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HBP QC&QA PROJECTS CONSTRUCTED IN 1995 UNDER QPM1 AND QPM2 SPECIFICATIONS

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After an initial pilot program, spanning three construction seasons during which the Department experienced an average increase in quality of 6.3% over historical quality levels, new specifications were written to include a steeper disincentive payment schedule, as well as other more stringent requirements.

These Standard Special Provisions (SSP) were implemented in 1995 and used on 11 projects. 29 "holdover" projects were also constructed, however, still under the Pilot Project specifications. On these 29 projects the downward trend, which became apparent during the last year of the pilot project (1994), continued, but at a steeper rate, suggesting that the rather lenient specifications resulted in lower quality.

The analysis of the 11 projects done in 1995 under the new SSP was encouraging. An average of 5.5% increase in quality levels over historical averages was noted. In addition, the performance of contractors was more uniform, when compared to the Pilot Project phase. It appears that the SSP will provide above average quality levels, as intended. Further fine-tuning will be based on continuing analyses of the QC&QA data.

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CDOT FOURTH ANNUAL REPORT
FOR HBP QA&QC PROJECTS CONSTRUCTED IN 1995

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CDOT FOURTH ANNUAL REPORT
FOR HBP QC&QA PROJECTS CONSTRUCTED IN 1995

EXECUTIVE SUMMARY

In the Spring of 1992, the Colorado Department of Transportation (CDOT) implemented a Pilot Program to construct hot bituminous pavements (HBP) under quality control and quality assurance type (QC&QA) specifications. As part of the QC&QA procedure, payment to the contractor is based on quality level analysis (QLA) of CDOT acceptance tests. In addition, the contractor is required to exercise quality control (QC) of all production functions, including performing materials tests to provide early assurance to him and CDOT the material meets requirements. CDOT evaluates the QC tests, but they are not the basis of payment.

QLA on CDOT test results for asphalt content, pavement compaction and aggregate gradation is the basis for incentive or disincentive payments to the contractor. When the quality level (QL) is above standard (based on historical averages), an incentive payment up to six percent above contract price is made. If the QL is below standard, but the materials are acceptable for use, a disincentive payment as much as 25 percent below contract price is assessed.

The Pilot program covered three construction seasons, 1992-1994. It was expected incentive payments would encourage the contractors to perform above average work. This did happen. The average improvement over the historical average QL was a significant 6.3%, with a slight downward trend in 1994. A new QC&QA Standard Special Provision (SSP) was written during 1994, similar to the Pilot specification, but with a steeper disincentive payment schedule and other more stringent requirements. These changes were based on the Pilot experience and recommendations from CDOT engineers and the contractors.

The SSP was implemented in 1995 and used on 11 projects. There were 29 "holdover" projects completed in 1995 that were bid under the Pilot specifications. On these 29, the downward trend in QL, apparent in 1994, continued, but at a steeper rate. The average QL for the holdover Pilot projects was one percent below the historical average. Of the 19 participating contractors, 16 had lower QL's than in 1994. This was disappointing, but not entirely unexpected. The rather lenient Pilot disincentive payment schedule apparently led to lower quality levels.

However, the analysis of the 11 SSP projects done in 1995 is encouraging. The average QL was 5.5% above historical average. Also, the performance of the contractors was much more uniform than under the Pilot specification, especially in 1995. It appears the SSP will provide above average QL's, as intended. Use of QC&QA specifications by CDOT is expected to continue. Regular analysis will be made on project QC&QA data to measure how well the SSP is working. This will provide information for fine tuning.

CDOT FOURTH ANNUAL REPORT
FOR HBP QC&QA PROJECTS CONSTRUCTED IN 1995

BACKGROUND OF CDOT HBP QC&QA SPECIFICATIONS

From about 1969 until 1995, the Colorado Division of Highways, now known as the Colorado Department of Transportation (CDOT), had a statistically based acceptance specification[1] (SBAS) for hot bituminous pavement (HBP) which included procedures for measuring the percent within tolerances for various HBP elements. Formulas were included for disincentive payments (negative price adjustments, "P") to the contractor for those materials not in reasonably close conformity with the specifications. There were no provisions for incentive payments for improved quality and uniformity beyond the minimum requirements of the specifications. Over the 25-year history of the SBAS[1] there were few significant changes made to it. Today it is used primarily for untreated aggregate sieve analyses, asphalt cements, liquid asphalts and for some elements in project special provisions.

Until initiation of the quality control and quality assurance (QC&QA) type specifications, there was little movement by CDOT in shifting the responsibility for process control of field construction work and materials to industry. Contractors and producers had continued to rely mostly on the CDOT acceptance tests for necessary process control information. Many of the producers had their own laboratories (or routinely used private facilities) in order to monitor their production. But for CDOT work, acceptance tests were a primary source of quality control information.

IMPLEMENTATION OF QC&QA TYPE SPECIFICATION SPECIFICATIONS

In about 1988, CDOT and the HBP Industry began to develop interest in QC&QA type specifications. The two primary components of QC&QA specifications are a well organized process control procedure by the seller, and a sound, statistically based acceptance plan by the buyer. Another component of is a reasonable payment schedule based on statistically measured quality (which may include disincentive and ***incentive*** payments).

In April 1991, CDOT formed the Colorado Flexible Pavement Oversight Group. Membership included prominent consultants, industry representatives and CDOT managers. A broad agenda was established, with suggested objectives. Task groups were organized for many subject categories. The main Oversight Group still exists and meets occasionally as necessary to monitor the work of task groups. There have been a number of significant accomplishments under its guidance.

One important need identified by the Oversight Group was development and implementation of QC&QA specifications for asphalt pavement construction. A QC&QA task group (TG) was formed and met independently several times in 1991. There was general consensus by the members, with full support by CDOT

administrators, that a serious effort should be made to develop and implement a HBP quality assurance type specification. In October of 1991, CDOT employed Bud Brakey (former CDOT Staff Materials Engineer and more recently, Asphalt Institute District Engineer) as a consultant to work with the TG to develop and implement a pilot specification using WASHTO Model QA Specifications[2] as guidelines. Under direct supervision of the CDOT materials engineer, with frequent reviews by the TG and CDOT managers, the consultant developed a QC&QA Pilot specification[3]. It was implemented in early 1992 and has been used on a total of 115 HBP projects through 1995 for over 3 million tons of hot mix.

Included in the Pilot program, were the following:

1. Provisions for incentive, as well as disincentive payments, tied directly to the quality level (QL) of work produced.

2. A computer program to calculate QL's and pay factors (PF) which would store data and print usable reports. (A program was developed by CDOT computer technicians and named QPM, an acronym for Quality Pay Management).

3. Early, regular analysis of construction data in order to measure objectives and progress.

Diskettes of the project computer QPM files have been routinely submitted to CDOT headquarters for data analysis at the completion of each project. Interim Pilot reports were published for 1992[4] and 1993[5]; and in 1994 a final Pilot report[6] was published. This report is the fourth annual report and covers 1995 hold-over Pilot projects, as well as projects constructed under a new Standard Special Provision (SSP)[7]. In this report, projects constructed under the Pilot specification will be referred to as QPM 1 and those built under the SSP as QPM 2. The respective QPM computer programs use those designations.

In 1995, due to the lateness of implementing QPM 2, 29 projects in process of design and bidding were done under QPM 1. Only 11 projects were constructed under the QPM 2 SSP[7]. QPM 2, has several significant changes from QPM 1, but uses the same basic structure. The wording in QPM 2 is the result of consensus by the Oversight Committee, with considerable input from CDOT field personnel and contractors who worked on Pilot projects. Also, the changes were influenced by evaluation of the Pilot data and recommendations by the consultant.

HISTORICAL DATA

In 1993, the CDOT materials branch was using a computer program called QLA, for storing and analyzing historical materials test data input from field reports. In February, 1993, to establish a base for comparing the Pilot projects, QLA was accessed for all available information currently on file relating to HBP. The

data evaluated in 1993 represented work done mostly in 1990 and 1991. In the several QC&QA reports, that data is referred to as 1991 Historical (i.e., the last full year it represents). It is the base used for evaluation of all QPM 1 and QPM 2 QC&QA projects.

DISCUSSION OF CDOT QC&QA STATISTICAL PROCEDURES

A common measurement of conformity to specifications, by statistical procedures, is quality level (QL), or percent within tolerances. CDOT uses Colorado Procedure 71[8], for QL analysis; it is referenced in all QA&QC specifications. CP 71 essentially complies with the procedures described in AASHTO R 9-90[9] for determining percent within tolerances. The two dominant parameters used to calculate QL are the standard deviation (SD) of the individual measurements within a lot (or process) and the distance the lot (or process) average ($\bar{X}$) is from tolerance limits ($\bar{X} - T_L$ or $T_u - \bar{X}$). To visualize how SD and $\bar{X}$ contribute to QL; consider that with lower variability (smaller SD) and the positive movement of $\bar{X}$ away from tolerance limits, QL will increase.

Another measurement of interest to CDOT is how close the pilot averages are to target, or the center of the tolerance limits (T_c). CDOT wanted to determine if the incentive concept resulted in $\bar{X}$ being more centrally located. With the SBAS[1], it was possible to receive 100 percent payment when $\bar{X}$ was a relatively small distance inside the limits (there was no incentive to move towards T_c).

The $\bar{X} - T_c$ parameter is complementary to $\bar{X} - T$. In analyzing the processes, as $\bar{X} - T_c$ grows smaller, $\bar{X} - T$ grows larger. The latter parameter is used directly in calculating QL. But because the tolerance limits varied considerably for the elements in the Historical and early Pilot data, $\bar{X} - T_c$ was the parameter chosen to evaluate the movement of process averages toward the center of the specification band (where T_c is constant, regardless of tolerance width).

The three elements included in the current QC&QA specifications requiring analysis for QL and PF, are asphalt content, percent relative density and aggregate gradation. For gradation, each specification sieve is evaluated for QL. The lowest QL on any specified sieve (controlling sieve) in a lot, or process, is used to determine the PF for the gradation element. The No. 8 sieve has been found to be the controlling sieve for most lots. To simplify gradation analysis, only the No. 8 sieve data for SD and $\bar{X} - T_c$ is used in the QC&QA reports[1]. The ***composite*** values in the Tables are the result of multiplying the element data times the composite weighting factors (used to weight the element PF's to determine the composite item PF), per the QC&QA specifications[2,5]. The factors are 30% for asphalt content, 50% for density and 20% for gradation.

[1] The 1994[6] report contains complete tables on C (3/4") and CX (1/2") gradations for all aggregates used in the 1994 QC&QA work. SD's, means, and other data are listed for each applicable sieve.

DISCUSSION OF 1995 TABULATED DATA AND RELATED FIGURES

Because of some significant differences in the QPM 1 and QPM 2 specifications, the 1995 projects constructed under them have been grouped and analyzed separately for this report. There were 29 QPM 1 and 11 QPM 2 projects. Some projects had only a single process (see the SSP[7] for the definition of process), while others had as many as four.

The field data, as taken from the computer diskettes, has been summarized for each process, and project, then tabulated in Tables 1 (QPM 1) and 2 (QPM 2). They are listed numerically by subaccount numbers. The CDOT Regions and Resident Engineer Units are listed in the second column as four digit numbers; the first digit is the Region number and the last two digits identify the Residency. The process SD (PRCSS SD) is calculated from all values in the process. "MEAN - TC" is the algebraic value of $\bar{X} - T_c$; in the summary Tables 6 and 7, for continuity in reporting, the final yearly averages have been converted to absolute differences. In Table 1 (QPM 1), there are two QL columns, one calculated by QPM 1 and the other by QPM 2 procedures. In Table 2 (QPM 2), only QPM 2 QL values are listed, since it is not possible to determine QPM 1 QL's from the QPM 2 reports.

