Washington County, Oregon

Department of Land Use and Transportation
Operations and Maintenance Division

Report on Quality Assurance Oversight
In-House Surface and Culvert Projects 2007

Prepared by

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Abstract

The Land Use and Transportation (LUT) Operations and Maintenance Division uses both in-house crews and contractors to maintain roads. This report answers the questions, –Are in-house crews held to the same standards as contractors?"

Executive summary

The Land Use and Transportation (LUT) Operations and Maintenance Division initiated a quality assurance review program in 2007 by contracting with Gerry Douglas Road Management Associates, LLC (RMA) to evaluate three of its more extensive categories of maintenance work: chip sealing, culvert installation, and machine patching.

LUT undertook this project to ensure the work its in-house crew performs meets or exceeds the standards it requires of contractors performing the same work. LUT also wants to ensure its crews comply with Best Management Practices (BMPs) when completing road maintenance work.

Methodology

RMA observed work LUT in-house crews were involved in and completed from July-September 2007. As an observer, RMA made no effort to direct or redirect the work underway, and crews conducted their scheduled work without interference from RMA.

RMA observed and recorded maintenance crews' activities daily while work was in process. RMA made and recorded observations via check sheets that listed industry quality standards for the three types of work mentioned above.

Findings

As a result of this study, RMA believes that except for the noted exceptions, LUT force account work adheres to the same standards as a contracted effort. When RMA's recommendations are evaluated and adopted, LUT can be confident that LUT performs at or above the standards to which contractors are held.

RMA's analysis of observations form the body of this report and support the overall finding that LUT in-house crews are performing at the same standards and providing the same quality of work outside contractors are expected to provide.

The report focuses on areas where process change or improvement can be realized. Equally important to suggestions and recommendations for changes are items rated "satisfactory" on matrixes and check sheet appendixes.

It is no small accomplishment to successfully carry out maintenance programs on a complex road system. The managers, staff, and crew members are all to be commended for the hard work and dedication required to keep Washington County's road system in shape for its citizens.

Recommendations for improvement

Overall, LUT crews performed at or above industry quality standards. However, to ensure an even better program, RMA makes the following recommendations for improvement.

Chip sealing gravel road upgrades

RMA recommends:

- Critical To Quality (CTQ) implementation of an independent liquid asphalt sampling and testing program. Alternatively, require supplier to certify and stamp each load ticket with quality data.
- CTQ implementation of an independent rock sampling and testing program.
- CTQ should ensure enough of the right product is on hand for each job and that extra product is handled in an appropriate manner.
- Consider using a liquid asphalt product other than MC-250 for shooting prime coats on gravel roads. MC-250 is a very expensive product. Several counties that were surveyed in July 2007 have experienced success with CRS2-P, a less expensive asphalt emulsion product.
- Consider using a two-shot system for gravel road upgrades as opposed to the current three-shot system.
- Ensure lead workers are empowered to make decisions in the field related to sanding chip seals that are picking.
- Review flagging effort and consider using fewer, more highly skilled flaggers. If contract crews are used for this effort, make certain they are identified accordingly to reduce a potential negative image reflecting on LUT crews.
- Require all LUT employees to wear appropriate personal protective equipment when on the job site (i.e., high visibility clothing when working on the ground in the work zone).
- Consider having the surface supervisor or qualified person on site during most of the day‘s operations (five-six hours) to ensure QA standards are met, including sampling, rolling, logistics coordination, and proper traffic control.

Chip sealing paved roads

RMA recommends:

- CTQ implementation of an independent liquid asphalt sampling and testing program. Alternatively, require supplier to certify and stamp each load ticket with quality data.
- CTQ implementation of an independent rock sampling and testing program.
- CTQ should develop a department standard rolling procedure for chip seals. Ensure rollers, chip spreader, and distributor all work as a unit on the application process.
- CTQ should ensure the surface to be sealed is clean. Additional sweeping may be required just ahead of the chip-sealing process.
- Pre-position trucks along the mat to increase efficiency.
- Cut back driveways encroaching on the road surface to improve effectiveness of the chip seal.
- Consider acquiring a 4WD chip spreader to better handle steep grades without damaging the oil mat.
- Consider having the surface supervisor or qualified person on site during most of the day‘s operations (five-six hours) to ensure QA standards are met, including sampling, rolling, logistics coordination, and proper traffic control.
- Develop a chip-sealing performance standard that identifies what, why, when, how, and what the finished result should be. This will answer most questions related to the work being done.
- Hold a pre-season discussion in 2008 led by the supervisor and the lead worker, relating the changes above as a way of leading toward continuous improvement.

Culvert installations permitted

RMA recommends:

- CTQ managers should comply with BMPs by assigning trained personnel to check the project site daily during periods of inactivity to ensure that erosion, sediment control, dewatering, and diversion measures are working.
- CTQ should always ensure the correct slope of the excavated area before allowing employees to work in the excavation.

- CTQ should park equipment for the night beyond the 150–foot distance from the critical zone. Build containment if it is impractical to move beyond the restricted area.

- Ensure workers are familiar with and trained in the BMPs at the earliest opportunity.

Culvert installations – Non-permit required

- CTQ should use a level rod and level to ensure correct percentage of slope on culvert installations. Where possible achieve two percent slope from inlet to outlet.

- CTQ should make certain the bedding base for pipes are consistent on the percent of fall from inlet to outlet to ensure self-cleaning.

- Mark inlets on cross pipes using a utility stake and paddle marker so the cross pipes can be locating quickly during a storm event.

- Ensure all workers receive BMP training at the earliest date.

- Ensure crews working in remote areas have enough work assigned to complete the work day. Alternate activities should be scheduled ahead to ensure efficiency.

Machine patching

RMA recommends:

- CTQ should develop a department-level rolling standard for rolling machine patches. Consult OSHD Standard Specifications 00744.24, 00744.49, 00745.49 for breakdown, intermediate, and finish rolling equipment requirements and number of passes to achieve appropriate compaction.

- Review HMAC test data from supplier to ensure they are within acceptable limits.

- Ensure there are enough trucks assigned to the effort for maximum productivity.

- Extend the four, ten-hour day work week until the program is completed to ensure greatest efficiency. This will reduce daily mobilization cost.

- Consider using relief operators to rotate breaks to ensure crew members received them appropriately.

Conclusion

While the number of recommendations may make it appear as if work the crews observed were problematic, both the body of the report and appendixes contain information that demonstrate that crews are overall performing at a satisfactory level. Additional details, broken down per project, are included in the body of the report.

Section 1: Quality assurance oversight 2007 in-house surface and culvert projects

1.0 Introduction

1.1 Purpose

The Land Use and Transportation (LUT) Operations and Maintenance Division initiated a quality assurance review program in 2007 by contracting with Gerry Douglas Road Management Associates, LLC. (RMA) to evaluate three of its more extensive categories of maintenance work: chip sealing, culvert installation, and machine patching.

The evaluation was specifically conducted to determine if heavy maintenance work performed by Force Account crews—LUT's in-house crews—uses the same standards required by outside contractors.

This Quality Assurance (QA) report documents observations RMA made during work Force Account crews performed from July 2007 through September 19, 2007. It will provide department managers and the public information to determine if work performed in-house is conducted efficiently, economically, and satisfactorially.

1.2 Background

LUT contracts with outside providers for considerable maintenance work, including asphalt overlays, slurry sealing, and some culvert replacements. The work is normally bid according to a detailed set of specifications and overseen by department inspectors as it is completed to ensure specifications compliance. Inspectors routinely give contractors direction on meeting the specifications.

Force Account work is usually not inspected the same way because LUT assumes crews are trained and follow accepted methods for performing the work. These crews typically work together for a number of years on the same activities and roads and develop maintenance expertise LUT can rely on without close inspection.

To assure LUT that the performance of in-house crews complies with specifications appropriate to the work, LUT contracted with RMA, an independent outside entity, to ensure fairness. RMA performed oversight during the fiscal year (FY) 2007 maintenance season.

1.3 Methodology

RMA began the QA evaluation in July 2007 and completed it September 19, 2007. The evaluation generally addressed the 2007 season for the selected maintenance activities. The evaluation consisted of observing maintenance crews as they performed chip sealing, culvert installation, and machine patching. RMA collected data continuously throughout the maintenance season.

RMA observed and documented work daily as it occurred, recording and explaining any deviations from standard practices. Some deviations occurred due to constantly changing

and variable conditions typical of road maintenance. (Note: There are often good reasons to vary from rigid specifications to get the best possible result. These have been noted in the report.)

RMA developed a check-sheet evaluation system (See Appendixes D-H) based on ODOT 2002 Standard Specifications for Construction, Washington County departmental specifications, and the adopted Washington County's Best Management Practices for Routine Road Maintenance 2005-2010. RMA noted exceptions, explaining conditions present and assessing the judgment of those performing the work. Notable exceptions are further discussed in the body of the report.

While some of these deviations may actually be considered minor or minimal and have relatively little impact on the finished product, RMA has classified others as "Critical to Quality" (CTQ) and discusses them along with a recommendation for improvement at the end of each section.

Minor deviations often do not have a discernable impact on the quality of a finished piece of work and may be discretionarily allowed as long as the deviation does not affect safety or the finished product.

On the other hand, CTQ may have considerable impact on the finished product either immediately or in the longer term if they are ignored.

Throughout this report and accompanying recommendations, RMA makes a distinction between minor deviations and CTQ occurrences. The report also includes recommendation after each notice that indicates changes should be made to ensure quality of work. Some recommendations will prompt discussion and further study. Each recommendation should be considered and a department-level decision rendered for each.

Numerous appendixes are included for each type of work, listing the observations and specification by location. Appendixes provide summary level information on the data-collection effort. Every effort was made to analyse the data in the summaries for recommendations to further assist Washington County in its QA program. Further analysis and review in appendix summaries may yield additional information useful to the department in its QA effort.

1.4 Summary findings

Generally, Washington County Operations and Maintenance crews perform their jobs conscientiously and diligently with an eye toward achieving a good result. They usually follow accepted industry construction standards. RMA did not observe any examples of individuals or crews knowingly or egregiously circumventing known processes or work standards.

Exceptions noted were generally based on lack of a clear standard, but those performing the work based their decisions on both their knowledge and best judgment. The crews worked collaboratively and focused on the work.

LUT employees take pride in their work and has an attitude that could be summarized as, –I'll do a good job today because I'll be back later to see the results of my work and possibly do it over or be held accountable if I do a poor job." Under this ethic, there is a tendency toward quality at a slight expense to quantity. Crews are more likely to stop and fix problems rather than press ahead for maximum production. While crew members work together to produce the quantity of work outlined for the day, they almost never sacrifice quality to meet a quota.

RMA documented several instances in which the work standard was unclear and not strictly adhered to; this is further discussed within this report. There were also several examples where judgment and familiarity with products, processes, or end results appeared to be a reason for not testing or measuring to ensure compliance.

Section 2: Chip sealing analysis for gravel road upgrades

2.0 Gravel road upgrades using a three-shot system

Washington County uses a three-shot system to upgrade its low-volume gravel roads. The gravel road base is prepared by adding rock and compacting it to a specified profile and grade. This first chip seal is commonly known as a ―prime coat," which consists of an application of approximately 1/2 gallon-per-square-yard of liquid asphalt (MC-250) over a gravel base.

The asphalt is immediately covered with 1/2"-3/8" rock chips and rolled with a double drum steel roller. The asphalt product used for this first shot has penetrating properties and binds well with the existing base and the applied rock. The mat cures fairly rapidly as it has a pure petroleum base and reducing agents. (Note: Naptha is the reducing agent.) While very expensive in today's market, the product is forgiving and provides a solid base from which to build an oil mat. Use of this product may not continue to be economically possible in the future. It is entirely petroleum based and its cost is very high by today's standards. Several Oregon counties have moved toward using less expensive products for the initial prime coat shot. Appendix A lists some of the counties and the products they use.

The second and third shots consist of a similar process but use a water-based emulsified liquid asphalt product. The products, called high float emulsions, add additional layers to the asphalt mat. These additional shots are HFE901c and are applied generally at a spread rate of .45 gallons per square yard and then covered immediately with 1/2"-1/4" rock chips. The third shot is immediately applied after the second shot but differs in that it uses a smaller gradation of rock—3/8"-#10. The smaller rock gradation provides a smooth wearing surface.

The second and third shots are generally compacted using rubber-tired rollers rather than steel drum rollers. Their purpose is to press and manipulate the rock into the voids and oil more than to compact and level the oil mat.

The finished oil mat surface is then covered lightly with sand to fill the remaining voids. The sand also blots the oil, helping to prevent the oil-enmeshed rock from picking out of the mat. While the sand does not add structurally to the mat, it allows the asphalt and rock time to cure and solidify without sticking to vehicle tires.

When the surface has had a chance to cure from this phase, it is generally accepted to sweep the surface to prevent flying rock and to keep vehicles from grinding the loose rock into the oil mat, which can deteriorate the oil mat.

Seavey Road was the only gravel road upgrade observed that was fog sealed this year.

2.1 Prime coat observations and data discussion

RMA began observation of the gravel road upgrades July 9. Temperatures were in the mid- to upper-80-degree range. Air temperatures of 60 degrees and above are generally acceptable for prime coating when using MC-250 to allow the asphalt to cure properly. Temperatures for application of the first shot of MC-250 were always above the minimum required.

RMA observed work on roads first hand and evaluated the process of using the Gravel Road Upgrade QA Matrix for prime coats. (See Appendix D for the ratings and their corresponding explanations.)

2.1.1 RMA observed that no one sampled liquid asphalt products during the work. Inquiry revealed that sampling was generally not conducted unless a problem was suspected. Quality control of materials is crucial to chip sealing, and failure to sample liquid asphalt leaves the department open to a risk that should be carefully weighed against the cost of a testing program. (See Appendix B.)

2.1.2 Rock sampling was not conducted. No test reports were conducted for the 1/2"-3/8" rock used for prime shots and second shots. A test sample taken periodically ensures the quality of the rock. Not testing rock leaves the department open to risk that should be carefully weighed against the cost of a testing program. (See Appendix B.)

2.1.3 Several crew members were new to the surfacing crew and chip sealing. RMA observed senior, experienced employees telling newer members what their role was and helping them as necessary. The crew had enough experience to perform the work while also training the newer members.

Lapses by newer members sometimes caused occasional slowdowns. All crews need thorough orientation to processes new to them. In addition to an orientation, a written performance standard for the work can help both newer employees and veteran employees with new assignments understand how to perform the work.

Crew size varied depending upon availability and the job. Typically there were 14 or 15 employees on the crew. A contracted truck and trailer was added into the operation as necessary, which was several times during this job. A contracted crew typically made up of six people provided flagging.

2.1.4 A newer chip spreader acquired from another county was placed in service. The unit had been maintained and somewhat refurbished for the season. The operator was new but experienced and worked diligently to make the equipment work correctly. The chip spreader operator monitored and recalibrated the chip spreader a number of times until the crew was confident it operated correctly.

The chip spreader was the source of much of the crew‘s difficulty until approximately July 31, the first part of the season. If the department‘s old Flaherty chip spreader had not been available from July 12 -26, the program might have been in jeopardy of not being completed. Final adjustments were completed to the new chip spreader on July 31, and the machine worked relatively well from then on.

It was also noted that there are a lot of fairly steep grades in Washington County; a 4WD chip spreader would have helped provide the best quality job possible. When starting and climbing on grades, wheels sometimes spin and trucks must push the chip spreader up the

hill. Several times the chip spreader‘s wheels spun and trucks tore and marked up the mat, which could prevent the rock from sticking or releasing rock prematurely. A number of these spots have been noted and can be reviewed by the department in the future to determine impact on the surface and the life of the chip seal. RMA will provide a follow up review on some of these locations in the spring of 2008.

2.1.5 Four trucks with transfer trailers were used and were generally adequate to keep the chip seal process moving. On several jobs with longer haul distances, a fifth contract truck and trailer was added to the string. It benefited productivity. RMA observed several other instances where an additional truck and trailer may have also increased productivity. Additionally, there were several times when additional liquid asphalt would have benefited productivity.

It is a very delicate balancing act to provide an appropriate combination of liquid asphalt and rock supplies to ensure production is sustained. In a couple of instances, overtime might have benefited the overall effort at a reduced cost.

2.1.6 Shooting on the first shot for the gravel road upgrades and Local Improvement District (LID) projects was completed July 12. The gravel roads and LIDs were then left to cure for at least a week before the second and third shots were applied. The mats generally looked solid, although they were tender, and several damaged spots occurred from traffic impacts before crews returned on July 24 to begin the next phase. Minor damage is fairly normal, and some damage can be fixed on succeeding coverages. Some of these areas will be included in the review in the spring of 2008.

2.2 Gravel road upgrades: second and third shots observation and discussion

RMA observed roads given second and third shots first hand and evaluated the process using the Gravel Road Upgrade Second and Third Shot QA Matrix for chip seals. (See Appendix E for the ratings and explanations.)

2.2.1 Seavey Road. The second and third shots on the gravel road upgrades began July 24. The work on Seavey Road generally went according to schedule, although the crews were using the older chip spreader. The hill on the Strohmayer end of the road was soft and spongy to walk on, and it was obvious that there had been difficulty getting the chip spreader up the hill. (Complete observation of the work was not possible as work was concurrently being observed on a culvert replacement project).

Upon review there was evidence of several raveled spots in the mat where tires had spun while climbing the hill. The crew had difficulty every time it climbed this hill. Even with a 4WD chip spreader it might have been difficult on this stretch. The hill portion should be watched for evidence of defects in the oil as a result of the difficulty applying rock to this piece of road.

2.2.2 On July 25, 2007, the crew placed the final panel on the second shot (northbound travel lane) up the hill from the hazel nut farm. The surface temp in the sun was 75 degrees;

however, the surface temp in the shaded areas was only 56–60 degrees. The lower surface temperatures on the shaded areas of the road were marginal, although it may not cause a quality issue. The area should be reviewed over the life of the seal.

2.2.3 The third shot at the intersection of Clapshaw Road resulted in several strips not getting shot with oil. These likely will be evident at a later date as rough spots and low spots.

2.2.4 A spivey on the spraybar had been replaced July 23, 2007, and RMA observed that it was still misaligned by 90 degrees on July 25, 2007. It was brought to the chip spreader operator‘s attention and fixed later that day.

2.2.5 Pumpkin Ridge Drive went very well for a while on July 26, 2007, before difficulty with equipment slowed production. The crew generally doesn‘t continue to push if equipment gives them problems. Instead, everyone stops and tries as a group to find the best solution. It then resumes trying to put out the best product possible.

The new Bear Cat chip spreader was brought back out after being repaired and needed several recalibration efforts. The calibrations wouldn‘t hold, and the rate had to continuously be increased to get coverage.

2.2.6 RMA first noticed on Pumpkin Ridge Drive that the two rubber-tired rollers used for this phase of the work appeared to be traveling too fast. Generally slower rolling is better for chip seals. As a rule walking speed is 3-4 MPH and close to an appropriate speed for rolling chip seals.

RMA asked the roller operators how fast they were traveling, and they said they had no way of telling. Their instructions were to give it two passes. The crew also continued to use a steel-wheel roller to try to consolidate and shape the mats. Rolling coverage was good, but it was too fast most of the time. There is considerable discussion in the field of chip sealing and on this crew about the best way to roll chip seals. Consensus agreement and improved direction and training to those doing the rolling is needed.

2.2.7 A measured distance and timed coverage revealed that the rollers were often covering the mat at between 7.5-10 mph. This is probably too fast to get good orientation of the rock. It was later discovered that the tires actually caused the rock to flip up off of the mat.

