendations regarding the future direction of westside chip seals.

DCJ:14:CO-2
Attachment

1989 WESTSIDE CHIP SEAL STUDY

AGGREGATE YIELDS



ASPHALT EMULSION YIELDS

* CRS-2P USED ON SR 500 (WESTERN WASHINGTON)
CRS-2 USED ON SR 14 AND SR 197 (EASTERN WASHINGTON)

1989 WESTSIDE CHIP SEAL STUDY

FIELD REVIEW TEAMS

January 1989

Contract 3308 SR 101 and 104
SR 101 to Hood Canal Bridge
Jefferson County

Newt Jackson, HQ Mats Lab

April 6, 1989

Contract 3122 SR 6
Frances to Rock Creek Bridge
Pacific and Lewis Counties

Contract 3444 SR 411, 506 and 603
District 4 Chip Seal North - 1988
Lewis and Cowlitz Counties

Dennis Jackson, HQ Plans
Newt Jackson, HQ Mats Lab
Mark Sehr, FHWA

April 12, 1989

Contract 3235 SR 7
MP 6.24 to Pleasant Valley Road
Lewis County

Contract 3318 SR 507 and 7
Rainier to Yelm and Alder to SR 702
Thurston and Pierce Counties

Dennis Jackson, HQ Plans
Newt Jackson, HQ Mats Lab
Ned Williams, Dist. 3 Maintenance

April 13, 1989

Contract 3205 SR 106
Skokomish River Bridge 106/2
Mason County

Dennis Jackson, HQ Plans
Newt Jackson, HQ Mats Lab

April 27, 1989

Contract 3249 SR 532 et al
District 1 Wide Chip Seal - North
Island, Skagit and Snohomish Counties

Dennis Jackson, HQ Plans
Newt Jackson, HQ Mats Lab
Del Reynolds, Dist. 1 Proj. Engr.
Joe Mahoney, Univ. of Washington
Tom Brown, Dist. 1 Construction
Coley Wyckoff, Barr and Associates
Jim Carter, Dist. 1 Maintenance

April 28, 1989

Contract 3415 SR 9, 203 and 534
District 1 Chip Seal - 1988
King, Snohomish and Shagit Counties

Dennis Jackson, HQ Plans
Newt Jackson. HQ Mats Lab
Del Reynolds, Dist. 1 Proj. Engr.
Joe Mahoney, Univ. of Washington
Coley Wyckoff, Barr and Associates
Pat Moyian, Dist. 1 Maintenance

May 31 and June 1, 1989

Contract 3459 SR 500 et al
District 4 Chip Seal South - 1988
Clark and Klickitat Counties

Dennis Jackson, HQ Plans
Newt Jackson, HQ Mats Lab
Duain Miller, Dist. 4 Proj. Engr.