Also there are two pay factor columns, QPM 1 PF and QPM 2 PF[2]. The QPM 1 data is that used for contract payments for projects listed in Table 1. The QPM 2 values are those used for contract payments for the projects listed in Table 2. The QPM 1 PF values were not determined directly, but were estimated using the historical QPM 2 QL level relationships of the two procedures. In Table 2 the incentive-disincentive dollar values are shown for each process element, for each process composite (item) and each project composite total for the item. The QPM 2 computer program prints reports showing these values; the project value is the basis for payment.

EXPLANATION OF DATA SUMMARIZED BY PROJECTS

Tables 3 and 4 are summaries for 1995 QPM 1 and QPM 2 **projects** respectively. SD, "n", and $\bar{X} - T_c$ data is not shown, since it is specific to elements only. The last column in these Tables shows the assigned code[3] for the hot-mix contractor for the project. The composite item data from Tables 1 and 2 is shown as a single line for the project.

For QPM 1, Table 3 consists of 3 pages. Each page has the same 29 projects, sorted into different configurations. The projects are listed numerically by

[2] In some previous reports the 1995 QPM 2 PF procedure has been referred to as either WASHTO[5] or Modified WASHTO.

[3] The codes have been assigned for the QC&QA annual reports, and have no other recognized purpose. For codes assigned to particular contractors, contact the Pavement Design Unit in the CDOT Central Laboratory.

subaccount number on page 1. The CDOT Resident Engineer's name is shown for each project. The bottom line shows total tons and weighted average values for QL and PF. The average QPM 2 QL of 84.2 is one point below the 1991 historical QL of 85.2 (to compare with other QC&QA work see Tables 5 & 6).

Table 3, page 2 presents the same 29 project summaries, sorted alphabetically by contractor code. Where contractors had more than a single project, a weighted average summary line is shown. Each contractor's summary data is shown in boxes. A column headed "QPM2 QL RANKING" lists the QL rank for each, A4 has the lowest QL of 61.9 and B2 has the highest at 94.1.

Page 3 of Table 3 again lists the same QPM 1 projects, in this case sorted numerically according to CDOT Regions. As has been done for the contractors, the regions have been ranked by QPM 2 QL. Region 5 has a rank of 1 with the lowest average QL of 65.6 and Region 2 a rank of 6 with the highest QL, 91.4. Later in this report, there are additional discussions on QL as related to specific contractors and regions.

For the 11 QPM 2 projects, in Table 4 the data has been summarized and grouped similarly to the QPM 1 data, including a column showing contractor codes. There are three configurations of the same data, all on a single page. The upper block lists the projects numerically by subaccount numbers, along with the names of the resident engineers.

In the second QPM 2 block, the projects are grouped alphabetically by contractors code and ranked according to QL; with 1 being the lowest and 9 the highest. The third block presents the projects grouped and summarized by CDOT Regions which are ranked according to QL, with 1 being the lowest and 5 the highest. Region 4 did not complete any QPM 2 projects in 1995, so only five regions are represented.

SUMMARY OF ALL QC&QA AND HISTORICAL DATA, 1991 - 1995

Table 5 has the information summarized and grouped by year. Table 6 has the data summarized and grouped by element and composite. Included in Table 5 (and not in 6) are the tons represented and number of tests for each element for each year. In the historical data, there are less tons represented for density than for asphalt content and gradation. This is because the study period included density tests based on percent of laboratory (previous procedure) and densities based on percent of maximum theoretical (current procedure). Only the latter information was included. Also, in some of the yearly QC&QA tonnages, the tons for densities are less than for the other elements. The reason is that some thin (maintenance type) overlay projects did not require density tests.

The column headed TESTS "n" is the total number of field tests reported for the corresponding element. The five columns to the right are the averages of field processes weighted by the number of tons in each. The SD column lists the weighted average process values for each year and element. The absolute "MEAN - TARGET" data is shown for each year and element; and for 1994 and 95, the algebraic values are included. The absolute values are more closely related to QL. The algebraic values indicate how close the process averages were to target.

For instance (see Table 5), the absolute average process distance (in percentage points) from target for asphalt content for 1994 was 0.06. Some differences were positive and some negative. The average algebraic difference was 0.01, showing the positives and negatives are nearly canceled out. On the average, the asphalt content was almost right on target. For density, the two values are closer to each other because only a few processes had positive differences; if none of the process differences was positive, the two values would be equal. From Table 5, it is apparent the 1992 through 1995 QPM 1 average field density was 0.60 below target (93.4% of maximum theoretical), while the average absolute distance from target was 0.67 points.

Quality levels in Tables 5 and 6 are based on QPM 2, that is, all data in each process was used to calculate a single mean and a single SD in order to determine QL. It is a better and more consistent measure than the QPM 1 procedure (where the process QL is the average of many lots within the process). It is expected that all future CDOT quality level analyses will be based on the QPM 2 procedure. Note that the QPM 1 projects were done under the Pilot specification[3]; the QPM 2 data was calculated for information, only. The 1995 QPM 2 work was done under the new SSP[7] and evaluated by QPM 2. This may introduce some unknown bias in making comparisons between the two QPM procedures. It is emphasized that none of the specification limits for the three measured elements were changed for the projects constructed under QPM 2.

COMPARISON OF QPM 2 DATA TO QPM 1

Pay factors by QPM 1 and QPM 2 are tabulated in both Tables 5 and 6. QPM 2 pay factors are based on QPM 2 QL's. The QPM 2 PF procedure provides progressively greater disincentive payments as QL's become lower. In other words, for high QL's (mid 80's and above), there is little difference in PF's by the two methods. But for low QL's there is a significant difference. Take the following examples: (1) For a QL of 86, where n = 12, the PF's are 1.00 for both QPM 1 and 2, and, (2) for a QL of 54, n = 12, QPM 1 PF = 0.89 and QPM 2 PF = 0.77; a disincentive of 11% compared to 23% (QPM 2 penalty is more than double QPM 1).

In theory, in order to avoid severe penalties, QPM 2 should encourage contractors to keep their QL's higher than under QPM 1. But this may work only to a point.

There are complex relationships between pay factors and production costs, sample size ("n", as related to sellers risks), element weighting factors (W), and probably many other things that make the outcome very difficult to predict. A review of the two PF calculation procedures shows that when QL is such that PF would be 0.98 or above and "n" is 8 or above, there is an average difference of less than 1% in PF between the two procedures for the same QL and "n".

However, based on only a relatively limited amount of production under QPM 2, it does appear the steeper disincentive PF rate for low QL's, plus other changes described below, may be having the desired effect. Using a QPM 2 PF of 0.98 as a base, which was the historical composite QPM 2 PF, an analysis was made of all QC&QA work performed through 1995. Figure 1 is a plot of the percent of tons produced and percent of projects with a QPM 2 PF of less than 0.98 for each year and QC&QA specification. For 1995 QPM 1, 27% of the projects and 36 % of the tonnage had PF's less than 0.98. While, for QPM 2, there were no projects or tonnage with PF's of less than 0.98.

As the Pilot projects were being evaluated, CDOT personnel expressed concern about some HBP contractors continuing to operate with 5-test moving average QL's (MQL's) under 65, (for a QL of 65 and "n" = 5, QPM 1 PF = 0.94 and QPM 2 PF = 0.93). This situation is defined in the specifications as condition red. There was wording in the Pilot Specification that should have prevented this. But the field engineers felt the specification was weak in providing them authority to prevent continued production under condition red.

So when the QPM 2 specification was written, wording was added to clearly prevent continued production under condition red. Also a provision was added to prevent having a PF greater than 0.75 for the **item** when ever an **element** had a PF of less than 0.75. Under QPM 1, the composite (item) PF was calculated using the actual PF's for each element. For example, on one QPM 1 process, two of the elements had QL's yielding PF's near 1.00 and one element had a PF just under 0.75, yet this resulted in only a 5% disincentive payment for the item. With the more stringent controls on continued production in condition red in QPM 2, this situation would never have been allowed to fully develop. But if did, there would have been an item disincentive of at least 25%. Figure 2 presents a comparison of total tons produced, QL's and percent of production in red under each specification and year. In 1995, clearly there was less percentage in red and higher QL's for QPM 2 than for QPM 1.

GRAPHIC PORTRAYAL OF DATA IN TABLE 6

It is not possible to directly composite SD and $\bar{X} - T_c$ values for the three elements because they are of different magnitudes. Therefore all the element data has been normalized as a percent of 1991 historical and tabulated in Table 6. As previously noted, it is grouped by element and composite. Figures 3

through 10 are plotted directly from Table 6. Figure 3 and 7 are from the upper block (Asphalt %). SD and $\overline{X} - T_c$ (Absolute) is shown in Figure 3, the bars are the normalized data, as a percent of '91. Also, in Figure 3, are the QL's for Asphalt % for each year. These are plotted as actual values rather than the normalized. Note that as the combination of SD and $\overline{X} - T_c$ values decrease in size, the QL values increase.

Figure 7 is the plot of QPM 1 and QPM 2 pay factors for Asphalt % for 1991 through 1995. Plotted are the normalized PF values (percent of '91). Also, the actual QL values, as in Figure 3, are plotted for ease of comparison. Observe the relationship of the two PF values and QL. When the QL values are at their highest ('92 QPM 1), the QPM 2 PF was slightly higher than QPM 1. And for '95 QPM 1, with the lowest QL, the PF for QPM 2 is less than QPM 1.

Figures 4 and 8 are plotted from similar data for the Density % element. Note that '95 QPM 1 has the highest combination of SD and $\overline{X} - T_c$ values and the QL value is much below the other yearly values. It is encouraging, however, that the QL value for '95 QPM 2 is back to a level almost equal to the values for 1992 through 1994.

Figures 5 and 9 are plotted from the gradation element data, in a similar manner as described above for the other two elements. And finally, for this series, Figures 6 and 10 are plotted from the composite data (the lower block of Table 6). Again, as was suggested for the elements, note the relationships of the two PF's and QL.

REVIEW OF PERFORMANCE BY QC&QA CONTRACTORS

With the rather obvious dip in QL for the QPM 1 projects reported in 1995, and the significantly higher QL for the 1995 QPM 2 projects, we decided to look carefully at the history of our QC&QA contractors. Figures 11 through 16 depict the information gathered relative to each participating contractor's total tons, percentage produced in red condition, weighted average QL for each year and the summary for the four-year period. The individual projects, for all QC&QA work to date, were examined and pertinent data entered into a spread sheet. This data was sorted and summarized according to contractors and is the basis of Figures 11-16. The spread sheet is not included in this report because it is rather unwieldly. The 1992 and 1993 seasons have been combined into a single period because of the small number of projects in 1992.

Figure 11 is typical of Figures 11 through 14 and depicts the 1992-93 individual contractor performance. Each participating contractor is represented by a bar. The bar heights represent the total tons produced, per the scale at left. The highest bar at left represents the total tonnage of "ALL" contractors for the period. The cross hatched upper portion is not to scale, but the lower portions

(hatched and solid black) are to scale, as are *all* portions of the other bars. The order of plot for the individual contractors is by tonnage, lowest tons at left, highest tons at right.