2.2.8 Mullerleile Road. July 30, 2007. The crew continued to experience difficulty with calibration holding on the Bear Cat chip spreader. They shot both the second and third shots, and all of the equipment was picking rock. When the rubber-tired rollers began picking badly, they sent them off the mat and used a steel drum roller to compact it. This is a very low volume road, and the deviations were probably acceptable. This will be a road to review for quality issues in the next year or two.

Mullerleile was again reviewed on August 28, 2007, and looked okay with the exception of a couple of soft spots in the mat.

2.2.9 The problems of chip spreader calibration continued on Daniel Road July 30, 2007. The chip spreader operator was frustrated but was pushing ahead by the end of the day. This was the only time during observations that the crew continued to press for productivity as difficulties were encountered. Additional adjustments were made the morning of July 31, 2007, and the chip spreader performed well during the rest of the season. Productivity increased after the calibration issue was resolved.

2.2.10 Dober Road, the first road the Bear Cat chip spreader worked as intended went exceptionally well. The exception is that the rollers were sometimes slow to get on the mat behind the trucks and chip spreader and continued to roll too fast. (See Chip Seal Timing Appendix I.)

2.2.11 There was no ―meet line" left on the first panel up the hill for the first shot. Not leaving an exposed meet line (centerline seam) can result in a linear bump or ridge in the road at the centerline. This was the only time during the season a ―meet line" was completely left off.

2.2.12 Raynard Road was shot as an experiment to compare two-shot and three-shot chip seals. The entire road was shot twice. Only the first (easterly) portion from Midway Road past the nursery was given a third shot.

2.2.13 Additionally, the last 200 feet (before the stop sign at McCormick Hill Road) on the second panel of the prime was shot using HFE901c liquid asphalt. This section of the road should be watched over the next few years to see if it develops surface defects as a result of the variation in liquid asphalt that was used.

The gravel road upgrade shooting was completed August 2, 2007.

Note: Seavey Road was fog sealed on August 28. The road surface had looseness on the upper end of the project, and the mat did not tie down tightly. The fog seal may help hold the rock on the areas that were shaded when it was shot. The looseness was likely due to the surface not being compacted tightly enough when the prime coat was applied.

2.3 Gravel road upgrades: Critical to Quality

2.3.1 Critical to Quality (CTQ) of chip sealing. Testing of liquid asphalt purchased from a third party vendor was not performed. The MC-250 Washington County used was supplied and shot by Albina Asphalt. Washington County has a long standing vendor relationship with Albina Asphalt who is hired to use their distributor to apply this product for the county. There were no known samples taken of the MC-250 product used for the prime coats. Albina was not responsible for testing, and the product purchased from someone else left product reliability an unknown. Failure to regularly sample liquid asphalt exposes Washington County to all of the risk associated with product quality should problems occur. A contracted effort would likely have included an element for sampling and testing of liquid asphalt or other certification.

One of the critical areas to manage in a chip seal program is the materials. Sampling and periodic testing provides assurance that what was applied to the roads met specifications. One example can be found in the problem that occurred in July on Clark Hill Road. The road was chip sealed in 2006 and began ~~"b~~leeding" July 10, 2007 during a period of high temperatures; the daily high on July 10th at the Hillsboro Airport was recorded at 100 degrees. The road had to be sanded heavily to stop the problem, and the surface was damaged from the bleeding. In the absence of any test reports there is no evidence that the liquid asphalt or the rock used on that road either met or did not meet specifications. (See Appendix C.)

A sampling and testing program would alert and provide evidence if a product fell outside of known specifications. A testing program would additionally help convey vendor responsibility in situations where the product did not meet specifications.

2.3.2 CTQ of chip sealing. Testing of rock used for chip seal prime coats was not performed. The 1/2"-1/4" rock was purchased from Baker Rock products and was not tested. Tests should have been performed periodically to ensure the rock met specification for prime shots and reviewed for use with MC-250. An initial test for rock hardness or evidence of a recent test of this nature should also be included in the effort. A contracted effort would have included an element for suitability and periodic testing of the rock.

2.3.3 Chip Sealing. Shot rate was boosted on Raynard Road to ensure that no MC-250 liquid asphalt remained in the Albina Asphalt distributor when shooting on this project was complete. The normal .50 gallons per square yard shot rate was boosted to .51 gallons per square yard beginning on the first panel. The result was the project ended up several hundred feet short of enough oil to finish the job on the second panel.

The oil used for the prime coats was purchased from a third party by Albina Asphalt. This arrangement made it impossible to return any unused portion of the product. Arrangements to ensure enough product to complete a job is important. Left over product needs to be dealt with in an approved manner.

2.4 Gravel road upgrade: specification deviations

2.4.1 The road shoulders (outer six inches) on most gravel road upgrades were observed to be somewhat soft. Building a road to its maximum width within the right-of-way does not allow for enough shoulder or support for the edge of the road. This makes proper compaction nearly impossible when there is a drainage ditch along the road shoulder. Trucks, chip spreaders, and rollers all had difficulty when they were forced to the edge of the road shoulders. The edges will likely give some problems in the future.

A contractor would not likely have been able to improve on this aspect of the gravel road upgrade program. A contractor, however, would likely have been required to compact the edges or shoot less than full width to ensure a compacted finished surface.

2.4.2 The surface on Seavey Road on July 9 at 5 p.m. was picking badly at 5 mph as RMA drove through it. It was in the upper 80s. A contractor would likely have been required to sand this to stop the picking. The fact that this is such a low volume road and the neighbors were very positive about getting it surfaced probably kept anyone from calling in. RMA checked the next day, and there apparently had been no calls from the public. There also did not appear to be anyone on site with the responsibility for making the decision to apply sand.

2.4.3 When the new chip spreader broke down on July 12 and the older machine was pressed into service, no calibration effort was undertaken. It is understood that there was a high degree of confidence in this older machine‘s reliability; however, a calibration should have been performed to simply check this assumption. A check of the mat behind the operation showed it was probably applying rock within specs at 24-28 lbs. per square yard.

A contractor would not have been allowed to proceed without a calibration check. A contractor, however, has a vested interest in applying rock in a manner that may benefit his profit on a job.

2.5 Gravel road upgrades: other

2.5.1 Traffic control. Washington County LUT used a contracted flagging crew supported by one of the utility workers from the Surface Maintenance crew. The six contract flaggers used were marginally able to do the job on low volume roads. There were numerous instances where more senior maintenance equipment operators had to step in and direct traffic. Operations at times were disrupted or halted because the flaggers were unable to effectively move traffic. The public was very unhappy with the flaggers at times.

2.5.2 RMA observed that one person on the chip seal crew never wore a safety vest or other high visibility clothing throughout the summer. This person worked regularly around the operation on the ground and equipment. On Minter Bridge Road he was observed flagging at the intersection with Grabel Road (because the contract flaggers were unable to control traffic). This is a violation of OROSHA rules, and both the county and the individual could have been cited.

2.5.3 Washington County uses a three-shot chip seal gravel road upgrade system because more shots of asphalt means a thicker more durable mat. On the low volume roads that are being upgraded, a two-shot system might yield similar performance at a reduced cost.

2.5.4 Using MC-250 for prime coats on gravel roads has historically been sort of the gold standard for this purpose. The county paid $723.10 per ton for the MC-250 used on the prime coats. The cost to continue using this product is nearly prohibitive, and there are other products that are a viable alternative.

2.6 Gravel road upgrade: recommendations

2.6.1 Critical to Quality (CTQ) is implementation of a liquid asphalt sampling and testing program for all materials used in chip sealing, from primes on gravel road upgrades to seals on paved roads. This is a control on one of the most important items to the finished product. The cost and time involved with testing is small compared to the department's budget for this activity. Failure of the liquid asphalt to meet specifications exposes the department to a significant risk. (See Appendix B.) Sampling should occur daily, and liquid asphalt testing should occur periodically, if not daily.

An alternative would be to require the supplier (Albina Asphalt) to stamp as certification on each bill of lading and indicate the tested properties of the liquid asphalt. RMA spoke with Dave Zillman of Albina Asphalt, and they are willing to do this.

2.6.2 CTQ is implementation of a rock sampling and testing program for all chip seal rock. This is a control on the other crucial material used in the finished product. Again, the cost and time involved with testing is small compared to the budgeted cost of this work. Unreported specification failure exposes the department unnecessarily. The one exception is no testing is recommended for the sand used to blot the sealed surfaces.

a. Sampling and testing of rock should occur regularly, perhaps every 200 – 300 tons.

b. If samples cannot be secured from the supplier, then consider taking samples from the conveyor of the chip spreader.

2.6.3 CTQ is ensuring there is enough of the right product on hand to complete projects. On Raynard Road the shortage of MC-250 material did not meet a contractor standard. If this decision was made because there might be too much product left at the end of the job that could not be returned, then an arrangement should have been made in advance to shoot it out on a gravel parking area around the LUT equipment sheds or at another work area. Ensure enough of the right product is on hand to complete the job.

2.6.4 Consider using a different product for shooting prime coats to reduce costs. Some counties are finding success with using emulsified asphalt on primes. A survey by the Association of Oregon Counties, County Road Program in July of 2007 identified processes used by eight Oregon counties. (See Appendix A.)

One of the most common alternatives to MC-250 as the prime coat is CRS2-P. Washington County should research this option further and consider using this product for the 2008 season.

2.6.5 Consider also the use of a two-shot system in place of the current three-shot system. A number of Oregon counties are finding success with this system. The reduced cost could allow the department to actually increase the number of miles of road upgraded on an annual basis.

The two-shot system could be used in 2008 and observed during the next year or so. If it appears not to work, then a third shot could be applied to complete the three-shot surface.

2.6.6 When the supervisor is not on site, the lead worker in charge needs to make decisions relative to requesting sand on a prime shot that is picking during hot weather.

2.6.7 Prepare the roads with six inches to one foot of shoulder outside of the edge of oil. This will allow for improved compaction under the oil mat. Because right-of-ways are narrow, cost likely prevents buying additional right-of-way for the gravel road upgrades. However, if placed in the existing row and then compacted and shot, the soft, outer shoulder could later be removed through drainage ditching or shouldering operation. The base under the remaining mat would remain compacted thoroughly.

2.6.8 If contract flaggers are used in the future, identify them so the public knows they are contracted and who they work for. Flaggers reflect directly on Washington County LUT image. Having folks unable to communicate effectively with the public and unable to perform effectively, presents a negative public image of the LUT folks.

Consider, however, using fewer but more skilled flaggers to be more effective. In most cases two or three skilled flaggers would be adequate. Even with a pilot car on busier roads, the total number of flaggers could be reduced.

2.6.9 Ensure all personnel wear safety vests or hi-visibility clothing when engaged in operations on the ground or around equipment. OAR 437-002-0128 requires that all personnel wear appropriate high visibility garments. The department provides them, and the individuals should wear them.

2.6.10 The lead workers on the chip seal crew are too busy trying to operate their assigned equipment to coordinate all the logistics of field operation. They had no time left to observe and work with the flaggers, rollers, perform QA sampling, etc. Someone needs to be dedicated to making sure the quality aspects of the operation are attended to. One possible way for this to be addressed is to have the surfacing supervisor on site five or six hours per day.

This could be done by providing relief to the surfacing supervisor from his daily time entry and administrative duties to spend five to six hours each day in the field. His role would be to handle the essential field coordination work and perform QA checks of the operation. Including sampling; testing; and ensuring adequate oil, rock, rolling and traffic control (flagging was nearly always an issue) would make the process operate more smoothly.

Section 3 - Chip sealing paved roads

3.0 Single shot paved road: chip seal

Washington County LUT uses a pavement management system to record and rate the surface conditions on its paved road system. Washington County maintains a relatively high pavement condition rating compared to many other counties. Part of maintaining a high system rating involves using an integrated approach of maintaining pavements. Chip sealing rural paved roads every five to eight years to prolong the pavement life is one such strategy. Chip seals are performed at a relatively low cost compared to pavement overlays.

RMA observed paved roads selected for chip seal first hand and evaluated the process using the Paved Road Chip Sealing QA Matrix for chip seals. (See Appendix F for the ratings and explanations.)

3.1 Chip sealing paved roads: observation and data discussion

3.1.1 The work began with McCormick Hill Road July 16. Due to cool morning temperatures, the crew decided to begin work in the middle of the project (near Hagg Ranch) where the sun was reaching the pavement and warming it more quickly. This was a good example of emphasizing quality in the performance of the work. The crew later dropped back and sealed the first section in the afternoon when temperatures on that section were higher. The specification that surface temperatures for successful chip sealing need to be at least 70 degrees was met.

The Flaherty chip spreader was used, and the crew switched from 1/2"-1/4" rock to a 3/8"-1/4" rock. The chip spreader had not been calibrated since bringing it onto the job. Visually, the application looked good, with generally a one rock layer with some voids to the oil being apparent. This visual gauge is a general indication that coverage is probably between 18 and 26 pounds of rock per square yard.

Chip sealing compaction on paved roads is generally performed using rubber-tired compactors, and Washington County rents two of them for its work. This was the first they were used on the job. One of the rollers had not been maintained and had plugged water spray nozzles that keep rock from sticking to the tires. The operator had to find tools and perform the maintenance, and the compactor was not available for the first panel from Hagg Ranch to the Yamhill County line. The one roller used had difficulty keeping up with the operation and consistently lagged five to eight minutes behind the chip spreader. These were otherwise very good rollers for the work as far as size and reliability.

The chip spreader had difficulty getting started and spun wheels in several spots along the first and second panel when starting up. There were also a couple of rock coverage problems and a pile of rock left on the mat for an extended period of time. This section of road should be reviewed in the spring of 2008 to see if the difficulties caused the mat to lose its rock prematurely. There was also some confusion on the crew about whether the

shooting should end on Southwest Buckhaven or the county line. The surface supervisor showed up on the job and clarified it should be the county line.

3.1.2 Aebisher Road was sealed and reviewed July 23, 2007. The project looked good, although there were some skips at the intersection where the distributor did not get full coverage when shooting the wings. There also did not appear to be covers placed over several utility lids in the roadway (although they may have been). This road was reviewed in the late afternoon after a heavy shower, and the surface was noticeably damp.

3.1.3 Work on Bald Peak Road began in the afternoon on July 23, 2007. The humidity was quite high, a mist fell, and showers passed over all sides of the work zone. The first half of Bald Peak Road should be reviewed for quality issues due to the high humidity and showers that occurred within two hours of completion. There is a possibility of some rock loss.

When viewed a few days later the surface looked okay. However, the climbing lane part way through the project appeared to be thin on rock and slightly flushed with black tracks in the uphill lane. It appeared there were some dual tracks where wheels spun during the climb.

RMA also observed that on Bald Peak sanding of the mat was occurring on the lower section of road ahead of the rolling. This stretch should be checked in the future.

Flaggers had difficulty controlling traffic, especially when the equipment was stacked at the beginning or end of a project. Bald Peak in the late afternoon was quite busy and presented the flaggers with their biggest challenge to date.

3.1.4 Minter Bridge Road was completed August 2, 2007. Shooting and productivity was good. A pilot car operation was used as this was a busy, urbanized area. The pilot car made the traffic control operation run smoother. The exception was flagging at the intersection of Minter at Grabel Road when the shooting was wrapping up. There was a lot of traffic, and the contract flaggers were not able to manage the traffic effectively. Senior members of the LUT chip seal crew temporarily directed traffic through the job and things improved. The contract flaggers during this time were rendered useless and stood around without much involvement.

3.1.5 Bridges Street and 325th Avenue were shot and completed by 9:30 a.m. August 6, 2007. Flagging and work went well with the exception of shooting over several alligatored spots on 325th Avenue near a big oak tree.

3.1.6 A contractor sealed Patton Valley Road in 2000. The road still looked good with the exception of several spots where the rock did not stick, which likely reduced skid resistance.

Road surface was clean, although it did not look like it had been recently swept. The outer six inches of the road had a fair amount of bark, debris, and sand. At one spot near Mt.

Richmond Road (on the west side), a section was shot over a pile of rock and debris encroaching from a driveway. These conditions may cause poor asphalt bonding and rock retention.

Patton Valley went extremely well as the crew was working with an additional rock truck and trailer to help production. The one exception was the fact that the rollers tended to lag by six or more minutes at times and then rolled too fast. RMA observed rock flying up behind the rollers wheels when the rollers were going fast.

The intersection of Patton Valley and Old Highway 47 had some difficulties with skips and should be looked at in the spring of 2008 for quality issues.

3.1.7 Vernonia Road was chip sealed beginning August 13, 2007. It had rained quite a bit the day before, and the surface was drying. Shooting began at 8:45 a.m. with the air temperature at 57 degrees and the surface temperature at 67 degrees. The shaded surface areas moving up the first section were only 57 degrees. There was some surface dampness in the shaded areas, but likely not enough to affect the oil, which was at 160 degrees.

Shooting began and then stopped because the utility workers had not covered the monument covers. When shooting resumed, progress was rapid as a fifth truck and trailer had been added into the string. This project was quite far out in the country, and waits for rock were reduced.

Rollers had some difficulty and got a late start several times. They were four to five minutes behind getting on the mat and then rolling too fast to catch up.

The last truck left for rock at 10:20 a.m. There was still 2,000 gallons of oil on the distributor. Rock began arriving at 11 a.m. and shooting resumed. The distributor then left to reload oil at 11 a.m. One truck and trailer sat while the distributor was reloaded. Oil was back and shooting resumed at 11:45 a.m. Meanwhile, the rollers left to fill up with water. Shooting resumed without the rollers. The rollers returned 8.5 minutes after the shot began. By the next shot the rollers were right in line and following the process closely.

This job was completed August 14, 2007. There was a short section to do, and the process began at 8:30 a.m.. It was sunny and 60 degrees, although at 54 degrees on the surface in the shade and 65 degrees on the surface in the sun. The rollers again lagged the operation, this time by 4.5 minutes, and then rolled too fast.

The process went well on Vernonia, although the rollers were inconsistent. Traffic control was performed without a pilot car, which would have been a better choice. There is a lot of traffic on Vernonia Road, with considerable log trucks and gravel truck traffic.

In a separate incident, the contract flaggers had difficulty at Highway 26 and caused the sealing operation to stop once due to not moving up the road. Frustration with the flagging group by the distributor operator and others on the crew was evident and justifiable.

3.1.8 Verboort Road was sealed in the afternoon of August 14, 2007. All temperature conditions were good, and monuments were covered. The flagging operation was slow to get underway (the shooting had already begun), but once the pilot car started, things smoothed out. There was only one roller present for the first panel near the school. The roller couldn‘t keep up until the rock trucks ran out and the distributor left to reload. The road was finished in the afternoon. It looked very good. The only problem observed along this road was that the rollers were rolling too fast.

3.2 Critical to Quality: chip sealed roads

3.2.1 Critical to Quality (CTQ) is testing of liquid asphalt. Washington County has a long-standing vendor relationship with Albina Asphalt, who supplies the high float asphalt emulsion (HFE) product for the county. Albina was not responsible for testing; however, they do perform in-house product testing to ensure quality. If a problem was encountered, independent tests could be compared to the proprietary tests to determine responsibility.

There were no independent samples taken or testing of the product used for the chip seals. Failure to regularly sample and independently test loads of liquid asphalt exposes Washington County to risk associated with product quality should problems occur. A contracted effort would likely have included an element for sampling and testing the liquid asphalt.

A critical item to manage in a chip seal program is the materials. Sampling and periodic testing provides assurance that what was applied to the roads met specifications. An example of this is found in the problem that occurred in July on Clark Hill Road. The road was chip sealed in 2006 and began ―bleeding" on July 10, 2007. The road had to be sanded heavily to stop the problem, and the surface was damaged from the bleeding. In the absence of any test reports there is no evidence to show if the liquid asphalt or the rock used on that road either met or failed to meet specifications. (See Appendix C.)

3.2.3 CTQ is testing of rock used for chip seals on paved roads. All of the 3/8"-1/4" rock was purchased from Baker Rock products. Only one set of test data was available from a test performed in June. Tests should be performed periodically to ensure the rock continues to meet specifications. It is fairly easy for crushing equipment or raw resources to change and move the rock out of specification. Chip seal success can be closely related to changes in rock specifications.

Failure to regularly have independent tests performed on rock resources exposes Washington County to the risk associated with product quality should problems occur. A testing program would help convey vendor responsibility in situations where the product did not meet specifications. (See Appendix C.) A contracted effort would likely have included an element for periodic testing of the rock.

3.2.4 CTQ is calibrating the chip spreader whenever it is brought onto a jobsite. Control of rock application is one of the most important quality considerations. If there is too little rock, the oil can flush to the top, creating fat spots, lowered skid resistance, and reduced

life of the chip seal. Too much rock can cause incomplete compaction and orientation of the rock into the mat. Too much rock wastes a valuable resource. Visual inspection of the mat is good; however, electronic calibration gives a much more precise and cost-effective control.

3.2.5 CTQ is rolling of chip seals. The effort ensures rock is compacted and, just as importantly, makes certain rock is correctly oriented into the mat. Once the chip spreader places rock on the mat, effective rolling is critical to the quality of the finished chip seal. The weight of the roller and the flexibility of the rubber tires accomplishes this. The rollers Washington County used were very good for this part of the work. They exceeded minimum specifications for weight, had water systems that worked, and were in good repair.

The standard ODOT specification calls for rolling to begin as soon as possible and to roll two complete passes on the new chip seal at a speed of less than 5 mph. Other studies have indicated not more than 10 mph, and some even advocate for only one pass with the roller.

The Albina representative says, ―Slower is better," and advocated that as slow as 3 mph is the best speed and rollers should never stop rolling on the mat. They do no good if they are parked. There does not seem to be a good industry consensus on how best to roll a chip seal.

The rollers nearly always made at least two complete passes. The rollers were often late getting onto the oil mat. There were a number of reasons for this, but there seemed to be no sense of urgency from a process standpoint. The roller operators did not know what their speed was nor were they aware that it mattered. Their main requirement was to make two complete passes. On a number of occasions RMA observed rock coming off roller wheels in a rooster tail nearly two feet long. The speed was too fast.

One reason the roller operators were late was that they were constantly badgered by the truck drivers to stay out of their way. The roller operators were wary of the truck drivers and as less senior employees often gave in. The roller operators were not entirely without fault, and a number of times they parked too close to the operation when they finished rolling, making it difficult for the trucks to maneuver into line for the chip spreader. This dynamic was probably the least cooperative relationship RMA observed on the chip seal crew. Although the conflict was minor, it was counterproductive.

3.3 Chip sealing paved road: specification deviations

3.3.1 Temperature records were kept during the chip seal season. Most of the time temperatures were above minimum recommendations. A few times in the early morning and late in the season, the minimums were stretched slightly. The crews were aware of the temperature requirements, but did not have any temperature testing equipment. When the equipment and materials were ready to go, they generally started. Some of the areas where temperatures were marginal were noted and can be reviewed for quality impacts in the future.

3.3.2 Warning signs of the new oil surface and loose rock were posted regularly when a project was completed. RMA did not observe any instances where they were not posted. Often however, the signs were placed within just a few feet of each other.

3.4 Chip sealing paved road: other

3.4.1 On July 10, Clark Hill Road, which was chip sealed during 2006, began having surface bleeding problems, and the road required heavy sanding in the afternoon. As a result, the oil mat picked up in a number of places and was permanently damaged. RMA was informed of the problems and looked at the road July 11.

The surface bleeding is a condition in which oil softens and flows up over the top of the rock that was placed on the oil. There were a number of conditions that could have contributed to the problem July 10, Including hot weather and heavy ladened truck traffic. Some of the roots may have occurred when the last chip seal was placed. No other roads sealed in 2007 seemed to have experienced this problem. This road is discussed further in Appendix C.

3.4.2 RMA was unable to find any specification that implied it was okay to sand the chip seal before it is rolled. RMA did speak with Dave Zillman of Albina Asphalt who believed it was a viable technique as long as rolling occurred and the speeds were slow enough to avoid rolling or turning the rock over.

3.5 Chip sealing paved road: recommendations

3.5.1 One of the most Critical to Quality (CTQ) items is implementation of a liquid asphalt sampling and testing program for the materials used to chip seal paved roads. This is a control on one of the most important items to the finished product. The cost and time involved with testing is small compared to the department‘s budget for this activity. Failure of the liquid asphalt to meet specifications exposes the department to a significant risk.

Sampling of liquid asphalt should occur at least daily. Daily or periodically (if the department is confident in its product quality) a sample should be compared with the known standards and cross checked with Albina‘s samples from the sample batch.

An alternative would be to require the supplier (Albina Asphalt) to stamp a certification on each bill of lading and indicate the tested properties of the liquid asphalt. RMA spoke with Dave Zillman of Albina Asphalt, and they are willing to do this.
3.5.2 CTQ is implementation and testing rock for the chip seal program. This creates a control on one of the critical items to the finished product. The cost and time involved with testing is small compared to the budgeted cost of this work. Only one preliminary test report was received for the 3/8"-#10 material used on sealing the paved surfaces and third shot chip seals. The report was received in June, and they didn‘t begin taking this rock until July. (The one exception is no testing is recommended for the sand used to blot the sealed surfaces.)

Sampling and testing of rock should occur regularly for approximately every 200 – 300 tons used. If samples cannot be secured from the supplier, consider taking samples from the chip spreader conveyor.

Regular comparisons of reports should be made to ensure the rock remains within acceptable limits.

3.5.3 CTQ is developing a standard rolling procedure. The rollers need to be tied into the process in the same way the chip spreader and the distributor are. RMA observed that an agreement occurred between the oil distributor operator and the chip spreader operator as to whether they were ready to make the next shot. The understanding was that the chip spreader needed to be close on the distributor. The relationship of the rollers to the chip spreader and the distributor needs to be clearly established, tying them into the operation by a written standard.

At present there is little or no agreement within the department about the best way to roll a chip seal. The roller operators are not clear other than they need to make two passes over the entire surface. The rollers are either traveling too fast or lagging behind much of the time. By integrating them into the CTQ process through a rolling protocol, shooting will not begin until the rollers are on line and ready. The roller operators will clearly understand when they should start rolling, how many passes to make, at what speed to roll, and where to park to leave enough room for the trucks.

The truck drivers need to acknowledge the importance of the rollers and their place in the operation. While the trucks are beneficial as they are backing up, they clearly do not cover the entire mat, and they do not perform the same work as the rollers.

3.5.4 CTQ is to sweep the road prior to chip sealing beginning. If it doesn‘t need to be swept entirely, it is still appropriate to sweep the corners and outer six inches of the road mat. If the roads are swept too soon they can become contaminated before being chip sealed. Contaminated surfaces do not create a good bond between the oil and the rock.

3.5.5 Take advantage of pre-positioning trucks along the mat. Whenever possible, pre-position rather than backing all trucks in a line. While backing slowly on the mat does provide a rolling function, it prevents the rollers from staying close to the chip spreader.

RMA noticed some drivers estimating where their load would be required when pulling onto the job. They then positioned their truck to be able to pull into line easily rather than backing down the entire mat. It is both safer and makes the operation more efficient, and this practice should be encouraged.

3.5.6 Cut driveways back that are encroaching on the oil mat. Shooting over them creates a bump and a spot where the mat will fail as the rock separates.

3.5.7 Acquire a 4WD chip spreader due to the number of grades in Washington County. This is a long-range recommendation as the county has just acquired a newer 2WD chip spreader. A 4WD chip spreader is not a complete answer when sealing grades, but an improvement would likely be seen. Any time the tires slip or trucks spin when pushing up hill, a defect is built into the mat. The rock will likely either not stick or will release early. Contracts for chip sealing should specify use of a 4WD chip spreader.

3.5.8 Pre-season equipment checks are important. While all of the equipment used by the department was very good and reliable during the season, downtime on a large crew is costly. There were some understandable downtimes with the new chip spreader until the bugs were worked out. The rubber-tired rollers caused a small amount of downtime on the first day that could have been avoided if they had been checked before use.

3.5.9 Increase spacing of the end-of-project signs. A number of signs were placed very close together. On long projects or intersections, consider placing additional signs in the middle.

3.5.10 As mentioned in section 2.6.9, the lead workers on the chip seal crew are too busy operating their assigned equipment to observe other phases of the operation. They rarely see or have time to work with the flaggers, rollers, or to perform QA sampling, etc. There is a need to dedicate someone to making sure the quality aspects of the operation are attended to. One way to do this is to have the surfacing supervisor on site five to six hours per day.

This could be done by providing relief to the surfacing supervisor from his daily time entry and administrative duties and have him spend five to six hours each day in the field. His role would be to handle the essential field coordination work and make him responsible for performing QA checks. Including sampling; testing; and ensuring adequate oil, rock, rolling and traffic control (flagging was nearly always an issue) would make the process operate more smoothly.

3.5.11 Develop a written performance standard for chip sealing. Nearly all the recommendations mentioned above could be covered in a written performance standard that describes what, why, when, and how the work is to be accomplished. A written performance standard would answer many of the questions that arose on the crews during the summer of 2007. Additionally, it would help both new and veteran employees to understand how the work should best be accomplished.

The standard should include the approved best management practices (BMP) by reference as well as rolling protocol.

3.5.12 As a final suggestion, the surfacing supervisor and lead worker should hold a pre-season discussion with the 2008 chip seal crew. A review and discussion of all accepted changes would be a valuable way of leading the crews toward continuous improvement.

Section 4: Culvert installation

4.0 Permitted culvert installation

Washington County routinely installs culverts that require permits from various state and federal regulatory agencies. Internal assistance from Environmental Services staff is available to ensure compliance and sound environmental practices. Some of the projects are performed via a contracted service and some are performed by Force Account. Whether projects are completed under permitted conditions or non-permitted conditions, RMA observed the Force Account drainage crew rigorously following and embracing the department‘s BMPs. Each crew person RMA spoke with knew about BMPs and the essential elements of compliance in performing his or her job.

Culvert work was observed first hand, and the process was evaluated using the Culvert Installation QA Matrix. (See Appendix G for ratings and explanations.)

4.1 Pottratz Road permitted culvert installation

Pottratz Road Culvert Replacement Project was assigned to the department‘s drainage crew for completion during the permitted ~~–in~~-water work window” for 2007. The project involved installation of an 8-foot diameter by 46-foot long corrugated metal culvert. The stream crossing had been used as a ford since a previous culvert washed out in approximately 1996. This was a joint effort between BLM and LUT, developed to replace the culvert and repair adjacent stream damage as a result of uncontrolled recreational off-highway vehicle (OHV) use in the area.

The project had all the required environmental and regulatory permits and authorizations in place by May 30, 2007. The LUT Operations Division and environmental and engineering staff prepared detailed plans and specifications that could have been used to bid the project. Since the project was well within the drainage crew‘s ability to complete, department managers decided to assign it to county forces.

The nature of this work was not typical of maintenance type work performed by crews on a daily basis. It had unique characteristics, making it a project with a defined scope of work and a number of well defined CTQ milestones.

4.2 Pottratz permitted culvert installation: observation and data discussion

4.2.1 The engineered plans clearly defined the scope and what the finished project would look like. The crews were familiar with the planned work, having had previous experience with this type of installation. There was a pre-project meeting July 16. The crew members felt this project was well within their project capability limits and were anxious to get started. RMA observed that The Erosion and Sediment Control Plan (ESCP) and project plans were on site and were referred to as questions arose.

4.2.2 There were plenty of erosion control materials available and utilized as needed. The lead worker and senior crew members know and are very familiar with Washington County‘s BMPs. All crew members were familiar with the BMPs except one utility worker who was relatively new (less than six months tenure) and had not yet been through Washington County‘s BMP training. The senior members of the crew were very good at mentoring this individual and others with less experience. The drainage supervisor provided daily support and took an active role in ensuring the installation and project logistics were attended to.

4.2.3 RMA observed the lead worker gathering the crew in the morning at the jobsite to explain the objective and expectation for the day on numerous occasions. Throughout the day as conditions or needs changed, the lead worker calmly gave new directions or reissued directions as needed. RMA also observed the lead worker and supervisor working well together as the project proceeded. Crew sizes were adjusted daily and even at times during the day to meet workload needs. Crew, equipment, and material resources were well coordinated on this project.

4.2.4 The project began July 16 when the diversion and dewatering systems were put in place. The controls were checked daily when the crews were on site. Work never proceeded until appropriate erosion, sediment, and BMP measures were addressed. The job was shut down from mid-day July 18 through July 23 due to unseasonal rain. When the work resumed the erosion controls and dewatering had done their jobs, and the crew was able to make fairly rapid progress.

4.2.5 The excavation proceeded for the pipe bed and excavation sides. The plans called for an excavation slope angle of 1½'–1' for safety of the workers who were in the approximately 12-foot deep excavation. When the engineer visited the site July 23, 2007, in the afternoon, he determined the walls of the excavation were closer to a 1'-1' angle, which was too steep for the safety of workers in the excavated area. The crew proceeded to cut the slopes back to the required slope angle, and when RMA visited the site early July 24, 2007, the slopes were at the 1 ½ '-1' slope, with the exception of one area on the south east corner that had embedded logs at about mid-depth (probably left from an old log ford that had been used many years ago). Because the excavation wall was very solid and stable, the engineer had given permission for this section to remain at the 1'-1' slope angle.

By 10 a.m. on July 24, 2007, the excavation was down to bedrock and pipe bedding installed for the first section of culvert. Once the pipe was installed, the grade and alignment was checked and rechecked to ensure alignment. The second section was installed, and again grades and alignment were checked and rechecked. Backfill of the pipe was initiated and compaction of the six-inch lifts proceeded.

The engineer had granted approval to use a non-standard backfill designated as reject. This product proved entirely satisfactory as it had a lot of 1" rock and varying amounts of finer material that compacted well. Multiple passes with a portable remote controlled sheeps foot vibrating roller was performed. Due to the nature of the material, compaction tests could

not be run, but approval of the product for backfill by the engineer made that unnecessary.

Compaction was closely integrated with the bedding and backfill on the pipe. A Bomag vibrating drum construction roller was used to compact the roadway once cover had been sufficiently established over the culvert. Each lift of road base was compacted thoroughly.

4.2.6 Installation of the –surge material" (special approved rock and soil placed inside the pipe to simulate a stream bed) along with resting rocks was placed over the next two days as the final grade was established over the culvert. The final day of the project was devoted to installing rip-rap protection on the side slopes and the stream improvements made down stream of the outlet.

4.2.7 A significant effort in this project went into meeting the environmental permit conditions by maintaining erosion and sediment control measures, stream diversion/dewatering, and ensuring all of the conditions of approval were met. The project occurred in a very confined area; that constraint presented some additional coordination issues and logistical challenges in such a tight area. For example, the access road was one lane, allowing very little room to maneuver near the culvert. Trucks could only come into the site at the bottom of the canyon one at a time, which limited rock deliveries to about one every 30 minutes. The crews coordinated carefully to ensure safety when trucks and equipment working were onsite.

4.2.8 The environmental details of the project were monitored by the department's Environmental Services (ES) staff. The ES staff will coordinate the final elements of the project, which is seeding the area with a riparian seed mix and then plantings according to the plans. This portion will be scheduled for after the fall rains begin.

4.2.9 The fact that crews have a vested interest in doing the right thing correctly makes these a natural project fit for Force Account work. There are no benefits to the crew to cut corners or push through just to get the job done.

A contracted effort, on the other hand, may have felt pressure (the profit motive) to complete the work in a shorter time, and the workers may not have been as thorough in meeting the permit and design specifications. An example occurred when the rain began July 17. The crew continued to work, but quickly shut the trucks off to keep from tearing up the access road, which had no rock on it. Then on July 18, they made a decision to shut down until the rains ended instead of pushing ahead. On July 24, the crew discovered the excavation slopes were steeper than allowable and immediately excavated them to the required slope before doing further work. The banks looked stable but were simply steeper than safety rules allowed.

4.2.10 Everyone associated with this project contributed to ensure it was built as specified by the permits and plans. The crew takes pride in and appreciates the fact that the department managers have the confidence in the drainage crew to tackle this kind of

project. The actual work itself is not as difficult as all of the precursor work and details leading up to the actual pipe installation.

However, there are many critical details to the work that can create problems if not dealt with correctly. Cooperation was evident among all of the folks in the department who participated, including the Drainage Division, Engineering, Environmental Services, and the Bridge Division.

The nearly finished project fits closely to the specifications, plans, and the permit conditions. The drainage supervisor and crew members self-monitored the project, and it was completed as designed. There was no project inspector required and oversight was minimal.

This is an example of why Force Account work can be accomplished without dedicated project inspectors.

4.3 Pottratz culvert installation: Critical To Quality

4.3.1 Adherence to engineered plans. Permits and approvals were issued based on the engineered plans developed for the project. Deviation from the plans could be construed as a violation of those permit and regulatory approvals. The crew worked carefully to ensure permit conditions and plans were strictly adhered to.

Strict control of grade and alignment of the culvert pipe. Installation of the pipe on the strict design profile was required to ensure successful mitigation of the streambed and bank damage and simulation of a streambed within the pipe. The crew used surveyed control points to ensure elevations. When it was time to bed the pipe, the crew used a level and rod to ensure the final grade and percentage of fall was correct. It checked multiple times to ensure accuracy.
Streambed horizontal alignment was set using a stringline and control points.

4.3.2 Adherence to permit and environmental conditions, Including Slopes III, ODF&W guidelines for road-stream crossing, ODOT Best Management Practices, and Washington County‘s Routine Road Maintenance BMPs.

4.3.3 All work was to occur within the defined project area, which was a defined significant natural resource area containing a restricted work area defined as the bed and banks of the stream, the adjacent riparian corridor and vegetation, and areas of the channel defined by the normal winter high flows.

RMA observed that equipment (dozer and several smaller pieces of equipment) were left overnight within the restricted work area during the project. This was a violation of the departments BMPs and the contract specifications. Section 00290.30(a)(1) required that equipment be parked at the end of shift at least 150 feet from the restricted work area.

The equipment was parked within 50 feet and no spill containment was provided. The equipment was all in good shape with no leaks and was clean; however, it was a direct slope to the stream. There was very little water in the stream, and any spill—whether by mechanical failure or vandalism—would have been harmful to the stream.

RMA observed evidence of off-work hour visits by OHVs even though the road was barricaded and signed closed. This increased the risk of vandalism to equipment parked within the restricted work area. No impacts from this deviation occurred during the project.

4.3.4 CTQ recommendation culvert installations. RMA noted that LUT did not perform any site visits during the work shut down from July 18 through July 23 to ensure ESCP controls and stream diversion systems worked as intended.

The BMPs and specifications required daily inspections of erosion and sediment control plan daily during construction and after heavy rainfall and during periods of inactivity. Section 00280.