The solid black represents the red tons produced by the identified contractor. For the 1992-93, 3.8% of the element tons were produced under condition red. "ITEM RED" tons is really the **equivalent** item tons determined by multiplying each particular element's red tons by its "W" weighting factor. The total of the three element products is the equivalent item red tons (or used to calculate percentage), but referred to here and in the figures as simply item red. The "ELEMENT RED" tons area is the total of the unweighted (by W) tons and includes the item tons.

The "OUT, NOT RED" gray portions represent the tonnage outside tolerance limits not in condition red. For example, in Figure 11, contractors K1, C1 and A1 had no red tons, but since each QL (percent within tolerance) was less than 100, each had **some** production outside tolerances. H1 had a QL of 99.5 and no red tons. With only 0.5% out of tolerance, the gray bar height is too small to show up on the graph. The cross hatched areas represent the tons "IN TOLERANCE, NOT RED", which is the total tons multiplied by QL/100 (less the element or item MQL tons that were in condition red in excess of the percent outside tolerances). As part of this tonnage, in Figures 12 and 13, there are hatched areas (pointed to by arrows) representing the quantity not requiring density tests. For these cases, the percent within tolerance represents only asphalt content and gradation elements.

In Figures 11 and 12, the "ALL" percent red is the same for both, at a relatively low 3.8%. The yearly QL dropped slightly for 1994 to 90.0 (the 1992-93 QL was 91.7). Figure 13, for 1995 QPM 1, shows the QL has dropped to 84.2; this 5.8 points below 1994 and one point below the 1991 historical. The red production has increased to 9.8%. The data plotted in Figure 14, for QPM 2 work, is encouraging. The percent red tons is the lowest of any reporting period for QC&QA, at 3.0%. The QL is only 0.5 points below 1994. Considering this plot represents a new, tougher specification than was used for the other periods, this data could be typical. With more data to be gathered in 1996, a better picture should develop.

TRACKING INDIVIDUAL CONTRACTORS' QC&QA PERFORMANCE

In looking at the contractors' QC&QA historical performance, there was a continued decrease in QPM 1 QL from 1992 through 1995, with rather a sharp drop in 1995. There have been 25 HBP contractors who have participated in the QC&QA program over its four-year history. When we combine 1992 and 1993, and break 1995 in QPM 1 & 2, there are four periods (sets of data). It would be desirable to track the performance of each contractor for the four periods, however we

found that only six (SIX) of the 25 produced QC&QA hot mix in each period. The SIX accounted for 55% of the 3.364 million QC&QA tons.

We decided to look at the individual performance of the SIX contractors, and lump the other contractors together as OTHERS for each period (the participators varied from period to period). The contractors' performance is portrayed in Figures 15 and 16. The bars represent yearly averages, weighted by tons, for each contractor or group. The next to last set of bars shown in each Figure is ALL, meaning the average values of all contractors for each of the four periods.

In analyzing the plots in the Figure 15, there are some inconsistencies in bar heights for condition red for 1992-3 and 1995 QPM 2. But what is very apparent and consistent is the significant increase in percent red for 1995 QPM 1. This is true for each of the SIX contractors and also, for the OTHERS (13 in number). For 1995 QPM 1, there are three new (to QC&QA) contractors included in the OTHERS data, they are A4, H2 and N1. The average red for these three is 19.1, and without them, the other ten contractors have an average red of 7.0%. H2 had only one small project, with a QL of 88.8 and percent red of 0.2%, and influenced the average of the three contractors positively by a small amount. The two bars to the right in Figure 15 show the relationship of the ten and three. Note that the ten contractors had about one percent less condition red than the SIX.

Figure 16 has a similar layout to Figure 15, except that it is for the QL's by the contractors. For every contractor and group, there was a significant drop in QL for 1995 QPM 1 from 1994. But in an encouraging trend, each of the above, except W2, showed a higher QL for 1995 QPM 2 over QPM 1 (90.0 average compared to 86.0). The double bar to the far right relates to the same ten and three contractors referred to in the discussion of condition red above. For 1995 QPM 1, the ten have a QL (88.1) about two points higher than the average of the SIX (86.0), while the new three contractors had a dismal QL of 67.1.

POSSIBLE CAUSES OF THE LOW 1995 QPM 1 QL'S

It now appears that initially the contractors were very cautious as they entered QC&QA Pilot program. Not knowing what to expect, they exercised very good quality control. This was partly out of concern for excessive disincentive payments. As the seasons have progressed, it has developed that QPM 1 apparently is too lenient to assure that CDOT receives the quality product desired. It must be remembered, however, that originally it was never intended for more than one or two seasons' of HBP work be done under the Pilot program. It was supposed to be a learning process. It was understood the next generation of QC&QA specifications would become more stringent.

In 1995, it seems likely the contractors no longer had great concern for excessive penalties under QPM 1. It had developed that they could continue

production with impunity in condition red. In fact, the 1995 QPM 1 yearly average composite QL of 84.2 is one point below the 1991 historical value of 85.2. And the PF's (calculated by both QPM 1 and 2 procedures) are approximately the same as the historical values (see Tables 5 and 6). The average percent of production in red was over 2.5 times the 1992-94 average of 3.8 percent.

The contractors seem to have reverted to about the same level of work being performed prior to QA&QC implementation. Even though this is disappointing, it should not be particularly surprising. The agreement between industry and CDOT was that the Pilot projects should provide specification limits and disincentive formulas approximately equal to the Standard Specifications. The idea was to gain acceptance of the QC&QA concept, while assuring the contractors they would not be seriously impacted financially.

On the positive side, the new specification (QPM 2) has already been implemented, and 328,000 tons produced under it in 1995. A review of the project QPM 2 printouts confirms only three incidents of two consecutive red MQL's. There were no cases of ***more*** than two consecutive red MQL's. This is the way it was supposed to work. Under QPM 2, the contractor is notified in writing if condition red occurs. He is supposed to take immediate corrective actions. A new MQL series is then started. If the next MQL (based on three acceptance tests for the offending element) is red, work is suspended. For 1995 QPM 2, condition red production was only 3.0 percent. This is better than 1992-94 QC&QA work by 0.8 points and 6.8 points better than 1995 QPM 1 production.

Although the 1995 QPM 2 average composite QL is below the 1992-1994 QPM 1 averages, it is still 4.3 points (5%) above the historical value of 85.2. This may be about what we should expect, but QPM 2 needs to be monitored closely. The QPM 2 composite PF is above 1.00, with the project PF's closely grouped around the average. The 1995 QPM 2 PF SD (distribution of project PF's around the average of 1.007) is 0.022, compared to 0.048 and 0.041 for 1994 and 1995 QPM 1, respectively. As of now, the QPM 2 work appears to be meeting the CDOT objectives.

POOLED FREQUENCY OF FIELD TESTS FOR THE ELEMENTS

As something new, this report includes pooled percent frequency distribution histograms for asphalt content and gradation (No. 8 sieve) tests for 1995 QPM 1 and QPM 2. Previous annual reports did not address the distribution of test values for these elements. Pooled relative density test frequency histograms have been included in past QC&QA annual reports.

Figures 16 and 17 are the pooled plots of all field asphalt content tests for 1995. The values have been normalized by relating each test to common job mix targets of 5.5% for QPM 1 and 5.6% for QPM 2. Normal frequency curves have been

superimposed on each histogram. For QPM 1, the data is pooled from 56 separate processes by 19 different contractors; and for QPM 2, there were 19 processes by 11 contractors. These histograms lend credibility to the concept of normal distribution where there are no biases. If the percents (bar heights) outside tolerances are accumulated and subtracted from 100, a rough approximation of the element's yearly QL can be obtained. (Compare to data in the boxes in the Figures).

The percent relative density histograms are plotted in a similar manner as the asphalt content histograms. It was not necessary to normalize the data, since the target value and tolerances, 94.0 ±2% are the same statewide for all projects. Figure 19 is a plot of 1994 test data, previously included in the 1994 report, and included here for information. As was discussed in the 1994 report, normally distributed test values, just below the lower tolerance of 92, appear to be missing (about 5% of the values). While just inside the limits, the first bar is about 5% too high.

Figure 20 is a pooled plot of 1995 QPM 1 density test values. The normal curve is flatter than the other curves, as can be expected from the larger SD (1.25, compared to 1.09 and 1.10 for 1994 QPM 1 and 1995 QPM 2). Again, some values are missing just below the tolerance limits and the first bar completely inside the limits is higher than normal (the condition is not as severe as for 1994). Again, in Figure 21, for 1995 QPM 2, the same trend is noticeable.

In Figure 22, the same three sets of data as in Figures 19 - 21 are shown as lines, rather than bars. A normal curve is superimposed over the three curves. The data curves are all skewed to the right with the modes (points of greatest frequency) about one percent to the left of the mean, with higher than normal frequencies. Also, the field means for the groups of tests vary from 0.6 to 0.4 below the target of 94%. On the average, our contractors are seemingly unable or unwilling to reach the target density. The information portrayed by the density histograms is not new. Involved CDOT personnel are well aware of possible bias in selection of test sites or reporting, and the related procedures are currently under review.

Finally, Figures 23 and 24 are the pooled plots of all field tests for percent passing the No. 8 sieve. The test values have been normalized by relating each test to the average job mix targets of 41% for QPM 1 and 38% for QPM 2. Normal frequency curves have been superimposed on each histogram. The 547 tests included in Figure 23 show a relatively normal distribution.

But the histogram for QPM 2 is abnormal. Two bars are significantly higher than expected. The +2% bar is about 6 or 7 percentage points high (50% more than normal) and the -4% bar is about 4 percentage points above the normal curve

(double normal bar height). By going back to the field reports, the sources of these two anomalies were located as coming from two separate projects. One large project, with 43 sieve analysis tests, had a mean of 34%, one percent above the target of 33% No. 8. At the mean there were 3 tests (7% of the tests), normal should be about 6 (13%). At one percent above the mean (2% above target) there were 11 tests, double the expected number of 5 or 6. The No. 4 and No. 30 sieve values were also distributed abnormally, indicating some sort of bias in production, sampling, testing or reporting.

The other conspicuous excessive bar height, at -4% from target, was traced to a medium sized project with only 10 sieve analysis tests. The job-mix target for the No. 8 was 39%; 6 of the 10 tests showed 35% passing (only one percent inside lower tolerance limit of 34%), yet the QL was 95. The No. 8 sieve test values were not normally distributed on this project. Neither were the values for the 3/8" and the No. 30 sieves, indicating again, there was bias taking place.

SUMMARY

The Pilot program went on for four construction seasons, and except for a lingering project or two, all QC&QA Pilot projects were completed in 1995. This final report shows mixed results. The yearly Pilot composite QL's for the first two seasons were six to seven points above 1991 historical values. There was a slight decline in 1994. But in 1995, under the Pilot specification, there was a major decrease in QL to one point below historical. The reason is not entirely clear. Perhaps the contractors made a choice after considering the higher costs necessary to achieve high QL's (and bonus payments) versus the reduced cost for lower QL's (and slight reductions in payments). Apparently it was more cost effective, in most cases, to pursue the latter option. Workmanship then tended to be about equal to what was being done under the Standard Specifications.

The bad news is that the Pilot specification clearly needed to be updated and made more stringent. The good news is that this has already been done. The 1995 QPM 2 data shows reasonable expectations were met. Based on our experience with the Pilot program, however, we should not be misled. The QC&QA program needs to be carefully monitored and analyzed for trends. Changes to our current SSP[7] specification should be made quickly where the need is indicated.

REFERENCES

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3. Revisions of the Standard Specifications, Sections 105, Control of Work and 106, Control of Material; to be used with the 1992 Pilot Projects, by the Staff Materials Branch, CDOT, March, 1992.