All devices did appear to work during the shut down. Water quality was good in the diversion, and the dewatered area and the erosion control devices worked.
The crew expressed surprise when they arrived on site July 23 that everything was working. Before the shutdown they had discussed having someone on call visit the site to ensure operation; however, it appeared no one had checked the site.

4.3.5 Safety in excavated areas is a critical safety item. When excavations are over four-feet deep the slope angle needs to be cut back to a 1½'-1' angle. The slope angle was not cut back to the required slope until the afternoon of July 23, 2007. Before workers enter the excavated area, the slope angle needs to be set to the required 1½' – 1' or approved at a lesser angle by an engineer.

The excavation walls were solid and stable. However, unless the engineer approves the lesser slope angle, the rule must be followed. A contractor would have been expected to comply with this requirement as well.

4.4 Pottratz culvert installation: specification deviations

RMA observed some deviations and concerns during the project. While none of the deviations appeared to have affected the finished project nor resulted in an adverse impact during the work, they are worthy of comment to ensure future projects are completed in an improved manner. If a contractor was performing the work, a project inspector may have intervened and required a different action.

4.4.1 A utility worker was assigned to the project with less than six months of service and had not yet been through the department‘s BMP training. Senior crew members directed this individual, who learned the procedures through mentoring. He did mention he was looking forward to receiving the training.

4.4.2 RMA observed a utility worker wearing chest waders on two occasions (July 23 and 24) getting into the pumping area between the primary and secondary diversion dam to move or reset the suction intake on the diversion pump. This would cause the diverted water being pumped to be very dirty for up to 20 minutes. ES staff reported later that turbidity was still somewhat high an hour later.

While not a violation of turbidity limits, it was unnecessary. The suction could have been moved and placed from the top of the dams. Ensure all workers understand the purpose of the ESCP and turbidity requirement.

4.5 Pottratz culvert installation: recommendations

4.5.1 Critical to Quality (CTQ) is compliance with BMPs that require someone to visit the site daily to ensure erosion and sediment control measures work continuously throughout shut downs and delays.

The on-call employee during weekends and shut downs should be directed to check the site to ensure all diversions and controls continue to work.

4.5.2 CTQ (safety) recommendation. Always ensure that slopes of the excavation are at the engineered degree of safe slope before placing workers in the excavated area.

4.5.3 CTQ is adhering to all permit and BMP requirements. Parking the equipment beyond the 150-foot distance or beyond the vertical curve may have been impractical in this situation. The project area was confined and steep. Equipment should either be moved away from the restricted area or the supervisor should seek approval from Environmental Services to park it within the restricted area.

If projects like this occur in the future and there are no alternatives, containment for equipment within the critical area could be constructed.

4.5.4 While crew members had been trained in BMPs, there were several situations in which a relatively new utility worker may have made errors because even with training, he did not yet grasp the entire concept of maintaining water quality.

Ensure all workers receive BMP training at the earliest date. If that is not possible, mentoring can be substituted. Refresher training is a good idea until crews have had several experiences with this kind of project.

Ensure utility workers clearly understand the ESCP and that the purpose of the diversion is to ensure constant stream flow around the dewatered work area.

Section 5: Non-permit required culvert installations

5.0 Non-Permit required culvert installations

Non-permit required culvert installations occur in roadside drainages and areas where live streams and restricted areas do not occur. These areas may receive seasonal storm water and crews install culverts to direct the water into another area. While not requiring permits, these installations are still covered by the county‘s BMPs and adherence to those and general good construction technique is required.

5.1 Bacona Road culvert installation: observations and data discussion

Bacona Road is a higher elevation gravel road located in the northwest portion of the county. The road is a winding, mountainous road typical of a number of rural Washington County roads. This road had previously not had enough cross culverts to divert water across the road. Crew members reported that during heavy rain the road was a mess, with water sheeting across the road because the ditches could not carry the run off. The gravel road portion has a sparse number of houses, some tree farms and private timberland. There are power and telephone utilities buried along the road that the crew had to work around continuously.

5.1.1 The work consisted of installing a number of cross culverts to improve winter drainage during higher water events. RMA reviewed eight such installations as part of this report.

RMA first visited the area August 1, 2007. The crew had already installed four cross culverts, which RMA reviewed. The crew was working on a fifth cross pipe when RMA arrived. The pipes were all 12" diameter N12 pipe, roughly 30- to 50-feet long.

5.1.2 The four pipes all appeared to have been installed in a practical manner to pick up water in the middle or end of fairly long stretches where runoff occurred. The pipes were bedded and installed on a bias to the roadway when on downhill runs. Pipe cover was good, but several pipes appeared to have their outlet ends protruding too far out from the road base. RMA was later informed that these would be cut back and diffuser rock would be installed on the outlet ends, and ditches would be improved to match the inlet ends. There were bio-bags in the ditches all along the road, which the crew informed RMA was a result of not having previously had any cross pipes to divert drainage. The bio-bags would be removed when the work was complete.

5.1.3 The crew was small, consisting of one or two trucks, a backhoe operator/lead worker, and two utility workers. Due to the distances crews had to travel to reach the work site, they were only getting about one culvert installed each day.

The crew‘s procedure was to install one half the pipe at a time, thereby maintaining an open travel lane for anyone who wanted past. With any time left at the end of the day the crew installed 4"-8" clean diffuser rock around the culvert outlets or shaped the adjacent ditches.

The local traffic consisted of a few residents daily and a log truck. Due to the extremely low traffic volume, flagging and signage was minimal, but adequate.

Veteran crew members acknowledged and were able to converse well about the requirements of the departments BMPs. They were familiar with the reasons for controlling erosion, sedimentation, turbidity, slowing velocities, and diffusing the discharge.

5.1.4 Excavations and exposure to utilities was carefully done (although some had been cut during earlier installations). Once the excavation was below flow line, pipe bedding was installed, and the pipe bedded and backfilled. The crews were using the same reject 1-inch minus rock that had been used on Pottratz for backfill. The rock was wet and installed in 4-6' lifts and thoroughly compacted in lifts using a rammer. The crew was very careful on backfill and compaction. The percent of fall on the pipes was visually checked instead of being checked with a level and rod.

5.1.5 RMA visited the site August 28. A level rod and hand level was used to check the fall on all eight installed culverts. The table below shows the average fall on the pipes. While adequate, RMA noted that the crew did not use a level rod or level to ensure the appropriate percentage of fall on the pipes. Instead, crew members visually confirmed the percentage of fall and then covered the bedded pipe. While a practiced eye can ensure fall, it is possible to have insufficient fall to the pipe to ensure it remains clean.

Small Diameter Culvert Data Bacona Rd

Culvert #	Inlet Elev	Outlet Elev	Length Ft.	10ths fall	Location (plus or minus 100‘ GPS)	Notes:
1	7.2	9.7	36	7%	N 45 42' 03.2" W 123 10‘ 55.2"	
2	7.1	9.5	39	6%	N 45 42' 30.5" W 123 10‘ 44.1"	Dog leg in middle
3	6.4	9.4	39	8%	N 45 42' 36.1" W 123 10‘ 46.3"	
4	6.9	8.2	39	3%	N 45 43' 40.6" W 123 10‘ 21.3"	
5	7.8	8.9	29	4%	N 45 44' 15.2" W 123 10‘ 03.9"	
6	7.5	8.25	31	2%	N 45 45' 12.6" W 123 09' 00.4"	Hump in the middle
7	7.1	9.8	44	6%	N 45 45' 13.3" W 123 08' 50.1”	
8	7.6	9.55	53	4%	N 45 45' 14.7" W 123 08' 29.4"	Dog leg left from outlet

5.1.6 RMA also observed that several of the pipes when viewed from the outlet end had either a dog-leg bend in the pipe at the joint or a hump in the middle. The N12 pipe used is flexible and easy to install. It also makes it possible to lay pipe in an unlevel bed. While the

dog-leg bends probably won‘t hurt the pipe, the humps in the middle may accelerate sedimentation and plugging in the pipe.

5.1.7 RMA noted that the inlets of several pipes were placed very close to the bank. As time passes and with sluffing of the bank, the location of the inlet may be lost unless they are somehow marked. During a storm event a marked inlet would help crews quickly locate the pipe inlet and clear them.

5.2 Critical to Quality non-permit required culvert installation

5.2.1 Critical To Quality (CTQ) NP12 culvert installation. The cross pipes installed were not checked for grade and percentage of slope angle from inlet to outlet. The crew would excavate to approximate depth for inlet and then excavate to achieve a visually estimated slope angle for the culvert. The table above illustrates the variation in percentage of slope angle. All were within the recommended amount of 2 percent slope angle. It could easily be possible to install a pipe under these conditions with reverse slope angle due to optical illusions.

5.3 Non-permit required culvert installation: minor deviations

5.3.1 A utility worker assigned to the project with less than six months service had not yet been through the department‘s BMP training. Senior crew members directed this individual, who was doing a good job and learning the procedures through mentoring.

5.3.2 Several inlets were placed very close to the bank in fairly narrow ditches. Inlet locations should be marked using a durable stake to allow crews to quickly locate them when cleaning inlets during storm events. Inlets to pipes installed on a bias to the road can be very difficult to locate once they have become plugged. This will also help crews clean ditches in the future. Grader operators will be less likely to fill them or hook them during grading operations.

5.4 Non-permit required culvert installation: other

5.4.1 This crew was performing its work in a remote location with the burden of working around utilities and with scarce resources. While productivity was lower than could be expected, each pipe was installed to complete the work each day while keeping the road available to those few residents who depended up it for access. The crew then kept busy doing other routine maintenance in the general area, including ditching, maintaining culvert trenches, graveling short stretches and installing diffuser rock.

5.5 Non-permit required culvert installation: recommendations

5.5.1 CTQ is for drainage crews to be equipped with and encouraged to use level rods and at a minimum a hand-eye level to shoot the grade and calculate the requisite fall. The N12 pipe product used is very slick and thus self-cleans easily with minimal fall. Optical

illusions, however, can cause a pipe to be installed without appropriate fall or even reverse fall given the grades and uneven terrain they were working in.

5.5.2 Mark inlets on cross pipes using a utility stake and paddle marker as a means of locating them quickly during storm events. There will be less likelihood of losing the pipe, especially on those installed on a bias to the road.

5.5.3 Make certain pipe beds are level on the percent of fall to ensure they are self cleaning.

5.5.4 Ensure all workers receive BMP training at the earliest date. If that is not possible, then mentoring can be substituted. Follow-up training is a good idea until crews have had experience on this kind of projects.

5.5.5 Ensure crews working in remote locations have enough work assigned to complete the work day. Alternate activities should be scheduled ahead to ensure the day can be completed productively.

Section 6: Machine patching

A pavement management system is used to record and rate the surface conditions on the paved road system. Washington County maintains a relatively high pavement condition rating compared to many other counties. Part of maintaining a high system rating involves using an integrated approach to maintaining pavements. Machine patching on paved roads is one such tactic.

Effective machine patches produce repairs to structurally deficient sections of the road surface when the rest of the road is otherwise sound. Machine patching combined with other tactics used in maintaining surfaces can reduce the frequency of need for pavement overlays.

RMA observed roads selected for machine patching first hand and evaluated the process using the Machine Patching QA Matrix. (See Appendix H for ratings and explanations.)

6.0 Machine patching with Hot Mixed Asphaltic Concrete (HMAC)

A paving machine was used to place a specified grade of hot mixed asphaltic concrete to produce patches with a uniform and finished look to them. Other forms of producing these types of patches are tailgate paver placement, hand raking, blade (grader) patching, and using various forms of mechanical assisted placement devices. Using a paving machine arguably creates the most uniform, even patches possible.

Once the asphalt has been placed and shaped to the desired result, it is compacted using rollers. Compaction is one of the CTQ elements in proper placement of asphaltic concrete. Proper rolling ensures the finished product will add to the structure of the road and provide a smooth ride. Compaction ensures the maximum longevity of the patch.

6.1 Machine patching: observations and data discussion

6.1.1 Hot Mixed Asphaltic Concrete (HMAC) used for machine patching was produced by two different batch plants. The mix was temperature tested and visually observed as it was being dumped and placed. The temperatures were observed to have always been well within acceptable limits (See Appendix J, Machine Patching Temperature table.)

Tack oil was a dilute CSS-1 and was shot at a .03 and allowed to break before the asphaltic concrete was spread.

6.1.2 The manpower available on the machine patching crew was judged to be right for the size of equipment available, the work to be completed, and conditions present. The exception was that there were fewer truck and trailers than needed to haul HMAC to the job sites on most days.

The flagging operation was handled by department personnel professionally and thoroughly. The work occurred in a heavy residential area, and there were many driveways with vehicles coming and going throughout the day. The flaggers simply handled business and routed traffic as needed.

6.1.3 The equipment available for use in machine patching was generally in good shape, adequate for the work performed, and reliable. There were no breakdowns that delayed operations during RMA's observations.

Through some misunderstanding, however, there were not enough truck and trailers to keep the process moving as needed. There were four truck and trailers from the Surface Division. The work would have benefited from at least two more truck and trailer units. Two bob tailed trucks from the Drainage Division were temporarily assigned to help, which improved production. The haul distance from Knife River was two hours round trip. Later the surface supervisor switched to hauling HMAC from Lakeside Industries, which reduced the haul to just under an hour and a half.

6.1.4 The technique used to produce the overlays was appropriate for the area being paved. The crew used manual screed adjustments to obtain two inches of HMAC behind the screed. The two screed operators were knowledgeable and did not make adjustments needlessly. On the second panel they set up the electronic controls to control the screed adjustments. The result was a reasonably smooth overlay placed on tight residential streets.

There were at least two rakers and usually three making sure the centerline joint was raked down. There were a large number of driveways that required an approach and hand raking.

6.1.5 Two rollers were available for the machine patching work. One roller was a Cat CB-534C tandem steel wheel roller that weighed 11 tons. This roller was used for most of the rolling, including breakdown and intermediate rolling. The smaller roller was a Dynapac CC 122. This roller weighed three tons and was used for rolling driveways.

OSHD Standard Specification 00744.24 calls for breakdown rolling to be performed by either a steel wheel tandem roller or a pneumatic wheeled roller. Steel-wheeled rollers need to weigh at least eight tons. The Cat roller exceeded this specification and was suitable for the work being performed.

Finish rolling was performed intermittently using the Dynapac roller (or not at all). One operator chose to use it as a finish roller as well as a driveway roller. The roller had fairly small diameter drums and tended to shove the mat around after it had been rolled by the larger machine intermediate rolling passes.

OSHD Standard Specification 00744.24 calls for tandem wheeled finish rollers to weigh at least six tons. A six-ton roller would have larger drums and would be suitable for finish rolling. The Dynapac was not suitable for finish rolling in either weight or capability and should probably only be used for driveways.

Breakdown rolling of the HMAC occurred near the back of the screed. Breakdown rolling and intermediate rolling was normally accomplished while the mix was well over 200 degrees. There were, however, never more than three complete coverages made across the mat.

OSHD Standard Specifications section 00744.49 calls for six complete coverages to be made by the breakdown and intermediate rolling. Section 00745.49(c)(2) indicates four complete coverages are adequate on small projects.

Finish rolling was not normally performed. One operator periodically assigned to the small roller (for driveways) would finish roll the mat as it reached temperatures close to or below 180 degrees.

A contractor would probably have been required to finish roll either with the breakdown roller (a bit large) or provide an appropriately sized roller for this purpose.

6.2 HMAC: Critical to Quality

6.2.1 Critical to Quality (CTQ) is testing of Hot Mixed Asphaltic Concrete. HMAC ordered for the work was a JMF Level 2. At a minimum a set of certified test documents should always be received to indicate the plant is really producing that product.

6.2.2 CTQ of machine patching is having the necessary manpower to handle and place the mix. The manpower assignments were about right on the crew, and the traffic control was just right. There were enough hands to ensure the mix was placed, raked, and rolled while it was hot.

The veteran workers were skilled and familiar with the equipment and work to be done. They coached and trained the newer utility workers as the work progressed. Finished results on the centerline joint and driveway wings continued to look better as the work progressed.

6.2.3 CTQ is the temperature of the HMAC at various stages of handling and placement. The HMAC cannot be over heated or it will be burned and not hold together. It should not be too cool when placed and worked or a finished look cannot be achieved. Proper roller breakdown and intermediate compaction is achieved prior to the temperature dropping below 180 degrees.

The temperature checks were above the minimums in all cases. Trucks tarped their loads if the air temperature was low, and the mat behind the screed was always above 250 degrees.

6.2.4 Rolling is critical to the quality of asphalt paving. The appropriate rolling technique and number of coverages is important to achieve compaction densities. The strength and structure of the mat are affected by the number of coverages made by the rollers.

6.3 Machine patching specification: deviations

6.3.1 RMA observed that on a number of occasions (fewer than five) HMAC placement commenced before the tack oil breaking on short stretches of road.

The crew did a good job of not shooting tack out too far in front of the operation. However, on those few occasions the paving operation caught up to the tack distributor, they shot tack and then immediately began to lay mix. This only occurred a few times over the course of observation on cool days.

6.4 Machine patching: other

6.4.1 Roller checks were observed in the mat on numerous occasions. Roller checks are short cracks less than a couple of inches long that appear in the mat after initial rolling has taken place. They are a result of using a steel tandem roller for the breakdown passes. Roller checking normally does not occur if a pneumatic wheeled roller is used for the breakdown rolling.

The checks usually do not extend very far into the mat and probably don‘t affect the finished product. Finish rolling would probably eliminate them altogether.

A contractor would likely be required to finish roll an overlay and therefore would eliminate the roller checking.

6.5 Machine patching: recommendations

6.5.1 A department level rolling protocol needs to be established when rolling HMAC. The protocol needs to be communicated to everyone who rolls HMAC.

As a recommendation OSHD Standard Specification 00744.24, 00744.49 address characteristics of compactors for rolling HMAC. Section 00745.49 (a)(2) addresses appropriate rolling patterns to be used.

6.5.2 Density. OSHD Standard Specifications exempt overlays of two inches and less from density standards. A rolling protocol should, however, address the number of coverages that are to be performed on the mat. Consistency is important to achieving mat densities.

6.5.3 If finish rolling is to be part of the protocol, then a minimum six-ton steel wheel tandem roller should be acquired or rented for finish rolling on machine patching.

6.5.4 Because of the small quantities typically used in machine patching, an on-going testing program is probably not indicated. It would be useful, however, for someone to periodically review the current test documents for JMF supplied to the county. If they are within acceptable limits, no further action need be taken.

6.5.5 The effort at machine patching was less productive than it could have been. There should be enough trucks with trailers to ensure mix is delivered to the job for almost continuous operations (while allowing for needed breaks and lunch break).

Before beginning the machine patching work, the haul distances, numbers of truck and trailers, and mix quantities needed to achieve a productive effort should be determined. Regular adjustments to these resources will assure the most productive effort possible.

6.5.6 Consider extending the four-ten hour day schedule until machine patching is completed. Mobilization and start up and shut down of the equipment took up 2.5-3 hours each day. An extra day of mobilization was added when the shift returned to the five-eight hour day schedule. This reduced productivity for the week by 100-150 tons, depending upon the number of trucks and haul distances involved. During the four-ten schedule the trucks hauled an additional round of HMAC each day. Productivity per labor hour would likely increase under this scenario.

Clarification with the crews about how and when to take breaks and lunches while machine patching is needed. This issue created a distraction for a couple of days while paving on Canyon Drive. Clarification of bargaining unit rules related to breaks and lunches and when they can be taken to ensure continuity of the operation is needed.