4. HBP QA/QC Pilot Projects Construction in 1992, Interim Report. Report No. CDOT-DTD-R-93-14, by Bud A. Brakey, Colorado Department of Transportation, 4201 East Arkansas Avenue, Denver, CO 80222.

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6. Hot Bituminous Pavement QC/QA Projects Constructed in 1994 and Summary of the 1992-1994 QC/QA Pilot Program, Final Report, June 1995, by Bud A. Brakey, Colorado Department of Transportation, 4201 East Arkansas Avenue, Denver, CO 80222.

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8. Colorado Procedure 71-94 For Determining Quality Level (Percent Within Tolerance Limits), 1996 Field Materials Manual. Colorado Department of Transportation, 4201 East Arkansas Avenue, Denver, CO 80222.

9. Standard Recommended Practice for Acceptance Sampling Plans for Highway Construction, AASHTO Designation R 9-90, Method B: Percent Within Tolerance, STANDARD SPECIFICATIONS for TRANSPORTATION MATERIALS and METHODS OF SAMPLING AND TESTING, 17th Edition, 1995, Part 1, Specifications; AASHTO, 444 N. Capitol ST., N. W., Suite 249, Washington, D.C. 20001.

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
ACNH 0503-041												
Turkey Creek	2013	10057	A	AC%	5.5	8	0.16	-0.10	90.3	89.8	1.021	1.030
Turkey Creek	2013	10057	A	Dn%	5.5	11	0.57	-1.36	90.1	86.9	1.026	1.018
Turkey Creek	2013	10057	A	Grad	5.5	5	2.61	0.40	97.4	97.4	1.042	1.031
			PROCESS ITEM		5.5	NA	NA	NA	91.6	89.9	1.028	1.024
Turkey Creek	2013	10057	B	AC%	22.2	12	0.14	0.02	96.7	97.9	1.039	1.050
Turkey Creek	2013	10057	B	Dn%	22.2	45	0.90	-1.03	89.2	86.0	1.016	0.973
Turkey Creek	2013	10057	B	Grad	22.2	11	1.69	0.40	97.7	97.6	1.042	1.040
			PROCESS ITEM		22.2	NA	NA	NA	93.2	91.9	1.028	1.010
			PROJECT ITEM		27.7	NA	NA	NA	92.9	91.5	1.028	1.013
NH 0502-031												
Gunnison East	3016	10088	A	AC%	2.0	4	0.17	-0.09	90.2	90.2	1.023	1.030
Gunnison East	3016	10088	A	Dn%	2.0	4	0.56	-0.88	100.0	100.0	1.050	1.030
Gunnison East	3016	10088	A	Grad	2.0	2	NA	2.20	NA	NA	1.000	1.000
			PROCESS ITEM		2.0	NA	NA	NA	96.3	96.3	1.032	1.024
Gunnison East	3016	10088	B	AC%	14.3	14	0.23	0.08	88.8	79.3	1.023	0.967
Gunnison East	3016	10088	B	Dn%	14.3	28	1.30	-0.68	82.0	79.4	1.000	0.948
Gunnison East	3016	10088	B	Grad	14.3	13	1.93	0.30	93.5	90.9	1.030	1.029
			PROCESS ITEM		14.3	NA	NA	NA	88.3	81.7	1.013	0.970
Gunnison East	3016	10088	C	AC%	17.8	20	0.23	-0.05	84.8	80.6	1.008	0.956
Gunnison East	3016	10088	C	Dn%	17.8	37	1.11	-1.47	68.9	68.4	0.983	0.864
Gunnison East	3016	10088	C	Grad	17.8	10	1.84	1.10	92.1	94.7	1.026	1.040
			PROCESS ITEM		17.8	NA	NA	NA	78.3	77.3	0.989	0.927
			PROJECT ITEM		34.1	NA	NA	NA	82.7	80.2	1.001	0.951
STU C100-003												
University & Dry Crk Rd	6016	10105	A	AC%	4.0	8	0.25	0.23	81.0	75.4	0.997	0.962
University & Dry Crk Rd	6016	10105	A	Dn%	4.0	10	1.37	-0.48	87.8	84.2	1.017	1.007
University & Dry Crk Rd	6016	10105	A	Grad	4.0	4	4.57	-1.80	64.1	64.2	0.951	0.948
			PROCESS ITEM		4.0	NA	NA	NA	81.0	77.6	0.998	0.982
University & Dry Crk Rd	6016	10105	B	AC%	4.6	10	0.29	-0.08	81.3	82.3	0.994	0.998
University & Dry Crk Rd	6016	10105	B	Dn%	4.6	10	1.37	-0.48	84.3	84.3	1.003	1.007
University & Dry Crk Rd	6016	10105	B	Grad	4.6	5	4.32	-1.80	66.9	73.1	0.951	0.998
			PROCESS ITEM		4.6	NA	NA	NA	80.0	81.4	0.990	1.003
			PROJECT ITEM		8.6	NA	NA	NA	80.4	79.6	0.994	0.993

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
NH 1191-005												
SH 52 - East	4015	10126	A	AC%	22.9	19	0.13	0.06	99.2	97.4	1.047	1.050
SH 52 - East	4015	10126	A	Dn%	22.9	46	1.38	-0.92	76.4	76.9	0.984	0.903
SH 52 - East	4015	10126	A	Grad	22.9	12	2.07	0.50	98.6	98.2	1.039	1.050
			PROJECT ITEM		22.9	NA	NA	NA	87.3	87.3	1.014	0.976
C 2873-067												
SH 287, I 70 - 74th Ave	6016	10155	A	AC%	3.7	8	0.15	-0.01	98.9	99.5	1.047	1.035
SH 287, I 70 - 74th Ave	6016	10155	A	Dn%	3.7	8	0.75	0.14	100.0	100.0	1.050	1.040
SH 287, I 70 - 74th Ave	6016	10155	A	Grad	3.7	4	2.08	1.50	58.7	58.7	0.936	0.915
			PROCESS ITEM		3.7	NA	NA	NA	91.4	91.6	1.026	1.013
SH 287, I 70 - 74th Ave	6016	10155	B	AC%	11.5	13	0.26	-0.16	81.4	87.5	0.996	0.885
SH 287, I 70 - 74th Ave	6016	10155	B	Dn%	11.5	26	0.96	0.30	96.5	96.1	1.036	1.050
SH 287, I 70 - 74th Ave	6016	10155	B	Grad	11.5	13	3.40	3.40	59.0	62.1	0.929	0.871
			PROCESS ITEM		11.5	NA	NA	NA	84.4	80.7	1.004	0.965
			PROJECT ITEM		15.3	NA	NA	NA	86.1	83.3	1.009	0.977
C 385A-010												
2 Locations, NE Reg 4	4011	10158	A	AC%	6.7	7	0.12	-0.04	100.0	100.0	1.050	1.035
2 Locations, NE Reg 4	4011	10158	A	Dn%	6.7	14	0.91	-0.29	90.4	97.5	1.023	1.050
2 Locations, NE Reg 4	4011	10158	A	Grad	6.7	7	2.79	-0.10	79.4	79.4	0.980	0.996
			PROJECT ITEM		6.7	NA	NA	NA	91.1	84.6	1.023	1.035
PFH 0141-010												
Cameron Pass E & W	4015	10220	A	AC%	6.5	7	0.11	ERR	ERR	99.8	1.029	1.040
Cameron Pass E & W	4015	10220	A	Dn%	6.5	13	0.91	ERR	ERR	75.1	0.981	0.941
Cameron Pass E & W	4015	10220	A	Grad	6.5	7	1.90	ERR	ERR	76.6	0.978	0.988
			PROJECT ITEM		6.5	NA	NA	NA	ERR	82.8	0.995	0.980
PFH 0149A-015												
Slumgullion Pass - So.	3016	10222	A	AC%	17.1	18	0.35	-0.07	83.6	59.9	1.004	0.823
Slumgullion Pass - So.	3016	10222	A	Dn%	17.1	35	0.95	-1.09	87.9	83.2	1.017	0.974
Slumgullion Pass - So.	3016	10222	A	Grad	17.1	10	1.40	-0.20	99.5	99.4	1.049	1.040
			PROCESS ITEM		17.1	NA	NA	NA	89.0	79.4	1.019	0.942
Slumgullion Pass - So.	3016	10222	B	AC%	1.6	4	0.52	0.38	25.2	38.3	0.843	0.751
Slumgullion Pass - So.	3016	10222	B	Dn%	1.6	4	1.02	-2.50	27.6	33.6	0.849	0.750
Slumgullion Pass - So.	3016	10222	B	Grad	1.6	2	NA	-1.00	NA	NA	1.000	1.000
			PROCESS ITEM		1.6	NA	NA	NA	28.7	35.4	0.878	0.800

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
STR 1192-004												
3 Miles N of Blackhawk	1013	10230	A	AC%	18.8	11	0.17	0.17	94.2	92.4	1.031	1.040
3 Miles N of Blackhawk	1013	10230	A	Dn%	18.8	36	1.12	-0.66	90.6	87.8	1.022	1.005
3 Miles N of Blackhawk	1013	10230	A	Grad	18.8	10	2.54	2.00	79.1	71.4	0.990	0.938
			PROCESS ITEM		18.8	NA	NA	NA	89.4	85.9	1.018	1.002
3 Miles N of Blackhawk	1013	10230	B	AC%	1.4	3	0.26	-0.03	100.0	100.0	1.050	1.025
3 Miles N of Blackhawk	1013	10230	B	Dn%	1.4	3	0.20	-0.20	100.0	100.0	1.050	1.025
3 Miles N of Blackhawk	1013	10230	B	Grad	1.4	2	NA	2.00	NA	NA	0.911	0.911
			PROCESS ITEM		1.4	NA	NA	NA	100.0	100.0	1.022	1.002
			PROJECT ITEM		20.2	NA	NA	NA	90.1	86.9	1.019	1.002
PLH 139A-022												
South of Rangely	3014	10370	A	AC%	13.4	12	0.22	0.16	81.1	72.7	0.998	0.923
South of Rangely	3014	10370	A	Dn%	13.4	20	0.99	-0.86	91.6	87.6	1.022	1.003
South of Rangely	3014	10370	A	Grad	13.4	8	2.00	1.50	96.3	95.9	1.040	1.040
			PROCESS ITEM		13.4	NA	NA	NA	87.6	82.0	1.018	0.987
South of Rangely	3014	10370	B	AC%	7.1	7	0.07	0.05	100.0	100.0	1.050	1.035
South of Rangely	3014	10370	B	Dn%	7.1	15	0.88	-0.63	98.7	98.5	1.048	1.050
South of Rangely	3014	10370	B	Grad	7.1	6	1.47	-0.60	100.0	100.0	1.050	1.035
			PROCESS ITEM		7.1	NA	NA	NA	99.3	99.2	1.048	1.043
			PROJECT ITEM		20.5	NA	NA	NA	91.7	88.0	1.029	1.008
NHS 0243-044												
2 Mi. S of Matheson - N	1015	10455	A	AC%	13.8	9	0.13	-0.13	97.3	90.8	1.043	1.032
2 Mi. S of Matheson - N	1015	10455	A	Dn%	13.8	29	1.15	-0.47	89.7	89.6	1.020	1.019
2 Mi. S of Matheson - N	1015	10455	A	Grad	13.8	14	1.15	-2.00	89.9	89.8	1.020	1.019
			PROCESS ITEM		13.8	NA	NA	NA	92.0	90.1	1.027	1.023
2 Mi. S of Matheson - N	1015	10455	B	AC%	28.8	22	0.15	-0.11	89.1	88.8	1.018	1.014
2 Mi. S of Matheson - N	1015	10455	B	Dn%	28.8	58	1.08	0.07	93.9	93.9	1.030	1.027
2 Mi. S of Matheson - N	1015	10455	B	Grad	28.8	13	2.50	-0.10	94.0	97.0	1.030	1.050
			PROCESS ITEM		28.8	NA	NA	NA	92.5	93.0	1.026	1.028
			PROJECT ITEM		42.6	NA	NA	NA	92.3	92.0	1.026	1.026
C 0703-210												
Bakerville - Silverplume	1012	10460	A	AC%	13.5	15	0.11	0.01	92.2	84.5	1.026	0.995
Bakerville - Silverplume	1012	10460	A	Dn%	13.5	27	1.04	-0.65	86.6	86.4	1.010	0.994
Bakerville - Silverplume	1012	10460	A	Grad	13.5	14	3.75	0.40	64.9	74.1	0.957	0.931
			PROJECT ITEM		13.5	NA	NA	NA	84.0	83.4	1.004	0.982

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
MC R200-010												
Mach. Patch, CO Spgs	2011	10492	A	AC%	2.5	5	0.22	0.04	100.0	100.0	1.050	1.030
Mach. Patch, CO Spgs	2011	10492	A	Dn%	2.5	5	0.66	-0.86	100.0	100.0	1.050	1.030
Mach. Patch, CO Spgs	2011	10492	A	Grad	2.5	3	3.51	-1.30	86.0	86.0	1.016	1.025
			PROCESS ITEM		2.5	NA	NA	NA	100.0	100.0	1.043	1.029
Mach. Patch, CO Spgs	2011	10492	B	AC%	3.5	6	0.12	-0.08	100.0	100.0	1.050	1.035
Mach. Patch, CO Spgs	2011	10492	B	Dn%	3.5	7	1.18	-0.30	94.7	93.2	1.035	1.035
Mach. Patch, CO Spgs	2011	10492	B	Grad	3.5	3	2.29	-2.10	40.4	41.6	0.859	0.823
			PROCESS ITEM		3.5	NA	NA	NA	85.5	84.9	1.004	0.998
Mach. Patch, CO Spgs	2011	10492	C	AC%	10.0	16	0.23	-0.07	93.3	91.9	1.032	1.035
Mach. Patch, CO Spgs	2011	10492	C	Dn%	10.0	20	0.59	-0.78	98.2	98.5	1.044	1.050
Mach. Patch, CO Spgs	2011	10492	C	Grad	10.0	13	2.28	1.00	58.3	70.0	0.933	0.905
			PROCESS ITEM		10.0	NA	NA	NA	88.7	90.8	1.018	1.016
Mach. Patch, CO Spgs	2011	10492	D	AC%	8.0	16	0.29	-0.13	92.2	79.9	1.026	0.969
Mach. Patch, CO Spgs	2011	10492	D	Dn%	8.0	16	0.86	-0.34	98.7	97.9	1.046	1.050
Mach. Patch, CO Spgs	2011	10492	D	Grad	8.0	10	3.68	-1.20	74.4	78.5	0.981	0.983
			PROCESS ITEM		8.0	NA	NA	NA	91.9	88.6	1.027	1.012
			PROJECT ITEM		24.0	NA	NA	NA	90.5	90.2	1.022	1.013
C 1603-013												
Blanca - La Veta Pass	5011	10507	A	AC%	51.6	105	0.19	0.07	88.1	87.2	1.014	0.971
Blanca - La Veta Pass	5011	10507	A	Dn%	51.6	44	2.21	-2.64	62.2	37.0	0.933	0.750
Blanca - La Veta Pass	5011	10507	A	Grad	51.6	53	2.94	-0.40	87.9	91.2	1.011	1.012
			PROCESS ITEM		51.6	NA	NA	NA	71.9	55.8	0.973	0.869
Blanca - La Veta Pass	5011	10507	B	AC%	1.2	2	NA	0.08	NA	NA	1.000	1.000
Blanca - La Veta Pass	5011	10507	B	Dn%	1.2	21	1.35	-4.14	-19.9	5.2	0.654	0.750
Blanca - La Veta Pass	5011	10507	B	Grad	1.2	1	NA	-4.00	NA	NA	1.000	1.000
			PROCESS ITEM		1.2	NA	NA	NA	-19.9	5.2	0.827	0.875
Blanca - La Veta Pass	5011	10507	C	AC%	13.3	26	0.17	-0.14	80.8	82.1	0.996	0.965
Blanca - La Veta Pass	5011	10507	C	Dn%	13.3	26	1.07	-0.25	93.6	93.7	1.030	1.037
Blanca - La Veta Pass	5011	10507	C	Grad	13.3	13	1.48	0.20	96.9	94.7	1.040	1.044
			PROCESS ITEM		13.3	NA	NA	NA	90.4	90.4	1.022	1.017
			PROJECT ITEM		66.0	NA	NA	NA	74.0	61.9	0.980	0.899

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
CR 400-023												
Yuma & Wash. Counties	4011	10516	A	AC%	26.9	18	0.14	0.09	97.8	93.0	1.044	1.040
Yuma & Wash. Counties	4011	10516	A	Dn%	26.9	54	1.06	-1.34	71.3	73.1	0.965	0.971
Yuma & Wash. Counties	4011	10516	A	Grad	26.9	13	1.91	-1.80	96.9	95.6	1.039	1.048
			PROCESS ITEM		26.9	NA	NA	NA	84.4	83.6	1.004	0.957
Yuma & Wash. Counties	4011	10516	B	AC%	4.0	8	0.26	0.25	57.7	56.9	0.933	0.929
Yuma & Wash. Counties	4011	10516	B	Dn%	4.0	2	NA	-0.60	NA	NA	0.971	0.991
Yuma & Wash. Counties	4011	10516	B	Grad	4.0	4	2.08	-2.50	90.0	90.0	1.022	1.030
			PROCESS ITEM		4.0	NA	NA	NA	70.6	70.1	0.970	0.950
			PROJECT ITEM		30.9	NA	NA	NA	82.8	81.8	0.999	0.956
CR 400-025												
Logan & Sedgew. Co.s	4011	10524	A	AC%	6.3	12	0.16	-0.09	88.4	91.0	1.013	1.028
Logan & Sedgew. Co.s	4011	10524	A	Dn%	6.3		No Density Tests Taken This Process				1.000	1.000
Logan & Sedgew. Co.s	4011	10524	A	Grad	6.3	6	0.89	-2.00	88.7	89.6	1.017	1.033
			PROCESS ITEM		6.3	NA	NA	NA	88.5	90.4	1.007	1.015
Logan & Sedgew. Co.s	4011	10524	B	AC%	11.7	12	0.22	-0.10	88.8	77.9	1.021	0.954
Logan & Sedgew. Co.s	4011	10524	B	Dn%	11.7	24	1.66	0.44	73.6	76.2	0.977	0.926
Logan & Sedgew. Co.s	4011	10524	B	Grad	11.7	8	0.99	-0.10	100.0	100.0	1.050	1.040
			PROCESS ITEM		11.7	NA	NA	NA	83.4	81.5	1.005	0.957
			PROJECT ITEM		18.0	NA	NA	NA	85.2	84.6	1.006	0.977
C 0641-009												
Junction SH 13 - West	3018	10555	A	AC%	3.3	7	0.38	0.27	49.0	49.0	0.877	0.799
Junction SH 13 - West	3018	10555	A	Dn%	3.3	7	1.14	-0.40	91.7	92.8	1.022	1.035
Junction SH 13 - West	3018	10555	A	Grad	3.3	3	2.52	-0.30	95.8	95.8	1.040	1.026
			PROCESS ITEM		3.3	NA	NA	NA	75.6	76.4	0.982	0.962
Junction SH 13 - West	3018	10555	B	AC%	1.4	3	0.07	0.04	100.0	100.0	1.050	1.025
Junction SH 13 - West	3018	10555	B	Dn%	1.4	3	1.40	-0.60	83.3	83.3	1.010	1.025
Junction SH 13 - West	3018	10555	B	Grad	1.4	2	NA	-3.00	NA	NA	0.911	0.936
			PROCESS ITEM		1.4	NA	NA	NA	89.6	89.6	1.002	1.007
Junction SH 13 - West	3018	10555	C	AC%	26.5	14	0.14	-0.07	98.6	95.2	1.045	1.046
Junction SH 13 - West	3018	10555	C	Dn%	26.5	54	1.22	-1.05	80.2	77.7	0.992	0.907
Junction SH 13 - West	3018	10555	C	Grad	26.5	13	1.51	-1.50	98.9	99.2	1.046	1.050
			PROCESS ITEM		26.5	NA	NA	NA	89.5	87.3	1.019	0.977
			PROJECT ITEM		31.2	NA	NA	NA	88.0	86.2	1.014	0.977

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
NH 5502-027												
S of Chipeta Dr - Co Lin	3016	10556	A	AC%	43.0	18	0.12	0.09	95.5	97.0	1.035	1.050
S of Chipeta Dr - Co Lin	3016	10556	A	Dn%	43.0	82	1.01	-0.94	87.5	85.0	1.008	0.950
S of Chipeta Dr - Co Lin	3016	10556	A	Grad	43.0	19	1.96	-0.80	93.4	93.6	1.027	1.036
			PROCESS ITEM		43.0	NA	NA	NA	91.1	90.3	1.020	0.997
S of Chipeta Dr - Co Lin	3016	10556	B	AC%	9.0	14	0.26	0.04	69.9	74.5	0.966	0.935
S of Chipeta Dr - Co Lin	3016	10556	B	Dn%	9.0	14	1.17	-0.80	85.0	84.4	1.005	0.992
S of Chipeta Dr - Co Lin	3016	10556	B	Grad	9.0	7	1.72	-1.40	46.4	58.3	0.895	0.872
			PROCESS ITEM		9.0	NA	NA	NA	72.8	76.2	0.971	0.951
S of Chipeta Dr - Co Lin	3016	10556	C	AC%	5.3	8	0.08	-0.04	100.0	100.0	1.050	1.040
S of Chipeta Dr - Co Lin	3016	10556	C	Dn%	5.3	15	1.48	-1.29	61.7	67.5	0.937	0.885
S of Chipeta Dr - Co Lin	3016	10556	C	Grad	5.3	6	2.61	-3.00	54.3	54.5	0.904	0.838
			PROCESS ITEM		5.3	NA	NA	NA	71.7	74.6	0.964	0.922
			PROJECT ITEM		57.3	NA	NA	NA	86.4	86.7	1.007	0.983
ACIM 0251-137												
Butte Crk Interch - North	2013	10643	A	AC%	42.9	19	0.15	0.01	96.5	96.9	1.038	1.050
Butte Crk Interch - North	2013	10643	A	Dn%	42.9	87	1.12	-0.78	88.7	85.6	1.013	0.957
Butte Crk Interch - North	2013	10643	A	Grad	42.9	19	2.34	-0.10	95.2	95.6	1.034	1.048
			PROJECT ITEM		42.9	NA	NA	NA	91.3	91.0	1.025	1.003
C 3651-007												
North of Wray	4011	10649	A	AC%	5.7	12	0.28	-0.06	68.9	70.8	0.950	0.909
North of Wray	4011	10649	A	Dn%	5.7		No Density Tests Taken This Process				1.000	1.000
North of Wray	4011	10649	A	Grad	5.7	6	0.82	-0.30	100.0	100.0	1.050	1.035
			PROCESS ITEM		5.7	NA	NA	NA	81.3	82.5	0.995	0.980
North of Wray	4011	10649	B	AC%	10.9	8	0.12	-0.03	100.0	99.9	1.050	1.040
North of Wray	4011	10649	B	Dn%	10.9	22	1.02	0.57	91.1	91.9	1.022	1.030
North of Wray	4011	10649	B	Grad	10.9	9	1.13	-0.40	90.5	90.5	1.021	1.034
			PROCESS ITEM		10.9	NA	NA	NA	93.7	94.0	1.030	1.034
			PROJECT ITEM		16.7	NA	NA	NA	89.4	90.1	1.018	1.015
C 0631-005												
North of Anton	4011	10671	A	AC%	3.6	7	0.22	0.01	84.6	85.4	1.002	1.021
North of Anton	4011	10671	A	Dn%	3.6	8	0.74	-0.53	100.0	99.2	1.050	1.040
North of Anton	4011	10671	A	Grad	3.6	4	2.83	0.00	75.0	74.7	0.980	1.002
			PROCESS ITEM		3.6	NA	NA	NA	90.4	90.2	1.022	1.027