The logistics of this should be worked out before beginning the work. Not all workers need to be on break at the same time, and flexibility in timing of breaks and lunches to coincide with natural breaks in mix delivery can smooth this issue out. Most importantly, everyone needs to have this communicated to them so they understand it.

One possible solution is to have one of the utility workers and one of the screed operators work as a team to ensure that breaks are given to crew members in rotation. This arrangement has been successfully used in production type work in the past.

For example: Complete the training of a utility worker to operate the screed on a temporary basis (there was some ongoing training of this type occurring during the work). Have the utility worker replace the screed operator while the other screed operator takes a break. A screed operator relieves the paver operator. The two roller operators either schedule their breaks for the natural breaks that occur or relieve each other as timing permits. The utility worker(s) then relieve the other utility workers (rakers) and, in rotation, the flaggers. Everyone should receive his or her allotted break within a one-hour timeframe. Truck drivers can schedule breaks for the natural break while waiting to load or unload or some other advantageous time.

Section 7: Conclusions quality assurance oversight 2007 surface and culvert projects

While this report focuses on areas where process changes or improvements can be realized, items listed in matrixes and appendixes rated as ―satisfactory" are equally noteworthy. It is no small accomplishment to bring to bear the elements necessary for a successful maintenance program on a complex road system. The managers, staff, and crew members are all to be commended for their hard work and dedication that keeps the county's road system in shape for its citizens.

As a result of this study, RMA concludes that with the noted exceptions, LUT force account work adheres to the same standards as a contracted effort. When the recommendations are considered and adopted, in-house crews will meet or exceed the standards to which contractors are held, which was the objective when department managers initiated the QA project.

Recommendations:

<u>Chip Sealing Gravel Road Upgrades</u>

- CTQ implementation of an independent liquid asphalt sampling and testing program. Alternatively require supplier to certify and stamp each load ticket with quality data.
- CTQ implementation of an independent rock sampling and testing program.
- CTQ ensure enough of the right product is on hand for each job. Ensure that extra product is handled in an appropriate manner.
- Consider using a different product than MC-250 for shooting prime coats on gravel roads. Several counties are experiencing success with using CRS2-P.
- Consider using a two shot system for gravel road upgrades as opposed to the current three shot system.
- Ensure lead workers are empowered to make decisions related to sanding chip seals that are picking.
- Review flagging effort and consider using fewer more highly skilled flaggers. If contract crews are used for this effort, make certain they are identified as such to reduce the potential negative image relecting on LUT folks.
- Require that all LUT employees wear appropriate personal protective equipment when on the job site: i.e., high visibility clothing when working on the ground in the work zone.

- Consider having the surface supervisor or some other person on site during most of the days operations to ensure QA standards are being met, Including sampling, rolling, logistics coordination, and proper traffic control.

Chip Sealing Paved Roads

- CTQ implementation of an independent liquid asphalt sampling and testing program. Alternatively, require supplier to certify and stamp each load ticket with quality data.
- CTQ implementation of an independent rock sampling and testing program.
- CTQ develop a department standard rolling procedure for chip seals. Ensure rollers, chip spreader and distributor all work as a unit on the application process.
- CTQ ensure the surface to be swept is clean. Additional sweeping may be required just ahead of the chip sealing process.
- Take advantage of pre-positioning trucks along the mat to increase efficiency.
- Cut driveways back that are encroaching on the road surface to improve effectiveness of the chip seal.
- Consider acquiring a 4WD chip spreader to better handle steep grades without damaging the oil mat.
- Consider having the surface supervisor or some other person on site during most of the days operations to ensure QA standards are being met, Including sampling, rolling, logistics coordination, and proper traffic control.
- Develop a performance standard for chip sealing. Identifying what, why, when, how and what the finished result should be. This will answer most questions that come up related to the work.
- Hold a preseason discussion in 2008, led by the supervisor and the lead worker, about the above changes as a way of leading toward continuous improvement.

Culvert installations permitted

- CTQ compliance with the BMP related to visiting the site daily to ensure erosion, sediment control, dewatering, and diversion measures are working.
- CTQ is ensuring the correct slope of the excavated area prior to allowing employees to work in the excavation.

- CTQ park equipment for the night beyond the 150-foot distance from the critical zone. Build containment if impractical to move beyond the restricted area.
- Ensure workers are familiar with and trained in the BMPs at the earliest opportunity.

Culvert Installations – non-permit required

- CTQ use a level rod and level to ensure correct percentage of slope on culvert installations. Minimum should be two percent from inlet to outlet.
- CTQ make certain the pipe beds are consistent on the percent of fall from inlet to outlet to ensure self cleaning.
- Mark inlets on cross pipes using a utility stake and paddle marker as a means of locating them quickly during a storm event.
- Ensure all workers receive BMP training at the earliest date.
- Ensure crews working in remote areas have enough work assigned to complete the work day. Alternate activities scheduled ahead to ensure efficiency.

Machine patching

- CTQ develop a department level rolling standard for rolling machine patches. Consult OSHD Standard Specifications 00744.24, 00744.49, 00745.49 for breakdown, intermediate and finish rolling equipment requirements, and number of passes to achieve appropriate compaction.
- Review HMAC test data from supplier to ensure they are within acceptable limits.
- Ensure there are enough trucks assigned to the effort to be as productive as possible with the effort.
- Extend the four ten hour day work week until the program is completed to ensure greatest efficiency with the work. This will reduce daily mobilization cost.
- Consider using relief operators to rotate breaks to ensure they are received appropriately by the crews.

Conclusion

Once these recommendations are incorporated into the already high standards in-house crews follow, both managers and the public can be confident that in-house crews are performing at or exceeding the standards to which contractors are held.

Appendix A

Application of oil mats to gravel roads
July 2007

The following statements are verbatim responses supervisors, managers, and engineers gave in response to the questions, "What is your standard practice when doing chip seals to upgrade gravel roads? Do you use a two- or three-shot process?"

Clatsop—Ron Ash, county engineer
We are normally using a 2-shot mat. We use 1/2 - 1/4 and then 3/8 - #10. We stopped using MC 250 about 10-12 years ago. Now we use strictly CRS2-p. Additionally, we are placing a fog seal over the top mat to avoid picking and enhance the striping. This appears to be standard practice as the participants of the 9th International Conference on Low Volume Roads in Austin explained. Some oil mat roads in South Africa have ADT's in the 20,000 range w/ heavy trucks. However, their specs and inspection process is very focused and the oiling contract is performance-based.

Deschutes—Roger Olsen, operations manager
I've always used 3 shots starting with 3/4-1/2. I don't know which county is using this, but it sounds awfully weak. I would have used 2 1/2-1/4 shots then a 3/8-#10 if I couldn't get 3/4-1/2.

Douglas—Tim Rummel, operations and division maintenance manager
We have used the two shot approach on our low volume roads for years. The first shot is MC-250 with 3/4 to 10 rock. The second is CRS-2 with 3/8 to 8 nickel mine slag our standard chip seal rock. Any other questions feel free to give me a call.

Hood River—Don Wiley, county engineer
We've had some success with 2 shots in place of a thin overlay on paved roads with bad raveling. On gravel we use 3 shots - 2 of 5/8-10 and 1 of 3/8-10. CRS-2 for all.

Jackson—Mike Kuntz, road maintenance engineer
We do use two shots and here's our process.

We sweeten the rock until we have a minimum section of 12-inches (depending upon volume/classification).

Shoot 0.55 to 0.60 gallon per square yard of CRS-2P topped by 30 to 32 pounds per square yard of 1/4"-1/2" chip seal rock on a well compacted recently wetted damp base.

One week later we shoot 0.52 to 0.57 gallon per square yard of CRS-2P topped by 30 to 32 pounds per square yard of 1/4"-1/2" chip seal rock.

One week later we (usually) apply a fog seal of CQS-1H at 0.12 to 0.16 gallon per square yard blotted with sand or other material to prevent tracking.

Klamath—Stan Strickland, public works director
We have done a couple 2-shot applications using PMCRS-2H and a similar rock recipe on low volume local streets. They have held up well so far; the oldest are only 3-4 years old.

Union County—Rich Comstock, public works director
Union County does a few of these. We do a 3 shot mat with one lift of 3/4" to 1/2" and two lifts of 1/2" to 1/4". The following year we do one or two more lifts of 1/2" to 1/4". We typically use Albina's high float (polymer) oil and have had very good results. If we do an LID and chip seal has been chosen because of the cost, then we mandate a five-shot application if we are to assume the maintenance.

Wheeler—Robin Ordway, secretary for Road Master Dewayne Simons
We use a two shot process.

Appendix B

ODOT accepts asphalt blame

LTM Inc.,which mixed the asphalt for the north interchange project, won't have to pay repaving costs

By Bob Albrecht
Mail Tribune
August 16, 2007

The public will pay the $300,000 to $400,000 cost of repaving needed at the north Medford interchange.

The Oregon Department of Transportation is accepting responsibility for the faulty asphalt mixture used during the 2005 paving of the interchange. In accepting the blame, ODOT is agreeing to pay to repave the highway.

Wednesday's announcement follows months of discussion over who was at fault for the separation and pooling, or "flushing," of the "F mix" asphalt used along Highway 62.

ODOT says the problem is just visual at this point, but ruts will develop in the road surface if the asphalt isn't replaced.

―At this point it's not (a safety concern),‖ said Joe Thomas, construction project manager for ODOT. ―That‘s why we want to get it replaced now.‖

ODOT conducted numerous tests on the mixture to determine whether it, or contractor LTM Inc. of Medford, was to blame, said Thomas.

―What we determined is that the primary responsibility for this is ODOT‘s,‖ Thomas said.

Although contractors are responsible for mixing asphalt on state projects, the state is responsible for checking the mixtures.

Jim Huddleston, director of the Asphalt Pavement Association of Oregon, said creation of the mix is an inexact science, especially with that grade of pavement.

He likened it to baking a cake, saying ODOT proposed the cake and LTM came up with the recipe. ODOT did tests on the mixture and was able to ask for changes.

They didn‘t request any alterations.

―All the ‗frosting‘ ran off the ‗cake‘ and pooled on the plate,‖ Huddleston said.

Huddleston added that a clause in the specifications says the contractor (LTM) must correct any defects in the materials and work, such as when oil separates from the rock, at their expense.

The mix used at the north interchange may have worked well in Coos Bay, but not in Medford‘s high temperatures, Huddleston said.

Regardless, ODOT is accepting the blame.

Dave Midtlyng, former vice president and general manger for LTM, told the *Mail Tribune* in a previous story that the company stands by its product.

Thomas said the pavement of the interchange, which was completed in October of 2005, was rushed to be finished before winter. Even in October, weather had an effect on ODOT‘s ability to properly analyze the asphalt mixture, Thomas said.

―The cold weather had some issues where it made the liquid asphalt stiffer and hid some of the signs we normally look for when we check out the oil,” Thomas said. ―You can usually tell when there‘s excess oil. But we really couldn‘t go through the winter without paving it.”

Thomas said LTM could have done things better, but the responsibility for checking the oil fell on ODOT‘s shoulders.

―There were some issues around gradation, but when it was all said and done, LTM didn‘t really cause what we saw,” he said.

Money to repave the north interchange remains available in the project‘s budget, said Gary Leaming, a project information coordinator for ODOT.

―There‘s always a contingency fund,” Leaming said.

Repaving the half-mile stretch from the Bear Creek bridge to 100 feet east of Poplar Drive, once again contracted by LTM, is set to begin on Sunday night and run through Wednesday. The work will be done exclusively at night, starting at about 9 each evening. It should be wrapped up by 7 each morning when commuters start heading to work, said Thomas.

One lane heading in each direction will remain open throughout the night.

He added that delays should be minimal, up to 20 minutes if drivers are caught when the crews are setting up for work.

The roadways will be bare on Monday and Tuesday but still drivable, Thomas said.

―We‘re going to inconvenience people as minimally as we can,” he said.

In future projects, Including pavement at the south Medford interchange project, Thomas said ODOT will go to greater lengths to make sure the mix is properly composed.

―We‘ll probably do some more tests on the tail end of the asphalt plant,” Thomas said.

Appendix C
Clark Hill Road

Clark Hill Rd. was chip sealed in 2006. RMA was notified that it had begun to bleed and visited the road July 11. Several factors can occasionally cause an old chip seal to bleed. Materials can contribute if they didn‘t meet the required specifications.

Since this was the only road that seemed to have a problem, and it did not appear to be happening along the entire road, materials may not have been the culprit. Test reports on the liquid asphalt and rock used along this stretch would be valuable as they could eliminate them as contributors. Methods could also contribute if the rock was over embedded when the chip seal was performed; generally, 50-60 percent embedment is optimal. However, the non-affected areas appeared to be okay, with no flushing outside of the wheel track areas.

It appeared that the road was being subjected to a combination of extreme factors, Including heat, heavy truck traffic, and heavy truck turning movements. The surface mat had chunks picked up in the wheel tracks. It was sanded heavily to blot the bleeding and stop the surface from picking up.

When RMA viewed this road July 11, temperatures were in the high 80s and low 90s. The sanding had done its job, but several sections of the road had been damaged. The damage was the worst—in both directions—where trucks turned on to Clark Hill Road from the quarry at Highway 10 and at the intersection of Tile Flat Road.

While not completely unusual for this to happen, it likely occurred from a number of conditions working in combination on this road. July 10 was one of the hottest days of the year, 100 degrees recorded at the Hillsboro Airport. Clark Hill Road is heavily traveled between Farmington Road and Highway 10 by both autos and trucks weighing up to 105,500 lbs. At the rock quarry heavily loaded trucks were turning out onto the oil mat going in both directions. Once the heat and pressure from the trucks started the oil flushing, tires began to pick it up and carry it down the road in both directions. The damage was less severe beyond Tile Flat Road, as it headed toward Farmington Road.

The road surface has been damaged in a number of places and will require increased maintenance. Skid resistance along this section will be reduced somewhat due to the oil that flushed up over the top of the rock. Potholes will certainly develop where the oil mat was lifted.

Options: There is little that can be done to fix the immediate damage. Another chip seal will likely have same result as the road sections have an over-rich oil condition making it a possibility for similar occurrence with a new chip seal or even a machine patch directly over the bad spots. A dig out and machine patch of several areas might fix the problem.

Consideration should also be given to whether chip sealing is the right maintenance solution for this road. A better possibility might be to periodically machine patch this and other areas where heavy truck traffic combined with severe turning movements occur.

Clark Hill Road near Tile Flat Rd. 7/11/07

Clark Hill Road at Tile Flat Rd. 7/11/07

Appendix D

Gravel road upgrade quality assurance matrix: explanation of ratings prime coats

Seavey Road

Personal protective equipment – Roller operator was not wearing a safety vest or other high visibility safety clothing. He worked on and around the chip spreader periodically.

Liquid asphalt samples – No sampling of the liquid asphalt has occurred. Therefore, no independent testing is possible. Albina Asphalt Co is supplying the MC-250, which it is purchasing it through a secondary supplier. A contractor would be required to certify the liquid products used.

Aggregate testing – There was no test performed on the aggregates used for prime coat chip seals. At a minimum suitability tests performed according to the Oregon State Highway Division (OSHD) Standard Specifications 00710.10 should have been performed before the start of the season. Periodic tests on the ½"-3/8" rock would ensure the rock remained in spec. ODOT Standard Specification 00710.15. Tests should be performed every 200 – 300 tons.

According to OSHD Standard Specification 00710.00, an initial test should have been performed to ensure rock hardness.

A contractor would have been required to provide independent certification of the above rock qualities.

Some contamination of the stockpiled rock was evident. On numerous occasions chunks of AC were dumped on the mat or dug out of the hopper. The chunks of asphalt contamination caused skips in the rock coverage on the oil mat by blocking the gate opening.

Sand choke - Sand choking is not generally required or performed on a prime coat. In this situation, however, it was a very warm day and at 5 p.m. the road was very sticky and picking badly. Driving through the project at 5 mph resulted in extreme rattling of rock off of vehicle fenders. However, apparently the office did not receive any calls about this. A contractor very likely would have been required by a project inspector to place sand on the surface to stop the picking.

Traffic control personnel - LUT hired a contract crew of flaggers to provide traffic control. There were six people on this crew, and there were only three people assigned to flag. At least three flaggers were sitting down during most of the day. A contractor would not be allowed to have unnecessary flaggers on the job.

Pumpkin Ridge Drive

Personal protective equipment –The roller operator was not wearing a safety vest or other high visibility safety clothing in the work zone. He worked on and around the chip spreader at times throughout the day.

Liquid asphalt samples – No sampling of the liquid asphalt has occurred. Therefore, no independent testing is possible. Albina Asphalt Co. supplied the MC-250, which it purchased through a secondary supplier. A contractor would be required to certify the liquid products used.

Traffic control personnel - The flaggers were not clear on their roles and were out of position to control traffic adequately. Senior members of the chip seal crew directed them and assisted with traffic control. There were six people on the flagging crew and there were only intersections for three people to flag. At least three flaggers were sitting down during most of the day. A contractor would not be allowed to have unnecessary flaggers on the job.

Mullerleile Road

Personal protective equipment – The roller operator was not wearing a safety vest or other high visibility safety clothing in the work zone. He worked on and around the chip spreader at times throughout the day.

Liquid asphalt samples – No sampling of the liquid asphalt has occurred. No independent testing will therefore be possible. Albina Asphalt Co, supplied the MC-250, which it purchased through a secondary supplier. A contractor would be required to certify the liquid products used.

Daniel Road

Personal protective equipment – The roller operator was not wearing a safety vest or other high visibility safety clothing in the work zone. He worked on and around the chip spreader at times throughout the day.

Liquid asphalt samples – No sampling of the liquid asphalt has occurred. No independent testing will therefore be possible. Albina Asphalt Co. supplied the MC-250, which it purchased through a secondary supplier. A contractor would be required to certify the liquid products used.

Traffic control personnel – There was six people on this crew and only assignments for two people to flag. The others were held in reserve to flag on Jacktown Road.

Jacktown Road

Personal protective equipment – The roller operator was not wearing a safety vest or other high visibility safety clothing in the work zone. He worked on and around the chip spreader at times throughout the day.

Liquid asphalt samples – No sampling of the liquid asphalt has occurred. No independent testing will therefore be possible. Albina Asphalt Co. supplied the MC-250, which it purchased through a secondary supplier. A contractor would be required to certify the liquid products used.

Traffic control personnel – There was six people on this crew and only assignments for four people to flag. At least two flaggers were sitting down during most of the day. A contractor would not be allowed to have unnecessary flaggers on the job. Inquiry revealed that all of these folks are certified flaggers; however, they have marginal skills and take constant direction from the chip seal crew members.

Dober Road

Personal Protective Equipment – The roller operator was not wearing a safety vest or other high visibility safety clothing in the work zone. He worked on and around the chip spreader at times throughout the day.

On the second day on Dober Road the roller operator operated the old chip spreader. Again, there was no safety gear when working on the ground in the work zone.

Liquid asphalt samples – No sampling of the liquid asphalt occurred. No independent testing will therefore be possible. Albina Asphalt Co, supplied the MC-250, which it purchased through a secondary supplier. A contractor would be required to certify the liquid products used.

Traffic Control Personnel – There were six people on this crew and only assignments for three people to flag. At least three flaggers were sitting down during most of the day. A contractor would not be allowed to have unnecessary flaggers on the job. When the job began on Iowa Hill Road, the flaggers were out of position and had to be directed by the chip seal crew members. They needed to get away from the equipment and to the brow of the hill where traffic could see them. RMA observed the same thing on Pumpkin Ridge Drive three days earlier when the job was getting starting.