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
North of Anton	4011	10671	B	AC%	87.1	45	0.19	0.08	96.1	85.2	1.037	0.971
North of Anton	4011	10671	B	Dn%	87.1	91	0.95	-0.83	87.5	88.9	1.009	0.980
North of Anton:	4011	10671	B	Grad	87.1	45	2.08	-2.20	93.7	90.8	1.029	1.009
			PROCESS ITEM		87.1	NA	NA	NA	91.3	88.2	1.021	0.983
			PROJECT ITEM		90.7	NA	NA	NA	91.3	88.2	1.021	0.985
IR (CX) 025-1 (120)												
Cuerno Verde Rest Area	2016	90025	A	AC%	7.8	10	0.19	-0.01	90.4	90.0	1.022	1.031
Cuerno Verde Rest Area	2016	90025	A	Dn%	7.8	16	0.91	0.21	97.1	97.9	1.040	1.050
Cuerno Verde Rest Area	2016	90025	A	Grad	7.8	6	2.73	-1.50	90.3	90.6	1.023	1.033
			PROJECT ITEM		7.8	NA	NA	NA	93.7	94.1	1.031	1.041
NH-AQCM-CX-CX-CC085-2(63)												
Iliff & Santa Fe	6014	91433	A	AC%	8.1	10	0.16	-0.00	100.0	100.0	1.050	1.040
Iliff & Santa Fe	6014	91433	A	Dn%	8.1	9	1.30	1.31	65.8	69.6	0.954	0.927
Iliff & Santa Fe	6014	91433	A	Grad	8.1	5	1.92	1.20	65.3	65.3	0.946	0.933
			PROCESS ITEM		8.1	NA	NA	NA	76.0	77.9	0.981	0.962
Iliff & Santa Fe	6014	91433	B	AC%	14.0	14	0.17	0.08	91.7	97.8	1.025	1.050
Iliff & Santa Fe	6014	91433	B	Dn%	14.0	14	0.70	0.49	99.3	99.1	1.048	1.050
iff & Santa Fe	6014	91433	B	Grad	14.0	10	1.96	0.40	83.3	90.0	1.000	1.030
			PROCESS ITEM		14.0	NA	NA	NA	93.8	96.9	1.031	1.046
			PROJECT ITEM		22.1	NA	NA	NA	87.3	89.9	1.013	1.015
BR CX BR 287-3 (63)												
Ft Collins-Poudre River	44015	91457	A	AC%	5.1	10	0.24	-0.33	46.6	45.6	0.880	0.736
Ft Collins-Poudre River	44015	91457	A	Dn%	5.1	9	1.79	-1.20	59.2	64.2	0.932	0.890
Ft Collins-Poudre River	44015	91457	A	Grad	5.1	5	4.16	0.60	78.2	78.2	0.985	1.000
			PROJECT ITEM		5.1	NA	NA	NA	75.3	77.7	0.978	0.957
BRF 0385-1(004)												
North of Cheyene Wells	1015	92043	A	AC%	6.9	7	0.14	0.00	100.0	99.7	1.050	1.035
North of Cheyene Wells	1015	92043	A	Dn%	6.9	14	0.62	-1.26	88.4	86.4	1.009	1.017
North of Cheyene Wells	1015	92043	A	Grad	6.9	7	3.21	2.10	84.4	86.4	1.004	1.002
			PROJECT ITEM		6.9	NA	NA	NA	91.1	91.4	1.020	1.019
NH(CX) 160-(10)												
Lathrop State Park	2013	92994	A	AC%	28.5	14	0.09	0.11	99.8	99.2	1.049	1.050
Lathrop State Park	2013	92994	A	Dn%	28.5	57	1.25	-0.35	89.0	87.8	1.015	0.988
Lathrop State Park	2013	92994	A	Grad	28.5	22	2.47	-0.30	91.7	88.1	1.026	1.006
			PROJECT ITEM		28.5	NA	NA	NA	92.8	91.3	1.027	1.010

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SBAC No.	PRCSS IDENT	ELE-MENT	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF
							Gradation is #8		*Gradation is CONTROLLING sieve*			
NH(CX) 040-2(34)												
SH 40, SH 34 West	3018	93120	A	AC%	14.9	17	0.17	-0.10	91.6	87.2	1.026	1.013
SH 40, SH 34 West	3018	93120	A	Dn%	14.9	30	0.91	-1.05	84.8	85.1	1.006	0.986
SH 40, SH 34 West	3018	93120	A	Grad	14.9	9	1.12	3.00	93.0	97.6	1.029	1.040
			PROCESS ITEM		14.9	NA	NA	NA	88.5	88.2	1.017	1.005
SH 40, SH 34 West	3018	93120	B	AC%	11.3	9	0.11	0.02	100.0	100.0	1.050	1.040
SH 40, SH 34 West	3018	93120	B	Dn%	11.3	23	0.93	-1.57	77.5	67.7	0.978	0.857
SH 40, SH 34 West	3018	93120	B	Grad	11.3	8	1.51	2.40	97.3	97.4	1.041	1.040
			PROCESS ITEM		11.3	NA	NA	NA	88.2	83.3	1.012	0.949
			PROJECT ITEM		26.2	NA	NA	NA	88.4	86.1	1.015	0.981
BRF 024-1(31)												
Two Bridges So of Malta	3063	93151	A	AC%	5.3	11	0.23	-0.05	87.1	88.5	0.964	1.035
Two Bridges So of Malta	3063	93151	A	Dn%	5.3	11	1.20	-0.75	84.0	84.5	1.002	1.008
Two Bridges So of Malta	3063	93151	A	Grad	5.3	6	1.21	2.33	100.0	100.0	1.050	1.035
			PROCESS ITEM		5.3	NA	NA	NA	82.1	82.8	1.000	1.022
Two Bridges So of Malta	3063	93151	B	AC%	3.5	6	0.13	-0.03	100.0	100.0	1.050	1.035
Two Bridges So of Malta	3063	93151	B	Dn%	3.5	7	0.79	-0.50	100.0	99.1	1.050	1.035
Two Bridges So of Malta	3063	93151	B	Grad	3.5	4	2.87	0.75	92.1	92.0	1.028	1.030
			PROCESS ITEM		3.5	NA	NA	NA	98.4	98.0	1.046	1.034
			PROJECT ITEM		8.8	NA	NA	NA	88.6	88.8	1.018	1.027
NH1601-031												
East of Cortez	5012	93277	A	AC%	25.5	17	0.18	-0.01	94.7	91.0	1.037	1.029
East of Cortez	5012	93277	A	Dn%	25.5	52	1.40	-1.62	54.8	54.8	0.918	0.750
East of Cortez	5012	93277	A	Grad	25.5	12	1.62	2.10	93.2	97.3	1.028	1.050
			PROCESS ITEM		25.5	NA	NA	NA	74.5	74.2	0.978	0.894
East of Cortez	5012	93277	B	AC%	2.7	6	0.13	-0.07	100.0	98.4	1.050	1.035
East of Cortez	5012	93277	B	Dn%	2.7		No Density Tests Taken This Process				1.000	1.000
East of Cortez	5012	93277	B	Grad	2.7	3	2.31	2.70	66.7	66.7	0.970	0.967
			PROCESS ITEM		2.7	NA	NA	NA	86.7	85.7	1.009	1.008
East of Cortez	5012	93277	C	AC%	27.1	25	0.20	0.54	11.4	11.6	0.761	0.750
East of Cortez	5012	93277	C	Dn%	27.1	55	1.02	-0.92	86.6	85.5	1.008	0.970
East of Cortez	5012	93277	C	Grad	27.1	18	1.71	1.30	87.3	90.6	1.014	1.027
			PROCESS ITEM		27.1	NA	NA	NA	64.2	64.3	0.935	0.915
			PROJECT ITEM		55.3	NA	NA	NA	70.0	69.9	0.957	0.910

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT AND MIX DESIGN FOR 1995 CONSTRUCTION SEASON USING QPM 2.**

PROJECT LOCATION	REG/ UNIT	SUBA NUMB	PRCSS/ MX D#	ELE- MENT	ITEM BID/TN	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM2 QL	QPM1 PF	QPM2 PF	Incent/ Disin $
								Gradation is #8		*Gradation is CONTROLLING Sieve*			
NH 2852-005													
Saguache-North	5011	10228	1	AC%	$34.00	59.2	60	0.17	0.06	91.3	1.022	1.013	$7,888
Saguache-North	5011	10228	1	Dn%	$34.00	59.2	115	0.82	-0.57	96.0	1.037	1.043	$43,054
Saguache-North	5011	10228	1	Grad	$34.00	59.2	59	3.34	1.10	84.9	1.002	0.985	($5,886)
TOTALS & W'TED MEANS FOR MIX DESIGN			#02195P	ITEM	$34.00	59.2	NA	NA	NA	92.4	1.026	1.022	$45,036
Saguache-North	5011	10228	1	AC%	$24.00	7.0	7	0.08	-0.14	99.0	1.047	1.035	$1,784
Saguache-North	5011	10228	1	Dn%	$24.00	7.0	14	0.74	-1.01	91.3	1.022	1.030	$2,559
Saguache-North	5011	10228	1	Grad	$24.00	7.0	4	1.71	0.80	100.0	1.050	1.030	$1,008
TOTALS & W'TED MEANS FOR MIX DESIGN			#61471a	ITEM	$24.00	7.0	NA	NA	NA	95.3	1.035	1.032	$5,331
Mix design #61471b is broken into 2 Processes below.													
Saguache-North	5011	10228	1	AC%	$24.00	16.9	18	0.21	0.07	83.7	0.998	0.992	($913)
Saguache-North	5011	10228	1	Dn%	$24.00	16.9	33	1.02	-0.73	89.2	1.015	1.013	$2,607
Saguache-North	5011	10228	1	Grad	$24.00	16.9	9	3.22	0.10	90.0	1.018	1.031	$2,497
TOTALS & WEIGHTED MEANS FOR PROCES			1	ITEM	$24.00	16.9	NA	NA	NA	87.7	1.011	1.010	$4,191
In Process 1A below, 1 element (density) has 1 test > 2V outside TL, see 105.03 & 105.03g of 403 QC/QA Specifications.													
Saguache-North	5011	10228	1A	AC%	$24.00	0.5	0	NA	0.00	NA	NA	0.750	($900)
Saguache-North	5011	10228	1A	Dn%	$24.00	0.5	1	NA	-4.40	NA	NA	0.750	($1,500)
Saguache-North	5011	10228	1A	Grad	$24.00	0.5	0	NA	0.00	NA	NA	0.750	($600)
TOTALS & WEIGHTED MEANS FOR PROCES			1A	ITEM	$24.00	0.5	NA	NA	NA	NA	NA	0.750	($3,000)
TOTALS & W'TED MEANS FOR MIX DESIGN			#61471b	ITEM	$24.00	17.4	NA	NA	NA	87.7	1.011	1.003	$1,191
PROJ TOTALS & MEANS W'TED BY TONS, ALL DESIGNS, ITEM					$31.09	83.6	NA	NA	NA	91.7	1.023	1.019	$51,558
C 0502-033													
Gunnison E - Co Line	3016	10554	1	AC%	$32.72	29.2	30	0.13	-0.07	96.4	1.039	1.050	$14,314
Gunnison E - Co Line	3016	10554	1	Dn%	$32.72	29.2	59	1.16	0.40	89.9	1.018	1.003	$1,484
Gunnison E - Co Line	3016	10554	1	Grad	$32.72	29.2	15	2.37	0.20	93.7	1.030	1.041	$7,867
TOTALS & W'TED MEANS FOR MIX DESIGN			#58550	ITEM	$32.72	29.2	NA	NA	NA	92.6	1.026	1.025	$23,664
C 0361-046													
US 85 @ Bromley Lane	6011	10678	1	AC%	$70.00	6.5	14	0.15	-0.16	94.9	1.034	1.046	$6,289
US 85 @ Bromley Lane	6011	10678	1	Dn%	$70.00	6.5			No	Density	Tests	This	Design
US 85 @ Bromley Lane	6011	10678	1	Grad	$70.00	6.5	9	0.71	2.00	100.0	1.050	1.040	$3,647
TOTALS & W'TED MEANS FOR MIX DESIGN			#64249	ITEM	$70.00	6.5	NA	NA	NA	96.9	1.040	1.044	$9,936