Chip spreader – When the old chip spreader was brought out to the job it was not physically calibrated before being placed in service. The crew had a lot of confidence and visually checked the mat to ensure appropriate coverage. The mat looked okay. A contractor would likely have been required to calibrate the equipment before putting the chip spreader in service. Washington County crews constantly check and adjust to ensure that minimal amounts of rock are used.

Raynard Road

Personal protective equipment – The chip spreader operator wore no safety vest or clothing, which is required when working on the ground in the work zone.

Liquid asphalt – No sampling of the liquid asphalt occurred. The shot rated was boosted to ensure all of the MC-250 would be used up as it was the last shot. Because the product was bought from a third party, it was not possible to return any unused portion.

The shot ran out approximately 100' from the end of the job. A surface supervisor decided to return and shoot the prime on this portion using HFE-901c at a later date My understanding is the HFE-901c is not an appropriate product for a prime coat chip seal. This would not be allowed under a contractor arrangement. The contractor would be required to provide the right product to complete the job.

Chip spreader- Chip spreader was not calibrated; however, it looked as if it was placing rock appropriately, and the mat looked okay. A contractor would likely have been required to calibrate to the equipment before putting the chip spreader in service. Washington County crews constantly check and adjust the chip spreader to ensure minimal amounts of rock are being used.

Appendix D

Appendix D

Appendix E

Gravel road upgrade quality assurance matrix: explanation of ratings second and third shots

Seavey Road

Traffic control personnel – There were six contracted flaggers on this crew, but only assignments for three people to flag. Quality of flagging was okay due to this being a very low volume road. A contractor would not be allowed to have unneeded extra flaggers on the job.

Liquid asphalt samples – Liquid asphalt was not sampled. No independent testing will be possible. The product being used is HFE-901c, supplied by Albina Asphalt Co. Washington County has a long-standing relationship with the vendor, and Albina Asphalt has an extensive in-house testing program and offers to stamp and certify each load with the appropriate test data certification. The bills of lading are not stamped with the certification data.

At a minimum a contractor would be required to certify the liquid products used meet Oregon Department of Transportation Standard Specifications for Asphalt Materials 2006.

Aggregate testing – The only test performed on aggregates used for chip sealing was an initial compatibility test performed by the asphalt supplier to determine suitability of the aggregate for use with its liquid asphalts.

At a minimum there should have been tests performed periodically on both the 1/2"-1/4" rock and also on the 3/8"-#10 rock. Tests should be performed every 200-300 tons.

An initial test should have been performed to ensure the rock harness and suitability for the purpose.

A contractor would have been required to provide independent certification of the above rock qualities.

Sand choker – There was no sand applied to the mat when shooting the third shot. The sander broke down and was sent to the shop. Because this is a low volume road, it did not create a problem. The mat was slightly picking at the end of the day.

Roller operators – Roller operators asked RMA numerous questions related to how soon to get on the mat, how many passes to make, and proper rolling technique. RMA told them to proceed as their supervisor would want it done and that there are various schools of thought on proper rolling. They indicated it changes from year to year.

Pumpkin Ridge Drive – See Seavey Road re: Liquid asphalt and aggregate testing.

Traffic control personnel – There were six contracted flaggers on this crew, but only assignments for four people to flag. Quality of flagging was okay because this was a very low volume road. A contractor would not be allowed to have extra flaggers on the job.

Chip spreader – On July 25, 2007, the crew encountered problems with the calibration of the chip spreader. It did not appear to hold the calibration setting. The crew continued to work with it instead of forcing ahead.

Re-calibrated again on July 30, 2007. RMA observed several thin spots and rollers had trouble picking going up the hill on the third shot second panel. Sanded heavy after rolling.

Broom surface - Road was checked on August 28. It did not appear to have been swept. A contractor would have been required to sweep the surface within 14 days of completion.

The outside panel at the first left-hand corner was rough, which looked consistent with the very end of Daniel Road. In both instances the chip spreader and a truck ran over some uncovered oil and then backed up and covered it.

Mullerleile Road

See Seavey Road re: Liquid asphalt and aggregate testing.

Chip spreader- Problems were again encountered with chip spreader calibration. The chip spreader did not appear to hold the calibration setting. The crew continued to work with it instead of forcing ahead. The rock coverage on Mullerleile was quite thin on the second shot and both rubber-tired rollers were picking badly.

Rollers - A decision was made to roll only with the double drum steel roller. The result will be interesting to watch as this was a gravel road upgrade. It is very short and has very low volume traffic. All three shots were rolled only with a double drum steel wheel roller.

A contractor would likely have been required to use a rubber-tired roller for at least part of the rolling on this project to comply with OSHD specifications 00715.23.

Broom surface – Road was checked on August 28, and it did not appear to have been swept. A contractor would have been required to sweep the surface within 14 days of completion.

Daniel Road

Not present during shooting.

See Seavey Road. re: Liquid asphalt and aggregate testing.

Broom surface – Reviewed on August 28, 2007. Swept and clean. End is rough, probably indicating the chip spreader had to back or drive through some uncovered oil during the covering process.

Jacktown Road

Not present during shooting.

See Seavey Road re: Liquid asphalt and aggregate testing.

Broom surface – Reviewed on August 28, 2007. Swept and clean.

Dober Road

See Seavey Road re: Liquid Asphalt and Aggregate testing.

Day 2, last half of second shot first and second panels and third shot.

Chip spreader - The on-going calibration problems with the chip spreader appeared to have been resolved. Production was good with good coverages.

Rolling - The rubber-tired rollers appeared to roll too fast at times. Coverage was generally two complete passes. Rollers at times delayed getting started to allow trucks in front of them. This is worst when all the trucks are ready at the beginning of a shot.
The speed of the rollers varies. OSHD Standard Specifications 00710.47 calls for a maximum speed of 5 mph. At 5 mph the rollers should cover approximately 73 feet in 10 seconds. The rollers were timed consistently between 5 ½ - 7 seconds over the distance. At times they were rolling slowly only to speed up on the next pass.

When RMA inquired how fast they thought they were going. they said they did not know and had no way of telling. They had not been told how fast to roll.

Raynard Road

See Seavey Road re: Liquid asphalt and aggregate testing.

Not present during shooting of second shot second panel and third shot.

Note: The last third of the Raynard project on the McCormick Hill Road end was shot with a double shot seal. This section will be watched for durability. Additionally, the last 100'-150' on the right-hand side, when headed toward McCormick Hill Road before the stop sign has a prime that is HFE-901c and the seal is HFE-901c.

Broom surface – Reviewed on August 28, 2007. Swept and clean.

Appendix E

Appendix E

Appendix E

Appendix F

Paved road chip sealing quality assurance matrix: explanation of ratings

McCormick Hill Road

Liquid asphalt samples – No sampling of the liquid asphalt occurred. No independent testing will be possible. The product used is HFE-100S, supplied by Albina Asphalt Co. Washington County has a long-standing relationship with the vendor, and Albina Asphalt has an in-house testing program and offers to stamp and certify each load with the appropriate test data. The bills of lading are not currently stamped with the certification data.

At a minimum a contractor would be required to certify the liquid products being used meet Oregon Department of Transportation (ODOT) Standard Specifications for Asphalt Materials 2006. Some independent samples and tests are also generally recommended to ensure product quality.

Aggregate testing – There was one test performed on the 3/8"-#10 rock used for chip sealing. The asphalt supplier also performed an initial compatibility test.

Oregon State Highway Department Standard Specification 00710.10, 00710.15 and 00710.16 identify minimum requirements for testing. Tests should be performed every 200-300 tons.

An initial test should have been performed to ensure the rock hardness and suitability for the purpose.

A contractor would have been required to provide independent certification of the above rock qualities.

Traffic control personnel – There were six contracted flaggers on this crew, but only assignments for three people to flag.

A contractor would not be allowed to have extra flaggers on the job.

Rolling – This was the first day of the season to use the rubber-tired rollers on chip sealing. One roller was brought onto the job with a plugged water system, and time was lost until maintenance could be performed. The single roller rolled almost continuously to keep up with the chip spreader. Several times during the first panel from Hagg Ranch to the county line it appeared the roller was only getting one pass on the mat. There was a lag time of up to six minutes in getting the roller onto the new chip seal until the second roller was placed back in service.

Chip spreader – The Flaherty chip spreader was used on this road and had difficulty at times getting started on the grades. Several wheel spins were noted when taking off.

Broom surface - The road was broomed and clean when checked on July 25, 2007. There were some thin spots on the second panel up the hill toward Hagg Ranch, as well as some skips and spins in mat on first panel from Hagg Ranch to county line.

Aebischer Road

No observation of the chip sealing process due to Pottratz job. RMA reviewed the project after completion on July 23, 2007.

Utilities – When reviewed on July 23, 2007, it appeared that several utility covers may not have been covered prior to chip sealing. There was a noticeable indentation where the covers were so they will be easy to identify at a later date.

Broom surface – Road was checked and had been broomed by July 31, 2007. There appeared to be some skips in shooting of the intersection. There also appeared to be some wheel tracks where a vehicle may have driven over bare oil.

BMP 226 BST – The humidity was very high on this job. When viewed late in the afternoon on July 23, 2007, the edges of the road were damp. A heavy shower had passed over the project. No surface run off was observed.

Bald Peak Road

Liquid asphalt - See comments from McCormick Hill Road.

Aggregate – See comments from McCormick Hill Road.

Traffic control – RMA observed this job beginning at 3 p.m. The second panel was being started. Traffic on this section of Bald Peak was fairly busy. The flaggers had some difficulty controlling traffic around the beginning of the job. A pilot car operation might have been a good option. Senior crew members had to direct the flaggers on how to move traffic through the work zone.

Sand choke – RMA observed that once the rock was in place, the sand choke was applied prior to rolling. This raises questions about whether the sand will prevent the oil from adhering to the rock properly. ODOT Standard Specifications do not address this item other than to say cover any bleeding areas with additional rock.

The Albina representative indicated that this is an acceptable technique and that it does not impair proper adhering of the rock to the asphalt.

BMP 226 BST - The humidity was very high on this job. However, the surface remained dry. Showers passed on both sides of the job and later dampened the surface. No run off occurred.

Minter Bridge Road

RMA began observing chip sealing August 2, 2007, after the first panel was down and the second panel was being placed due to concurrent observation of culvert work.

Liquid asphalt – See comments from McCormick Hill Road.

Aggregate – See comments from McCormick Hill Road.

Traffic control – A pilot car system was used on this road, and it made the work much easier. This is an urban road and had the highest traffic counts of any roads observed to date. Some problems occurred when the work reached the intersection with Grabel Road.

The flaggers were simply ineffective at moving traffic through the work zone. They were visibly frustrated.

A Washington County LUT truck driver got out and directed traffic through the work zone. One good flagger was able to keep the congestion moving around the ongoing work. However, the driver was not wearing any safety clothing/vest. OROSHA is fairly clear on the flagging and safety clothing requirements for flaggers.

Contractors‘ employees are required to wear safety clothing when working in the work zone.

Rolling - The process was moving very fast, and the rollers were obviously rolling too fast. OSHD Standard Specifications 2002, 00710.47 indicates a maximum rolling speed of 5 mph. Some passes were occurring in the 0:05:50 second range for 73 feet (1 MPH = 1.466667 feet per second), which indicates a speed of close to 9 mph.

Where: (73'/5.5sec.=13.27273ft./per sec./1.466667=9.04 MPH)

Grabel Road

This road was added to the list and completed concurrent with Minter Bridge Road. Most of the same issues were apparent on Grabel Road.

Rolling - The rollers were late getting onto the mat (seven minutes behind the chip spreader) and then rolled too fast.

Bridges Street and 325th Avenue

Liquid asphalt – See comments from McCormick Hill Road.

Aggregate – See comments from McCormick Hill Road.

Traffic control – This was a low volume local street, and the flaggers were able to communicate and handle the traffic okay.

Rolling – The rollers were behind by up to six minutes on this road. The trucks were lined up and crowded in front of the rollers. This was a short narrow local road, and the rollers deferred to the trucks.

Surface preparation – On 325th Avenue near the big oak tree, there was an alligatored section chip sealed over. This likely will fail prematurely. The low volume nature of the road and no truck traffic may allow this section to meet expectations.

A contractor may have been directed to repair the section prior to sealing.

Patton Valley Road

Liquid asphalt - See comments from McCormick Hill Road.

Aggregate – See comments from McCormick Hill Road.

Traffic control – A pilot car was used on this road. The flaggers responded, and the traffic control went pretty well. The pilot car helped to keep speeds down. There were five or six flaggers, and they seemed to all have a place along this road. The project was over five miles long with numerous intersections.

Surface preparation – The shoulders of this road did not look like they had been swept recently. OSHD Standard Specification 2002; 00710.42 calls for the surface to be cleaned immediately before shooting the asphalt.

At a minimum the road shoulders should have been swept to remove the accumulation of bark, wood chips, horse manure, and gravel along the outer 6-12 inches of the travel lane.

In one location near Mt. Richmond Road, along the left (west) side of the road, the oil was shot over a pile of gravel that was encroaching out into the road from a driveway.
The chip seal will likely not stick along this small section of road. Near Dundee Road there were scraps of roofing scattered across the road. They were also shot over.

A contractor would have been required to sweep the road ahead of the chip seal operation until the road was appropriately clean for chip sealing.

Trucks and rock on hand – A fifth contracted truck and trailer was added to the string. This helped with productivity and cut the wait times noticeably for rock.

Rolling – The rolling effort lagged by six minutes at the start and then rolled too fast. They were getting their two passes over the entire surface; however, when checked on numerous sections, they were consistently rolling at 8.6 mph and above.

RMA noticed a pattern in which one roller operator will not roll on the outer edge of the mat. This forces the other operator to do all of the outside rolling. Roller operators should probably be trained to roll the entire mat. This is a process issue, but not one that would affect the finished product.

On the second day on Patton Valley Road, two veteran operators were on the rollers. They were right on the chip spreader with no delays. With the additional truck, the process moved right along, and the rollers had to speed up again. By mid-morning they were rolling at nearly 9 mph. They would roll the first pass at a slower speed and then speed up on the second pass.

Vernonia Road

Traffic control - This was quite a busy road, and a pilot car would have made things easier for the crews and everyone else involved. The normal pilot car operator was apparently on vacation, and there was no one to fill in.

Communication - There was one incident where one of the contract flaggers stopped traffic on Hwy. 26 unnecessarily. A lead worker became upset at the individual due to the potential for accidents on this high-speed road. There were at least two incidents where the chip sealing operation caught up to the flaggers and had to stop the operation while the flaggers repositioned and traffic was routed around the equipment. The lead workers are quite frustrated with the flaggers on this road.

Liquid asphalt - See comments from McCormick Hill Road.

Aggregate – See comments from McCormick Hill Road.

Chip spreader - As evidence of the concern the crews have for doing quality work, the chip spreader was recalibrated before beginning the work. It had been roaded out to the job, and the operator wanted to ensure nothing had changed before starting the job.

Surface preparation - It rained heavily the day before beginning this road. The air was humid and cool, but the surface was warm enough in the sun. However, the shaded areas were a little cool. Additionally, the edge of the pavement and corners in several shaded areas were still damp.

Pilot car – It is likely that if this were a contract chip seal job, the specifications would require the contractor to use a pilot car. There are a lot of log trucks, dump trucks, and fast vehicles on this road. As soon as they are away from the flaggers, they are traveling fast.

Rolling – The same issues with rolling again. They are late on the mat and then rolling too fast. The rollers were lagging by over five minutes most of the time. The speed issue is the same–covering 73 feet in less than six seconds except when climbing the hills. Two complete coverages are being made.

Sweeping – The sweeping was the same as Patton Valley Road. The outer six inches to a foot had quite a lot of fine sand gravel and debris on it.

BMP 226 BST – The chip sealing on this road is along the Nehalem river. RMA did not observe any special requirements undertaken, and there were no observed impacts to the river.

Verboort Road

Pilot car – The process was underway and congestion was bad at the intersection of Highway 47 and Verboort. The first several loads of rock were placed before the pilot car began operation.

Rolling – The rollers were again having the same issues of getting on the mat late and then rolling too fast. The first panel was nearly down to the school before the second roller was finally put into service.

Winters Road

Surface preparation – Several fresh asphaltic concrete patches were shot over. Normally these need to set for a period before chip sealing or be fog sealed.

Fern Hill Road

Traffic control – The pilot car was late getting signs and flaggers set up. Flaggers were ineffective. At the beginning, equipment operators took over traffic control through the work zone so the distributor could shoot the intersection. Traffic was being sent past him while he was trying to back into the intersection to shoot the wings.

The flaggers failed to move up the road as the operation approached, and the shooting had to stop until flaggers could be repositioned and the traffic they had stopped could be routed around.

Liquid asphalt – See comments from McCormick Hill Road.

Aggregate – See comments from McCormick Hill Road.

Pilot car - There were four trucks shot off before a pilot car began operation.

Rolling – The rollers were late getting on the mat because all the trucks were lined up trying to back down the mat. Rollers lagged by at least four minutes. They were then covering the 73' sections in less than 5.5 seconds, a speed of about 9 mph. RMA observed the rollers actually had a rooster tail coming off of their back tires as they rolled the mat.

The truck drivers had been giving the roller operators a bad time for a few days about being in their way. The roller operators are wary of the more senior truck drivers. This may be causing the rollers to stay back and instead of getting to the mat as quickly as needed.

Surface preparation – On the first panel near Blue Heron Road there was a section of alligatored pavement that was shot over. Normal practice is to make repairs before chip sealing.

Appendix F

Appendix F

Appendix F

Appendix G

Culvert installation quality assurance matrix: explanation of ratings

Pottratz Road Culvert

Backfill and bedding – The project plans called for the pipe bed for the culvert to be ¾"-0 granular back fill material. The engineer granted an exception to this requirement for the use of a reject material that was near to ¾"-0 material. The material used was readily available and had adequate fines and larger stone so as to compact very tightly.

OSHD Standard Specifications 2002; section 00405.14 allows for the use of a Class A Backfill material, which is a native fill material. The reject material approved for use was actually closer to a Class B Backfill material, which is a ¾"-0. The material was very suitable for the purpose and apparently cost much less than a spec'd ¾"-0 material. Similar material was used for the backfill on the pipe. The material was wet when delivered and placed in approximately 6" lifts and compacted carefully.

Establish culvert bed – Plans called for the excavation for the pipe bed to be 2' below grade. The excavator was able to get approximately .8 below grade and was on bed rock. Because the bed was solid and would not have been any more solid had excavation continued, the bed was placed and compacted at that elevation. A contractor would have been granted the same deviation from the plans.

Crew awareness – The crew was well aware of all of the permit conditions, ESCP, and BMPs that needed to be followed. The lead worker gathered the crew each morning at the site and issued instructions and objectives for the day. During the course of the project there were a couple of instances when a utility worker either unknowingly or inadvertently entered the pumping chamber between the primary and secondary dam. This caused the diverted water to become dirtied for a period of time.

Excavate – Initially, the excavation did not have the correct slope angle of 1½-1. The engineer visited the site on the afternoon of July 23, 2007, when the excavation was nearing the below-grade excavation point. He checked the slope angle and directed the excavator operator to ensure that the correct slope angle was achieved. When RMA visited the site the next morning, the slope angle was at least 1½ -1, possibly more.

A contractor performing the same work would have been given the same direction and expected to achieve the desired result.