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT AND MIX DESIGN FOR 1995 CONSTRUCTION SEASON USING QPM 2.**

PROJECT LOCATION	REG/ UNIT	SUBA NUMB	PRCSS/ MX D#	ELE- MENT	ITEM BID/TN	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM2 QL	QPM1 PF	QPM2 PF	Incent/ Disin $
								Gradation is #8		*Gradation is CONTROLLING Sieve*			
C 0331-063													
Parker Rd, Quincy - I 225	6013	10682	1	AC%	$31.80	2.2	3	0.04	-0.21	100.0	1.050	1.025	$535
Parker Rd, Quincy - I 225	6013	10682	1	Dn%	$31.80	2.2	5	0.57	-0.66	100.0	1.050	1.030	$1,069
Parker Rd, Quincy - I 225	6013	10682	1	Grad	$31.80	2.2	3	2.08	2.70	92.3	1.025	1.025	$356
TOTALS & W'TED MEANS FOR MIX DESIGN			#642313	ITEM	$31.80	2.2	NA	NA	NA	98.5	1.045	1.028	$1,961
Parker Rd, Quincy - I 225	6013	10682	1	AC%	$31.80	9.2	10	0.11	-0.11	96.3	1.038	1.040	$3,519
Parker Rd, Quincy - I 225	6013	10682	1	Dn%	$31.80	9.2	18	1.13	-1.13	77.8	0.979	0.958	($6,223)
Parker Rd, Quincy - I 225	6013	10682	1	Grad	$31.80	9.2	8	1.39	1.80	81.8	0.992	0.996	($245)
TOTALS & W'TED MEANS FOR MIX DESIGN			#642314	ITEM	$31.80	9.2	NA	NA	NA	84.2	0.999	0.990	($2,950)
PROJ TOTALS & MEANS W'TED BY TONS, ALL DESIGNS,				ITEM	$31.80	11.5	NA	NA	NA	87.0	1.006	0.997	($989)
C 0404-029													
Colfax Ave, Colo-Peoria	6013	10687	1	AC%	$20.91	20.9	20	0.12	0.00	100.0	1.050	1.050	$6,566
Colfax Ave, Colo-Peoria	6013	10687	1	Dn%	$20.91	20.9	42	1.07	-0.43	91.9	1.024	1.018	$3,896
Colfax Ave, Colo-Peoria	6013	10687	1	Grad	$20.91	20.9	14	2.43	-1.90	89.1	1.015	1.020	$1,761
TOTALS & W'TED MEANS FOR MIX DESIGN			#64243	ITEM	$20.91	20.9	NA	NA	NA	93.8	1.030	1.028	$12,223
IM 0703-217													
Georgetown West '	1012	10772	1	AC%	$31.60	24.7	25	0.20	0.12	79.5	0.984	0.949	($11,981)
Georgetown West	1012	10772	1	Dn%	$31.60	24.7	50	1.20	-0.32	89.5	1.016	1.000	$37
Georgetown West	1012	10772	1	Grad	$31.60	24.7	13	3.83	-1.00	80.0	0.966	0.971	($4,601)
TOTALS & W'TED MEANS FOR MIX DESIGN			#74418e	ITEM	$31.60	24.7	NA	NA	NA	84.6	1.001	0.979	($16,545)
Georgetown West	1012	10772	1	AC%	$31.60	13.1	15	0.21	0.01	84.5	1.001	0.997	($388)
Georgetown West	1012	10772	1	Dn%	$31.60	13.1	27	1.04	-0.85	86.4	1.006	0.995	($978)
Georgetown West	1012	10772	1	Grad	$31.60	13.1	14	3.75	0.40	74.1	0.967	0.933	($5,535)
TOTALS & W'TED MEANS FOR MIX DESIGN			#74418	ITEM	$31.60	13.1	NA	NA	NA	83.4	0.997	0.983	($6,901)
PROJ TOTALS & MEANS W'TED BY TONS, ALL DESIGNS, ITEM					$31.60	37.9	NA	NA	NA	84.2	0.999	0.980	($23,445)
NH 2854-059													
Antero Junction North	1012	10773	1	AC%	$26.00	43.8	44	0.22	-0.01	82.6	0.994	0.948	($17,589)
Antero Junction North	1012	10773	1	Dn%	$26.00	43.8	88	1.00	-0.11	95.4	1.035	1.038	$21,596
Antero Junction North	1012	10773	1	Grad	$26.00	43.8	22	3.38	1.50	79.6	0.985	0.949	($11,519)
TOTALS & W'TED MEANS FOR MIX DESIGN			#63356	ITEM	$26.00	43.8	NA	NA	NA	88.4	1.013	0.993	($7,511)
STR 069A-017													
Westcliffe North	2013	10958	1	AC%	$29.70	31.8	32	0.26	0.00	75.6	0.972	0.921	($22,494)
Westcliffe North	2013	10958	1	Dn%	$29.70	31.8	64	0.69	-1.03	91.9	1.024	1.018	$8,266
Westcliffe North	2013	10958	1	Grad	$29.70	31.8	16	2.91	2.30	73.5	0.965	0.929	($13,355)
TOTALS & W'TED MEANS FOR MIX DESIGN			#87151	ITEM	$29.70	31.8	NA	NA	NA	83.3	0.997	0.971	($27,584)

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT AND MIX DESIGN FOR 1995 CONSTRUCTION SEASON USING QPM 2.**

PROJECT LOCATION	REG/ UNIT	SUBA NUMB	PRCSS/ MX D#	ELE- MENT	ITEM BID/TN	TONS 1000	TEST "n"	PRCSS SD	MEAN - TC	QPM2 QL	QPM1 PF	QPM2 PF	Incent/ Disin $
								Gradation is #8		*Gradation is CONTROLLING Sieve*			
MCR 100-014													
SH36 Last Chance-Co. Line	1015	10959	1	AC%	$30.00	6.1	6	0.10	-0.19	84.7	1.001	1.018	$1,001
SH36 Last Chance-Co. Line	1015	10959	1	Dn%	$30.00	6.1	12	0.97	-1.13	81.5	0.991	0.980	($1,851)
SH36 Last Chance-Co. Line	1015	10959	1	Grad	$30.00	6.1	3	1.73	-3.00	42.0	0.864	0.825	($6,385)
TOTALS & W'TED MEANS FOR MIX DESIGN			#83651	ITEM	$30.00	6.1	NA	NA	NA	74.5	0.969	0.960	($7,236)
SH36 Last Chance-Co. Line	1015	10959	2	AC%	$30.00	12.4	13	0.12	-0.00	99.7	1.049	1.050	$5,594
SH36 Last Chance-Co. Line	1015	10959	2	Dn%	$30.00	12.4	25	1.13	-0.41	90.9	1.021	1.029	$4,328
SH36 Last Chance-Co. Line	1015	10959	2	Grad	$30.00	12.4	7	1.11	-3.30	95.3	1.035	1.035	$2,611
TOTALS & W'TED MEANS FOR MIX DESIGN			#83651B	ITEM	$30.00	12.4	NA	NA	NA	94.4	1.032	1.034	$12,533
PROJ TOTALS & MEANS W'TED BY TONS, ALL DESIGNS,				ITEM	$30.00	18.5	NA	NA	NA	87.9	1.011	1.010	$5,298
IM 0704-174													
Agate - East & West	1015	10964	1	AC%	$30.00	7.8	8	0.18	0.11	95.6	1.038	1.040	$2,804
Agate - East & West	1015	10964	1	Dn%	$30.00	7.8			No	Density	Tests	This	Process
Agate - East & West	1015	10964	1	Grad	$30.00	7.8	4	1.71	-0.20	100.0	1.050	1.030	$1,402
TOTALS & W'TED MEANS FOR MIX DESIGN			#84248a	ITEM	$30.00	7.8	NA	NA	NA	97.4	1.042	1.036	$4,208
Agate - East & West	1015	10964	2	AC%	$30.00	13.0	13	0.22	0.03	94.5	1.032	1.044	$5,182
Agate - East & West	1015	10964	2	Dn%	$30.00	13.0	26	1.01	-0.04	95.9	1.037	1.050	$9,748
Agate - East & West	1015	10964	2	Grad	$30.00	13.0	7	1.51	-0.40	100.0	1.050	1.035	$2,729
TOTALS & W'TED MEANS FOR MIX DESIGN			#84248a	ITEM	$30.00	13.0	NA	NA	NA	96.3	1.038	1.045	$17,659
PROJ TOTALS & MEANS W'TED BY TONS, ALL DESIGNS,				ITEM	$30.00	20.8	NA	NA	NA	96.7	1.039	1.042	$21,865
C 1121-0045													
Del Norte to Jct SH 285	5011	10984	1	AC%	$29.17	0.7	1	NA	0.07	NA	1.000	1.000	$0
Del Norte to Jct SH 285	5011	10984	1	Dn%	$29.17	0.7	2	NA	-0.75	NA	1.000	1.000	$0
Del Norte to Jct SH 285	5011	10984	1	Grad	$29.17	0.7	1	NA	3.00	NA	1.000	1.000	$0
TOTALS & W'TED MEANS FOR MIX DESIGN			#WCT	ITEM	$29.17	0.7	NA	NA	NA	NA	1.000	1.000	$0
Del Norte to Jct SH 285	5011	10984	1	AC%	$29.17	22.8	23	0.17	0.10	87.3	1.010	1.001	$271
Del Norte to Jct SH 285	5011	10984	1	Dn%	$29.17	22.8	46	1.29	0.03	88.2	1.012	0.990	($3,225)
Del Norte to Jct SH 285	5011	10984	1	Grad	$29.17	22.8	12	2.49	-0.80	93.1	1.028	1.039	$5,143
TOTALS & W'TED MEANS FOR MIX DESIGN			#WCT 2	ITEM	$29.17	22.8	NA	NA	NA	88.9	1.014	1.003	$2,189
PROJ TOTALS & MEANS W'TED BY TONS, ALL DESIGNS,				ITEM	$29.17	23.5	NA	NA	NA	88.9	1.014	1.003	$2,189