Compaction – The crew used a remote controlled sheep's foot Wacker vibrator rolled to perform compaction on the pipe bed and the backfill. The unit worked well and was used methodically. There were no compaction tests taken as the bedding was placed under approval by the engineer for use of Class ~~–A~~" type backfill. RMA observed that the backfill compacted tightly and there was no soft spots or pumping evident. The use of a steel drum construction roller was initiated once there was about 18"-2' of compacted cover in place.

Each 6" lift was thoroughly compacted and vibrated. There was no noticeable deflection when the final lifts were compacted.

Monitor temporary controls – On July 18 work was suspended on the project due to rainy weather. Crews placed additional temporary controls and then secured the site until weather improved. Washington County BMPs call for the site to be visited regularly to ensure temporary erosion control measures are working. However, it didn‘t appear that this BMP was followed. No impacts from the rain and failure to monitor the temporary controls were evident when RMA visited the site again on July 23, 2007.

BMPs – There was a crawler tractor parked within 50 feet of the critical zone on the project. The project was extremely confined and work space was at a minimum. Crews may have had permission from environmental staff to park the equipment in the critical zone; however, it should have had a protective berm (containment) placed around it.
A contractor would likely have been required to remove the equipment to 150' away from the critical zone or to build a protective containment around the equipment.

Bacona Road culvert Installation(s)

Establish culvert bed – The bed for the culverts was excavated based on what the crew felt would be the bottom of the invert on the adjacent ditch. The ditches would then later be excavated to match the invert of the culvert. There were either no ditches or very shallow ditches evident along most of this road.

Ensure flow and grade – The crews eyeballed the grade for the culvert slope. There were no previous cross drains on Bacona Road. The pipes were set based on memory and the experience crews had with winter storms and flooding across the road.

A contractor would have been required to check the flow and grade before backfilling.

Appendix G

Appendix G

Appendix G

Appendix H

Machine patching quality assurance matrix: explanation of ratings

Canyon Drive

Personnel protective equipment – Roller operator did not wear a safety vest when off of the roller and working around the paving machine. Either a safety vest or other high-visibility clothing is standard in work zones.

A contractor‘s employees would be required to wear safety clothing when in the work zone.

Rollers – The rollers used for machine patching were a Cat CB-534C, which weighed 11 tons. This roller was used for most of the rolling: breakdown, intermediate, and finish rolling. The smaller roller was a Dynapac CC 122. This roller weighed three tons and was used for rolling driveways (although one roller operator used it as a finish roller).

OSHD Standard Specification 00744.24 calls for breakdown rolling to be performed by either a steel-wheel tandem roller or a pneumatic wheeled roller. Steel-wheeled rollers need to weigh at least eight tons. The Cat roller exceeded this specification and was suitable for the work performed.

Finish rolling was performed intermittently by the Dynapac roller. One operator chose to use it as a finish roller as well as a driveway roller. The roller had fairly small diameter drums and tended to shove the mat around after it had been rolled by the larger machines Intermediate rolling passes.

OSHD Standard Specification 00744.24 calls for tandem wheeled finish rollers to weigh at least six tons. A six-ton roller would have larger drums and be suitable for finish rolling. The Dynapac was not suitable for finish rolling in either weight or capability. It should probably only be used for driveways.

Adequate trucks/HMA – There were four truck and trailers used, and it took them nearly two hours to make a round trip to the asphalt plant. There were several extended breaks during the first couple of days. Two bob tailed truck from drainage were added into the string and things improved somewhat. Six truck and trailers would have kept the paving process going almost nonstop.

Begin rolling as soon as possible – The breakdown rolling generally occurred while the mat was in excess of 220 degrees and was done right up to the back of the paver. Normally there were from five to six passes being made. The drum was 67" wide, allowing for full coverage in two passes.

Finish roll – The first couple of days the operator on the small roller attempted to finish roll with the Dynapac. It was difficult to tell the difference between what had been finish rolled and what had been left with only intermediate rolling completed. During the last portion of Canyon Drive, the same operator was again put on the small roller, and he again

pursued finish rolling. The result was unremarkable except that the small roller pushed the mat around, probably due to the small diameter drums.

Density checks – There is no requirement to perform density checks since there was only 1 ½" of HMAC being placed [OSHD Standard Spec. 00745.49(c)]. RMA did speak with Michael Mullins at Carlson Testing, Inc. and Washington County has a contract in place through 2010 for this type of testing. On larger or longer projects the department might wish to ensure the compaction is adequate by having a few tests performed.

Mat smoothness - Because the effort was geared at only placing 1 ½" of finished HMAC down, there was some noticeable roughness in the finished mat. The roughness was due to what was underneath the mat. Since this was not a two-lift overlay, pre-leveling was not performed, which would have removed some of the roughness. These are local streets and at low speeds the ride is acceptable.

Miner Way

Rollers - See Canyon Drive

The breakdown and intermediate roller operator rolls the mat slowly but may only get three or four passes on the mat. When it is covered and no major marks are evident, he stops. Sometimes there was a person on the little roller finishing, and sometimes the breakdown roller operator used the small roller for driveways.

There was a new operator on the roller September 13, 2007. He was instructed by the senior operator and seemed to do a good job of rolling. He generally followed the same pattern each time and made six passes.

Adequate trucks/HMA – There were four trucks and two bobtails hauling mix. The haul was a two-hour round trip. One or two more truck and trailers would have kept the operation moving non-stop.

Begin rolling as soon as possible – The breakdown rolling generally occurred while the mat was in excess of 220 degrees and was done right up to the back of the paver. The drum was 67" wide, allowing for full coverage in two passes.

Finish roll – The first day the operator on the small roller finish rolled with the Dynapac. It was difficult to tell the difference between what had been finish rolled and what had been left with only intermediate rolling completed. During the last portion of Miner Way there was no operator on the little roller; it was used only for driveways. Generally five or six passes were being made.

Density checks – See Canyon Drive.

Mat smoothness – See Canyon Drive.

Milon Lane

The same issues present on the other roads RMA observed were also present on Milon Lane. The following occurred on September 13, 2007.

Roller operator – There was another new operator on the roller. This operator generally only put three or four passes down the mat. The rolling pattern was inconsistent; it sometimes began on the shoulder and sometimes on the centerline.

HMA – On September 19, 2007, a different asphalt supplier was used. The haul time was shorter and the mix seemed to be consistently 20 degrees hotter at the screed.

Adequate trucks/HMA - On September 19, 2007, there were four trucks hauling mix, but only three had trailers. The haul was shorter than the previous two-hour round trip. One more truck and trailer would have kept the operation moving non-stop.

Finish roll - The small roller was not used on Milon Lane except to roll driveways and the cul-de-sac.

Power Court

This short local street was completed concurrent with Milon Lane on September 19 and September 20, 2007.

86th Avenue

RMA made no additional observations other than those discussed above.

Appendix H

Appendix H

Appendix H

Appendix I

Appendix I

Appendix I

Appendix I

Appendix J

Machine Patching HMAC – Temperature Table

Appendix J

Glossary

BMP – Best Management Practices used in routine road maintenance; either those adopted by Washington County or the Oregon Department of Transportation (ODOT). BMPs are designed to protect and reduce the environmental impacts to fish and wildlife from necessary maintenance and construction activities.

BLM – Bureau of Land Management, an agency under the U.S. Department of the Interior.

CRS2-P – Liquid asphalt emulsion product that has been modified using polymers. Used in some cases as a ~~"p~~rime coat" asphalt.

CSS-1 – Liquid asphalt emulsion product used as a tack coat under the hot asphaltic concrete during machine patching. Usually, it is diluted with additional water to create a thin bonding agent.

CTQ – Critical To Quality is a characteristic in a maintenance process that can directly affect the outcome of the finished product. CTQs need extra attention or the finished result may not be what was expected.

ES – Environmental Services staff of the Washington County Department of Land Use and Transportation Division. It provides the environmental services support for work the division performs.

ESCP – Erosion and Sediment Control Plan. Prepared and approved as part of the permitted project to ensure water quality standards are maintained while the project is being completed.

HFE – High Float Emulsion. Category of liquid asphalt used for chip sealing that has been additionally modified to ensure successful result when chip sealing.

HFE-100s – High Float Emulsion is used by Washington County when chip sealing paved roads.

HFE-901s – High Float Emulsion is used by Washington County to build the mat during 2nd and 3rd shot chip sealing during their gravel road upgrade program.

HMAC – Hot Mixed Asphaltic Concrete. Used for machine patching and overlays on paved roads.

JMF – Job Mix Formula. Recipe for making HMAC that combines the rock and hot liquid asphalt into a mix suitable for the purpose. May vary depending upon the type of liquid asphalt being used and the gradation of the rock being used.

LID – Local Improvement District. A district formed to create and pay for road improvements. Generally, these are additional projects (gravel road improvements) that would not be performed using the county‘s normal funding mechanisms.

LUT – Washington County Land Use and Transportation Department.

MC-250 – A category of liquid asphalt entirely petroleum based (versus emulsified products). Due to its 100 percent petroleum make-up, organic volatiles (vapors) and expense it is becoming less friendly as a product for prime coats.

N12 – Class of corrugated culvert pipe made entirely of plastic. Black N12 pipe is flexible with a smooth interior and is easily installed and handled in the field, requiring minimal tools and equipment for placement.

OAR – Oregon Administrative Rule. The rules adopted by state government that interpret the way state law will be applied or enforced. Carries nearly the weight of state law but can be adopted, amended and changed through a rule making process as opposed to action by the legislature. Work place health and safety rules are OARs as opposed to state law.

OHV – Off Highway Vehicle. OHVs are popular recreational vehicles and can negotiate rough terrain and soft ground. Motorcycles, quads, and 4X4 as all fit in this classification. They can cause erosion damage easily because their tire treads are aggressive and they need only a primitive trail or path to negotiate. Fording streams with them can cause bank erosion and riparian damage.

OROSHA – Oregon Occupational Health and Safety Administration, the state agency charged with enforcing work place health and safety rules in Oregon.

QA – Quality Assurance. Ensures the product being bought provides the performance for which has been paid. Identifies of areas of deficiency and where higher quality than needed is being bought.

RMA – Gerry Douglas Road Management Associates, LLC.

Spivey – A spray nozzle that sprays the liquid asphalt on the road. Usually machined to create a specific spray pattern and rate of discharge given a set pressure and volume.

4WD – Four Wheeled Drive. All four wheels provide driving force to the ground. Creates increased traction with less chance of wheel spin. Useful when climbing grades or when the surface being driven over is loose or slippery.

Gravel Road Upgrade Quality Assurance Matrix for Prime Coats

Appendix "D"

0 - Insufficient
1 - Partial Comp.
2 - Satisfactory
NA - Not Applicable

Gravel Road Upgrade	**Safety:**	**1. Work Zone Set Up** Appropriate Signs and spacing for the work zone and traffic conditions	**2. Personal Protective Equipment** - individuals are wearing appropriate PPE for assigned job	**3. Communication** between traffic control and operation	**4. Signs** posted upon completion "Loose Gravel - Fresh Oil" & "Slow"	**Technical: Materials, Labor, Equipment**	**5. Liquid Asphalt** temperature 140 - 185 degrees, type used dependent	**6. Liquid Asphalt Samples** taken	**7. Aggregate** size used 1/2"-1/4" certified	**8. Sand Choke**	**9. Asphalt Distributor** Calibration & Condition	**10. Aggretate Spreader** - Calibration & Condition	**11. Roller(s)** - Type, Weight & Condition	**12. Other Equipment** appropriate for operation	**13. Distributor Operator** - training for job, knowledge of spreading, rates	**14. Chip Spreader Operator** - training for job, equipment operation.	**15. Roller Operator** - training for job, knowledge of rolling chipseals.	**16. Traffic Control Personnel** - certified, knowledge of operational responsibilities
Seavey Rd		2	1	2	2		2	0	0	1	2	2	2	2	2	2	2	1
Pumpkin Ridge Dr		2	1	1	2		2	0	0	2	2	2	2	2	2	2	2	1
Mullerliele Rd.		2	1	2	2		2	0	0	2	2	2	2	2	2	2	2	2
Jack Town Rd		2	1	2	2		2	0	0	2	2	2	2	2	2	2	2	1
Daniel Rd		2	1	2	2		2	0	0	2	2	2	2	2	2	2	2	1
Dober Rd		2	1	2	2		2	0	0	2	2	2	2	2	2	2	2	1
Dober Rd - day 2		2	1	2	2		2	0	0	2	2	1	2	2	2	2	2	1
Raynard Rd		2	1	2	2		2	0	0	2	2	1	2	2	2	2	2	2

Gravel Road Upgrade Quality Assurance Matrix for Prime Coats

Appendix "D"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Gravel Road Upgrade	**Organization: Crew Size, Equipment.**	**17. Crew** Sized for work flow	**18. Equipment** appropriate for the job, size, numbers, capacity.	**Methods:**	**19. Surface preparation** cleaned, temporary pavement markers, utilities	**20. Pilot Car** in operation sufficiently prior to beginning work.	**21. Application Rate** set -	**22. Joint** - take off on paper to ensure application & smoothnes s (broom	**Rock Application:**	**23. Chip Spreader** close on the distributor	**24. Rock Coverage Rate** - 25 lbs. per/sq. yd. - (adjusted for field	**25. Joint** - raked down to ensure smoothn ess	**26. Centerline joint**- left bare to match	**27. Trucks/ Rock** on hand to complete coverage	**Compaction:**	**28. Begin rolling** as soon as possible, 5 MPH or less	**29. Cover** entire surface twice	**Final**	**30. Remove cover from utilities**, joints, level any piles.	**31. Sand Choke** if necessary - bleeding or to fill excess voids	**BMP's**	**32. 227 BST**- Chip Seal - Gravel Road
Seavey Rd		2	2		2	NA	2	2		2	2	2	2	2		2	2		2	1		2
Pumpkin Ridge Dr		2	2		2	NA	2	2		2	2	2	2	1		2	2		2	NA		2
Mullerliele Rd.		2	2		2	NA	2	2		2	2	2	2	2		2	2		2	NA		2
Jack Town Rd		2	2		2	NA	2				2						2		2	NA		2
Daniel Rd		2	2		2	NA	2	2		2	2	2	2	2		2	2		2	NA		2
Dober Rd		2	1		2	NA	2	2		2	2	2	2	1		2	2		2	NA		2
Dober Rd		2	2		2	NA	2	2		2	2	2	2	1		2	2		2	NA		2
Raynard Rd		2	2		2	NA	1	2		2	2	2	2	2		2	2		2	NA		2

Gravel Road Upgrades 2nd 3rd Shot QA Mattrix

Appendix "E "

0 - Insufficient
1 - Partial Comp.
2 - Satisfactory
NA - Not Applicable

Gravel Road Upgrade 2nd & 3rd shot	**Safety:**	1. **Work Zone Set Up** Appropriate Signs and spacing for the work zone and traffic conditions	2. **Personal Protective Equipment** - individuals are wearing appropriate PPE for assigned job	3. **Traffic Control** - pilot car operation in place	4. **Communication** between traffic control and operation	5. **Signs** posted upon completion "Loose Gravel - Fresh Oil" & "Slow"	**Technical: Materials, Labor, Equipment**	6. **Centerline Tabs** in place	7. **Liquid Asphalt temperature** 140 - 185 degrees, type used dependent	8. **Liquid Asphalt Samples** taken	9. **Aggregate** size used 3/8"-#10 & 1/2 -1/4" certified	10. **Sand Choker -**	11. **Power Broom - core in good condition**	12. **Asphalt Distributor** - Calibration & Condition
Seavey Rd		2	2	NA	2	2		NA	2	0	1	2	2	2
Seavey Rd		2	2	NA	2	2		NA	2	0	1	1	2	2
Pumpkin Ridge Dr		2	2	NA	2	2		NA	2	0	1	2	2	2
Mullerlie Rd.		2	2	NA	2	2		NA	2	0	1	2	2	2
Jack Town Rd *						2		NA			1	2	2	2
Daniel Rd *						2		NA						
Dober Rd		2	2	NA	2	2		NA	2	0	1	2	2	2
Raynard Rd		2	2	NA	2	2		NA	2	0	1	2	2	2

* Blank space means I was not physically present to view this part of the operation.

Gravel Road Upgrades 2nd 3rd Shot QA Mattrix

Appendix "E "

0 - Insufficient
1 - Partial Comp.
2 - Satisfactory
NA - Not Applicable

Gravel Road Upgrade 2nd & 3rd shot	13. **Chip Spreader** - Calibration & Condition	14. **Roller(s)** - Type, Weight & Condition	15. **Other Equipment** appropriate for operation	16. **Distributor Operator** - training for job, knowledge of spreading, rates	17. **Chip Spreader Operator** - training for job, equipment operation.	18. **Roller Operator** - training for job, knowledge of rolling chipseals.	19. **Traffic Control Personnel** - certified, knowledge of operational responsibilities	**Organization: Crew Size, Equipment.**	20. **Crew** - sized for work flow	21. **Equipment** - appropriate for the job, size, numbers, capacity.	**Methods:**	22. **Surface preparation-** cleaned, temporary pavement markers, utilities	23. **Pilot Car** in operation sufficiently prior to beginning work.
Seavey Rd	2	2	2	2	2	2	2		2	2		2	NA
Seavey Rd	2	2	2	2	2	2	2		2	2		2	NA
Pumpkin Ridge Dr	2	2	2	2	2	2	2		2	2		2	NA
Mullerlie Rd.	1	2	2	2	2	1	2		2	2		2	NA
Jack Town Rd	2	2	2	2	2							2	NA
Daniel Rd	1												
Dober Rd	2	2	2		2	2	2		2	2		2	NA
Raynard Rd	2	2	2	2	2	2	2		2	2		2	NA

Gravel Road Upgrades 2nd 3rd Shot QA Mattrix

Appendix "E "

0 - Insufficient
1 - Partial Comp.
2 - Satisfactory
NA - Not Applicable

Gravel Road Upgrade 2nd & 3rd shot	24. **Application Rate Set** - .35 -.50 gal/per/sq/yd.	25. **Joint** - take off on paper to ensure application & smoothness (broomed back)	***Rock Application:***	26. **Chip Spreader** - close on the distributor	27. **Rock Coverage Rate** - 25 lbs. per/sq. yd. - (adjusted for field conditions)	28. **Joint** - raked down to ensure smoothness	29. **Centerline joint**- left bare to match	30. **Trucks/ Rock-** on hand to complete coverage	***Compaction:***	31. **Begin rolling -** as soon as possible, 5 MPH or less	32. **Roller Coverage -** entire surface twice	***Final***	33. **Remove** cover from utilities, joints, level any piles.	33. **Sand Choke** - prevents bleeding or to fill excess voids	**BMP's**	**226 BST**- Chip Seal - Paved Road
Seavey Rd	2	2		2	2	2	2	2		2	2		2	2		2
Seavey Rd	2	2		2	2	2	2	2		2	2		2	1		2
Pumpkin Ridge Dr	2	2		2	2	2	2	2		2	2		2	2		2
Mullerlie Rd.	2	NA		2	1	2	2	2		1	1		2	2		2
Jack Town Rd	2				2	2								2		2
Daniel Rd					1	2								2		2
Dober Rd	2	2		2	2	2	2	2		1	1		2	2		2
Raynard Rd	2	2		2	2	2	2	1					2	2		2

Paved Road Chip Sealing QA Mattrix

Appendix " F"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Single Shot Surfaced Road Seal	**Safety:**	**1. Work Zone Set Up** Appropriate Signs and spacing for the work zone and traffic conditions	**2. Personal Protective Equipment** - individuals are wearing appropriate PPE for assigned job	**3. Traffic Control** - pilot car operation in place	**4. Communication** between traffic control and operation	**5. Signs** posted upon completion "Loose Gravel - Fresh Oil" & "Slow"	**Technical: Materials, Labor, Equipment**	**6. Centerline Tabs** in place	**7. Liquid Asphalt temperature** 140 - 185 degrees, type used dependent	**8. Liquid Asphalt Samples** taken	**9. Aggregate** size used 3/8"-#10 certified	**10. Sand Choke-**	**11. Power Broom - core in good condition**	**12. Asphalt Distributor** - Calibration & Condition
McCormick Hill Rd.		2	2	NA	2	2		NA	2	0	2	2	2	2
Aebischer Rd.						2		2				2	2	2
Bald Peak Rd.		2	2	NA	2	2		NA	2	0	1	2	2	2
Minter Bridge Rd.		2	2	2	2	2		2	2	0	1	2	2	2
Grabel Rd.		2	1	2	2	2		2	2	0	1	2	2	2
Bridges St.		2	2	NA	2	2		NA	2	0	1	2	2	2
325th Ave.		2	2	NA	2	2		NA	2	0	1	2	2	2
Patton Valley Rd		2	2	2	2	2		2	2	0	1	2	2	2
Patton Valley Rd day 2		2	2	2	2	2		2	2	0	1	2	2	2
Old Hwy. 47						2		2				2	2	
Hillside Rd.						2		2				2	2	
Vernonia Rd.		2	2	1	2	2		2	2	0	1	2	2	2
Verboort Rd.		2	2	1	2	2		2	2	0	1	2	2	2
Winters Rd.		2	2	NA	2	2		NA	2	0	1	2	2	2
Fern Hill Rd.		2	2	2	1	2		2	2	0	1	2	2	2

Blank Space means RMA was not physically present to watch that part of the operation

Paved Road Chip Sealing QA Mattrix

Appendix " F"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Single Shot Surfaced Road Seal	**13. Chip Spreader** - Calibration & Condition	**14. Roller(s)** - Type, Weight & Condition	**15. Other Equipment** appropriate for operation	**16. Distributor Operator** - training for job, knowledge of spreading, rates	**17. Chip Spreader Operator** - training for job, equipment operation.	**18. Roller Operator** - training for job, knowledge of rolling chipseals.	**19. Traffic Control Personnel** - certified, knowledge of operational responsibilities	**Organization: Crew Size, Equipment.**	**20. Crew** - sized for work flow	**21. Equipment** - appropriate for the job, size, numbers, capacity.	**Methods:**	**22. Surface preparation-** cleaned, temporary pavement markers, utilities	**23. Pilot Car** in operation sufficiently prior to beginning work.	**24. Application Rate Set** - .35 -.50 gal/per/sq/yd.
McCormick Hill Rd.	2	2	2	2	2	2	2		2	2		2	NA	2
Aebischer Rd.	2			2	2	2						1		
Bald Peak Rd.	2	2	2	2	2	2	1		2	2		2	NA	2
Minter Bridge Rd.	2	2	2	2	2	2	1		2	2		1		2
Grabel Rd.	2	2	2	2	2	2	2		2	2		2	2	2
Bridges St.	2	2	2	2	2	2	2		2	2		2	NA	2
325th Ave.	2	2	2	2	2	2	2		2	2		2	NA	2
Patton Valley Rd	2	2	2	2	2	2	2		2	2		2	2	2
Patton Valley Rd day 2	2	2	2	2	2	2	2		2	2		2	2	2
Old Hwy. 47														
Hillside Rd.														
Vernonia Rd.	2	2	2	2	2	2	2		2	2		2	1	2
Verboort Rd.	2	2	2	2	2	2	2		2	2		2	1	2
Winters Rd.	2	2	2	2	2	2	2		2	2		2	NA	2
Fern Hill Rd.	2	2	2	2	2	2	1		2	2		2	1	2

Paved Road Chip Sealing QA Mattrix

Appendix " F"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Single Shot Surfaced Road Seal	**25. Joint** - take off on paper to ensure application & smoothness (broomed back)	***Rock Application:***	**26. Chip Spreader** - close on the distributor	**27. Rock Coverage Rate** - 25 lbs. per/sq. yd. - (adjusted for field conditions)	**28. Joint** - raked down to ensure smoothness	**29. Centerline joint**- left bare to match	**30**. **Trucks/ Rock-** on hand to complete coverage	***Compaction:***	**31. Begin rolling -** as soon as possible, 5 MPH or less	**32. Roller Coverage -** entire surface twice	***Final***	**33. Remove** cover from utilities, joints, level any piles.	**34. Sand Choke** - prevents bleeding or to fill excess voids	**BMP's**	**36. 226 BST**- Chip Seal - Paved Road
McCormick Hill Rd.	2		2	2	2	2	2		2	2		2	2		2
Aebischer Rd.				2								1	2		2
Bald Peak Rd.	2		2	2	2	2	2		2	2		2	1		2
Minter Bridge Rd.	2		2	2	2	2	2		2	2		1	2		2
Grabel Rd.	2		2	2	2	2	2		2	2		2	2		2
Bridges St.	2		2	2	2	2	2		2	2		2	2		2
325th Ave.	2		2	2	2	2	2		2	2		2	2		2
Patton Valley Rd	2		2	2	2	2	2		1	2		2	2		2
Patton Valley Rd day 2	2		2	2	2	2	2		1	2		2	2		2
Old Hwy. 47				2									2		2
Hillside Rd.				2									2		2
Vernonia Rd.	2		2	2	2	2	2		1	2		1	2		2
Verboort Rd.	2		2	2	2	2	2		1	2		1	2		2
Winters Rd.	2		2	2	2	2	2		2	2		2	2		2
Fern Hill Rd.	2		2	2	2	2	2		1	2		2	2		2

Culvert Installation QA Matrix Appendix "G"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Culvert Replacements	**Safety:**	1. **Work Zone Set Up** Appropriate Signs and spacing for the work zone and traffic conditions	2. **Personal Protective Equipment** - individuals are wearing appropriate PPE for assigned job	3. **Traffic Control** - flaggers appropriate to the job	4. **OROSHA** - requirements for trenching . 4' depth = ladder, 5' depth = trench box	5. **Communications** - between traffic control and operation	6. **Signs -** posted upon completion	**Technical: Materials, Labor, Equipment**	7. **Culvert** - dimensions to be determined by scheduling authority and based on drainage study	8. **Culvert Spec.** - meets requirements of OSHD Standard specifications 2002 00445.11	**9. Band Couplers** - same corrugations as pipe, snug tight and straight	10. **Backfill & bedding** - granular material 3/4"-0" or approved substitute	11. **CLSM** Slurrey, 28 day 150-250 psi (OSHD - 00442.00)	12. **Permits** - in hand as required by all of the regulating agencies (in water work sensitive)
Pottratz Rd.		2	2	NA	1	NA	NA		2	2	2	2	NA	2
Bacona Rd.		2	2	2	2	2	NA		2	2	2	2	NA	NA

Culvert Installation QA Matrix Appendix "G"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Culvert Replacements	13. **Letter to ODFW** - (two weeks prior) when working in an identified sensitive area	14. **Crew Awareness** - project objectives and BMP covering this project	15. **Temp Erosion controls** - materials on hand as required by permiting agencies and ES	16. **Excavation Equipment -** and trucks appropriate to the work at hand	17. **Misc. Equip:** pumps sandbags, pipe handling tools, trench plates, wattles, bio-bags	18. **Traffic Control Personnel -** certified and with knowledge of operational responsibility	**Organization: Crew Size, Equipment.**	19. **Crew** - sized for the job at hand	20. **Equipment** - appropriate for the job, size, numbers, capacity.	**Methods:**	21. **Traffic Control** - established prior to project beginning	22. **Saw Cut Asphalt** - if necessary	23. **Establish Erosion Control Measures** - silt fence, straw bales, wattles, bio-bags, diversions	24. **Excavate** - excavate old culvert if necessary or trench below flow line for new culvert 20% of diameter	25. **Handle excavated material** - appropriately (OSHD 00405.00 - 00405.14) if approved may reuse as backfill
Pottratz Rd.		2	2	2	2	NA		2	2		NA	NA	2	2	2
Bacona Rd.	NA	2	2	2	2	2		2	2		2	NA	NA	2	2

Culvert Installation QA Matrix Appendix "G"

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Culvert Replacements	26. **Establish Bed** - culvert bed along flow line using backfill material as necessary	27. **Lay Pipe** - place pipe on bed beginning at downstream end checking grade as it is placed	28. **Ensure Flow & Grade** - correctness prior to commencing backfill	29. **Backfill** - OSHD Spec 00405.46 pipes < 72" and 00510.00 > 72"	30. **Install Trench Plates** - adequate for the job if necessary. 12" outside of trench edges	**Compaction**	31. **Compact -**appropriate backfill in lifts 10" (compaction 90% then 95% top 3") or use CLSM	32. **Use CLSM -** if pipe is under the asphalt	**Final**	33. **Permenant erosion control** - establish final controls and plantings	34. **Monitor -** temporary controls daily	35. **Maintain/ replace** - erosion controls	36. **Document** - performance and maintenance of erosion controls	**BMP's**	37. **412 Culvert -** install or replace 12"	38. **419 Maintain** Erosion Control
Pottratz Rd.	2	2	2	2	NA		2	NA		2	1	2	2		NA	2
Bacona Rd.	1	2	1	2	NA		2	NA		NA	NA	2	NA		2	2

Machine Patching QA Matrix Appendix "H "

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Machine Patching	**Safety:**	1. **Work Zone Set Up** Appropriate Signs and spacing for the work zone and traffic conditions	2. **Personal Protective Equipment** - individuals are wearing appropriate PPE for assigned job	3. **Traffic Control** - flaggers appropriate to the job	4. **Communications** - between traffic control and operation	5. **Signs -** posted upon completion	**Technical: Materials, Labor, Equipment**	**6. Asphaltic Concrete**- temperature <350 degrees at plant, 240 degrees behind screed	**7. Tack Oil -** applicatio rate, type appropriate for work	**8. Fabric -**	**9. Power Broom or blower -**	**10. Paving Machine -** calibration & condition, heated screed	**11. Tack Distributor-** calibration & condition	**12. Steel Wheel Roller(s) -** type, weight, condition
Canyon Drive		2	1	2	2	NA		2	2	NA	2	2	2	1
Miner Way		2	2	2	2	NA		2	2	NA	2	2	2	1
Milon Lane		2	2	2	2	NA		2	2	NA	2	2	2	1
Power Court		2	2	2	2	NA		2	2	NA	2	2	2	1
86th Avenue		2	2	2	2	NA		2	2	NA	2	2	2	1

A blank space means RMA was unable to observe that task

Machine Patching QA Matrix Appendix "H "

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Machine Patching	**13. Rubber Tired Roller(s)-** type weight condition	**14. Distributor Operator-** training for the job, equipment operation	**15. Paving Machine Operator-** training for the job, equipment opeartion	**16. Roller Operator-** training for the job, knowledge of rolling HMA	**Organization: Crew Size, Equipment.**	**17. Traffic Control Personnel-** certified, knowledge of operational responsibility	**18. Crew** - sized for the job at hand	**19. Equipment** - appropriate for the job, size, numbers, capacity.	**Methods:**	**20. Surface Preparation-** cleaned, utilities referenced	**21. Structural patching/dig outs completed**	**22. Traffic Control** - established prior to project beginning	**23. Screed set-** take off joint tapered	**24. Cold Joint - t**ake off from prior days work.	**25. HMA-** proper spec for the purpose, "B","C"
Canyon Drive	NA	2	2	2		2	2	2		2	2	2	2	2	2
Miner Way	NA	2	2	1		2	2	2		2	2	2	2	2	2
Milon Lane	NA	2	2	1		2	2	2		2	2	2	2	2	2
Power Court	NA	2	2	1		2	2	2		2	2	2	2	2	2
86th Avenue	NA	2	2	1		2	2	2		2	2	2	2	2	2

Machine Patching QA Matrix Appendix "H "

0 - Insufficient
1 - Partial Compliance
2 - Satisfactory
NA - Not Applicable

Machine Patching	**26. HMA temperature** when spread (240 degrees behind the screed)	**27. HMA -** spread rate (mat thickness)	**28. Center line joints -** matched to ensure smoothness (raked down)	**29. Adequate trucks/ HMA -** on hand to provide continuous operation	**Compaction**	**30. Begin rolling as soon as possible-** breakdown and intermediate	**31. Finish roll -** until marks are **gone**	**32. Density checks**	**Final**	**33. Mat smoothness -** ride ability	**34. Utilities-** remove covers expose covers	**35. Sand seal seams -** where necessary	**36. Replace shoulder material-**	**BMP's**	**37. 206 Machine Patching - ACP**	**38. 210 Shoulder Aggregate**	**39. 211 Shoulder Grading**
Canyon Drive	2	2	2	1		2	1	1		1	2	2	2		2	2	2
Miner Way	2	2	2	1		2	1	1		2	2				2		
Milon Lane	2	2	2	2		2	1	1		2	2	2	2		2	2	2
Power Court	2	2	2	2		2	1	1		2	2						
86th Avenue	2	2	2	2		2	1	1		2	2						

Date	Road Name	Unit	Time	
	Prime Coat	D,C,R	min.	
7/9/07	Seavey Rd			
	9:00 AM	D	0:00	
		C	:45	
		R	20:00	
	9:30 AM	D	0:00	
		C	:15	
		R	:30	
	9:40 AM	D	0:00	
		C	:25	
		R	:40	
	10:00 AM	D	0:00	
		C	:15	
		R	:30	
		D	0:00	
		C	:15	
		R	:30	Continuous to intersection of Old Clapshaw Hill Rd.
	10:55 AM	D	0:00	
		C	1:55	
		R	:20	
	Prime Coat	D,C,R	Time	
7/10/07	Pumpkin Ridge Dr.			
	9:10 AM	D	:00	
		C	:30	
		R	:30	
	9:25 AM	D	0:00	
		C	:30	
		R		
		D	0:00	
		C	:30	
		R	1:00	
	Prime Coat	D,C,R	Time	
7/10/07	Mullerlilie			
		D	0:00	
		C	:30	
		R	:30	
		D	0:00	
		C	:20	
		R	:10	
		D	0:00	2nd Panel
		C	1:00	
		R	:20	
		D	0:00	
		C	:20	
		R	:25	
	Prime Coat	D,C,R	min.	
7/11/07	Daniel			
		D	0:00	
		C	:25	
		R	1:58	
		D	0:00	
		C	:24	
		R	:00	Continuous rolling to keep up
		D	.:00	
		C	:16	
		R	:00	Continuous rolling to keep up

Date	Road Name	Unit	Time	
	Prime Coat	D,C,R	min.	
7/11/07	Daniel			
		D	0:00	
		C	:23	
		R	2:00	1st panel comnplete
		D	0:00	
		C	:45	
		R	2:30	
		D	0:00	
		C	:21	
		R	:00	continuous rolling to keep up
		D	0:00	
		C	0:30	
		R	1:38	
		D	0:00	
		C	:22	
		R	1:10	
	Prime Coat	D,C,R	min.	
7/11/07	Dober Rd			
		D	0:00	
		C	:41	
		R	:00	
		D	0:00	
		C	:15	
		R	0:00	continuous rolling to keep up
		D	0:00	
		C	:20	
		R	:15	
		D	0:00	
		C	:15	
		R	:30	
		D	0:00	
		C	:20	
		R	:00	continuous rolling to keep up
		D	0:00	
		C	:12	
		R	1:17	
		D	0:00	
		C	:40	
		R	0:00	
		D	0:00	
		C	:15	
		R	:30	
7/12/07	Dober Rd	D	0:00	
		C	:15	
		R	2:05	
		D	0:00	
		C	:15	
		R	0:00	
		D	0:00	
		C	:20	
		R	:00	continuous rolling to keep up
		D	0:00	
		C	1:50	
		R	0:00	continuous rolling to keep up
		D	0:00	
		C	:20	
		R	0:00	continuous rolling to keep up

Date	Road Name	Unit	Time	
	Prime Coat	D,C,R	min.	
7/12/07	Dober Rd	D	0:00	
		C	:25	
		R	0:00	continuous rolling to keep up
7/12/07	Raynard			
		D	0:00	
		C	:20	
		R	4:18	
		D	0:00	
		C	:25	
		R	0:00	continuous rolling to keep up
		D	0:00	
		C	:45	
		R	0:00	continuous rolling to keep up
		D	0:00	
		C	:20	
		R	0:00	continuous rolling to keep up
		D	0:00	
		C	:10	
		R	8:00	continuous, playing catch up
		D	0:00	
		C	:05	
		R	2:00	
		D	0:00	
		C	:10	
		R	0:00	continuous playing catch up
	Chip Seal			
7/16/08	Mc Cormick Hill Rd			
		D	0:00	
		C	:15	
		R	2:37	
		D	0:00	
		C	:11	
		R	1:32	
		D	0:00	
		C	0:00	
		R	4:00	
		D	0:00	
		C	:15	
		R	6:45	
Distributor and Chip Spreader are always in sync and moving together. Further timing will focus on rollers behind the chip spreader.				
		C		
		R	2:05	
		C	0:00	
		R	1:18	
	Chip Seal			
7/25/07	Seavey Rd.	D,C.R	min.	
1st shot 8:00 AM, second panel. Filbert orchard up the hill. Liquid temp 110 degrees.		C	0:00	
		R	0:45	
	Chip Seal			
7/30/07	Mullerlelie Rd			
		C	0:00	No rubber tired rollers used.
2nd panel second shot.		R	1:32	Steel Drum Roller only both second and third shots.
2nd panel 3rd shot		C	0:00	
		R	1:30	
Date	Road Name	Unit	Time	
	Chip Seal			
8/1/07	Dober Rd			
		C	0:00	
		R	2:20	**Note:** Speed of rolling may be an issue.

Date	Road Name	Unit	Time	
	Chip Seal			
8/6/07	Bridges & 325th			
		C	0:00	
		R	6:00	Roller speed is ok.
8/6/07	Patton Valley Rd.			
		C	0:00	
		R	6:06	Rolling too fast.
		C	0:00	
		R	3:30	Rolling too fast.
	Chip Seal			
8/13/2007	Vernonia Rd.	D,C,R	min.	
		C	0:00	Bergerson Park
		R	5:15	Plus cool temps, damp surface, 57 degrees
		C	0:00	shaded areas. 67 degrees sunny areas.
		R	5:13	at the top of the first hill
		C	0:00	
		R	4:15	
2nd panel up the hill		C	0:00	
		R	2:06	
		C	0:00	
		R	7:06	
		C	0:00	
		R	:45	Good! But last truck in the string.
		C	0:00	
		R	8:40	Rollers went for water. Process started anyhow.
		C	0:00	
		R	:30	Good!
8/14/2007	Vernonia Rd. day 2			
		C	0:00	65 degrees sun, 54 degrees shade
		R	4:30	started w/o rollers on line, only one roller.
8/14/2007	Verboort Rd.			
		C	0:00	
		R	7:12	only one roller for 1st panel to midway school
		C	0:00	
		R	1:30	rolling too fast.
8/15/2007	Winters Rd.			
		C	0:00	
		R	2:00	
Date	Road Name Chip Seal	Unit	Time	
8/15/2007	Fern Hill Rd.	D,C,R	min.	Surface 75 degrees
		C	0:00	
		R	4:00	Late but maybe due to conflicts with truck drivers
				Late on the mat and then rolling too fast.
				Observed rooster tail of rock coming off roller tires
				on several occasions.