TABLE 3, Pg 1

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SUBA NUM	PRCSS IDENT	ELE- MENT	TONS 1000				QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF	CN TR CD
						Resident Engineer							
						(Projects Sorted by Subaccount Number)							
Turkey Creek	2013	10057	PROJECT ITEM		27.7	Wrona			92.9	91.5	1.026	1.013	B4
Gunnison East	3016	10068	PROJECT ITEM		34.1	Carlson			82.7	80.2	1.001	0.951	H1
University & Dry Crk Rd	6015	10105	PROJECT ITEM		8.6	Self			80.4	79.6	0.994	0.993	B1
SH 52 - East	4015	10126	PROJECT ITEM		22.9	Leonard			87.3	87.3	1.014	0.976	B1
SH 287, I 70 - 74th Ave	6016	10155	PROJECT ITEM		15.3	Self			87.6	85.6	1.014	0.987	B3
2 Locations, NE Reg 4	4015	10156	PROJECT ITEM		6.7	Ellis (Gable)			91.1	94.6	1.023	1.035	P1
Cameron Pass E & W	4015	10220	PROJECT ITEM		6.5	Leonard			79.7	82.8	0.995	0.980	C3
Slumgullion Pass - So.	3016	10222	PROJECT ITEM		18.7	Carlson			83.7	75.7	1.007	0.930	C4
3 Miles N of Blackhawk	1013	10230	PROJECT ITEM		20.2	Hirschfeld			90.1	86.9	1.019	1.002	A1
South of Rangely	3014	10370	PROJECT ITEM		20.5	Patton			88.6	86.1	1.018	0.998	C4
2 Mi. S of Matheson - N	1015	10455	PROJECT ITEM		42.6	Goetzcke			92.3	92.0	1.026	1.026	W2
Bakerville - Silverplume	1012	10460	PROJECT ITEM		13.5	Goff			84.0	83.4	1.004	0.982	A1
Mach. Patch, CO Spgs	2011	10492	PROJECT ITEM		24.0	Watwood			90.5	90.2	1.022	1.013	R1
Blanca - La Veta Pass	5011	10507	PROJECT ITEM		66.0	Schneider			74.0	61.9	0.980	0.899	A4
Yuma & Wash. Counties	4011	10516	PROJECT ITEM		30.9	Ellis (Gable)			82.6	81.8	0.999	0.956	P1
Logan & Sedgew. Co.s	4011	10524	PROJECT ITEM		18.0	Ellis (Gable)			85.2	84.6	1.006	0.977	P1
Junction SH 13 - West	3016	10555	PROJECT ITEM		31.2	Pyle			88.0	86.2	1.014	0.977	C4
S of Chipeta Dr - Co Lin	3016	10556	PROJECT ITEM		57.3	Carlson			86.4	86.7	1.007	0.983	U1
Butte Crk Interch - North	2013	10643	PROJECT ITEM		42.9	Wrona			91.3	91.0	1.025	1.003	H1
North of Wray	4011	10649	PROJECT ITEM		16.7	Ellis (Gable)			89.4	90.1	1.018	1.015	P1
North of Anton	4011	10671	PROJECT ITEM		90.7	Ellis			91.3	88.2	1.021	0.985	G1
Cuerno Verde Rest Area	2016	90025	PROJECT ITEM		7.8	Rizley			93.7	94.1	1.031	1.041	B2
Iliff & Santa Fe	6014	91433	PROJECT ITEM		22.1	McKenzie			87.2	89.8	1.013	1.015	K1
Ft Collins-Poudre River	4015	91457	PROJECT ITEM		5.1	Leonard			59.2	61.4	0.927	0.866	W2
North of Cheyene Wells	1015	92043	PROJECT ITEM		6.9	Goetzcke			91.1	91.4	1.020	1.019	A3
Lathrop State Park	2013	92994	PROJECT ITEM		28.5	Wrona			92.8	91.3	1.027	1.010	W1
SH 40, SH 34 West	3018	93120	PROJECT ITEM		26.2	Pyle			88.4	86.1	1.015	0.981	A1
Two Bridges So of Malta	3063	93151	PROJECT ITEM		8.8	Nelson			86.6	86.6	1.018	1.027	H2
East of Cortez	5012	93277	PROJECT ITEM		55.3	Lewis			70.0	69.9	0.957	0.910	N1
SUMMARY FOR ALL 1995 QPM 1 PROJECTS					775.63				86.05	84.18	1.008	0.978	

TABLE 3, Pg 2

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SUBA NUM	PRCSS IDENT	ELE- MENT	TONS 1000		QPM2 QL RANKING	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF	CN TR CD
							1-19, 1 = Lowest					

(Projects Sorted & Summarized by Contractor Code)

3 Miles N of Blackhawk	1013	10230	PROJECT	ITEM	20.2			90.1	86.9	1.019	1.002	A1
SH 40, SH 34 West	3018	93120	PROJECT	ITEM	26.2			88.4	86.1	1.015	0.981	A1
Bakerville - Silverplume	1012	10460	PROJECT	ITEM	13.5			84.0	83.4	1.004	0.982	A1
					59.9		8	88.0	85.8	1.014	0.988	A1
North of Cheyene Wells	1015	92043	PROJECT	ITEM	6.9		17	91.1	91.4	1.020	1.019	A3
Blanca - La Veta Pass	5011	10507	PROJECT	ITEM	66.0		1	74.0	61.9	0.980	0.899	A4
University & Dry Crk Rd	6016	10105	PROJECT	ITEM	8.6			80.4	79.6	0.994	0.993	B1
SH 52 - East	4015	10126	PROJECT	ITEM	22.9			87.3	87.3	1.014	0.976	B1
					31.4		4	85.4	85.2	1.008	0.981	B1
Cuerno Verde Rest Area	2016	90025	PROJECT	ITEM	7.8		19	93.7	94.1	1.031	1.041	B2
SH 287, I 70 - 74th Ave	6016	10155	PROJECT	ITEM	15.3		6	87.6	85.6	1.014	0.987	B3
Turkey Creek	2013	10057	PROJECT	ITEM	27.7		18	92.9	91.5	1.028	1.013	B4
Cameron Pass E & W	4015	10220	PROJECT	ITEM	6.5			79.7	82.8	0.995	0.980	C3
South of Rangely	3014	10370	PROJECT	ITEM	20.5			88.8	86.1	1.018	0.996	C3
					27.0		5	86.6	85.3	1.013	0.993	C3
Junction SH 13 - West	3016	10555	PROJECT	ITEM	31.2			88.0	86.2	1.014	0.977	C4
Slumgullion Pass - So.	3016	10222	PROJECT	ITEM	18.7			83.7	75.7	1.007	0.930	C4
					50.0		3	86.4	82.3	1.011	0.959	C4
North of Anton	4011	10871	PROJECT	ITEM	90.7		11	91.3	88.2	1.021	0.985	G1
Gunnison East	3016	10088	PROJECT	ITEM	34.1			82.7	80.2	1.001	0.951	H1
Butte Crk Interch - North	2013	10643	PROJECT	ITEM	42.9			91.3	91.0	1.025	1.003	H1
					77.0		9	87.5	86.2	1.014	0.980	H1
Two Bridges So of Malta	3063	93151	PROJECT	ITEM	8.8		13	88.6	88.8	1.018	1.027	H2
Illiff & Santa Fe	6014	91433	PROJECT	ITEM	22.1		14	87.2	89.8	1.013	1.015	K1
East of Cortez	5012	93277	PROJECT	ITEM	55.3		2	70.0	69.9	0.957	0.910	N1
Yuma & Wash. Counties	4011	10516	PROJECT	ITEM	30.9			82.6	81.8	0.999	0.956	P1
2 Locations, NE Reg 4	4015	10158	PROJECT	ITEM	6.7			91.1	94.6	1.029	1.035	P1
Logan & Sedgew. Co.s	4011	10524	PROJECT	ITEM	18.0			85.2	84.6	1.006	0.977	P1
North of Wray	4011	10649	PROJECT	ITEM	16.7			89.4	90.1	1.018	1.015	P1
					72.3		7	85.6	85.6	1.007	0.982	P1
Mach. Patch, CO Spgs	2011	10492	PROJECT	ITEM	24.0		15	90.5	90.2	1.022	1.013	R1
S of Chipeta Dr - Co Lin	3018	10556	PROJECT	ITEM	57.3		10	86.4	86.7	1.007	0.983	U1
Lathrop State Park	2013	92994	PROJECT	ITEM	28.5		16	92.8	91.3	1.027	1.010	W1
Ft Collins-Poudre River	4015	91457	PROJECT	ITEM	5.1			59.2	61.4	0.927	0.866	W2
2 Mi. S of Matheson - N	1015	10455	PROJECT	ITEM	42.6			92.3	92.0	1.026	1.026	W2
					47.7		12	88.8	88.8	1.016	1.009	W2
SUMMARY FOR ALL 1995 QPM 1 PROJECTS					775.6			86.0	84.2	1.008	0.976	19

BOXES ABOVE REPRESENT SUMMARIES BY CONTRACTOR

TABLE 3, Pg 3

HOT BITUMINOUS PAVEMENT QC/QA DETAILS & SUMMARY BY PROJECT & PROCESS FOR 1995 CONSTRUCTION SEASON USING PILOT QPM 1.**

PROJECT LOCATION	REG/ UNIT	SUBA NUM	PRCSS IDENT	ELE-MENT	TONS 1000		QPM2 QL RANKING	QPM1 QL	QPM2 QL	QPM1 PF	QPM2 PF	CN TR CD
							1-6, 1 = Lowest					
(Projects Sorted & Summarized by Region, Ordered in Each, Lowest to Highest QPM2 QL)												
Bakerville - Silverplume	1012	10460	PROJECT	ITEM	13.5			84.0	83.4	1.004	0.982	A1
3 Miles N of Blackhawk	1013	10230	PROJECT	ITEM	20.2			90.1	86.9	1.019	1.002	A1
North of Cheyene Wells	1015	92043	PROJECT	ITEM	6.9			91.1	91.4	1.020	1.019	A3
2 Mi. S of Matheson - N	1015	10455	PROJECT	ITEM	42.8			92.3	92.0	1.026	1.026	W2
					83.19	Reg. 1	5	90.3	89.3	1.020	1.012	3
Mach. Patch, CO Spgs	2011	10492	PROJECT	ITEM	24.0			90.5	90.2	1.022	1.013	R1
Butte Crk Interch - North	2013	10643	PROJECT	ITEM	42.9			91.3	91.0	1.025	1.003	H1
Lathrop State Park	2013	92994	PROJECT	ITEM	28.5			92.8	91.3	1.027	1.010	W1
Turkey Creek	2013	10057	PROJECT	ITEM	27.7			92.9	91.5	1.028	1.013	B4
Cuerno Verde Rest Area	2016	90025	PROJECT	ITEM	7.8			93.7	94.1	1.031	1.041	B2
					130.9	Reg. 2	6	92.0	91.4	1.027	1.010	5
Slumgullion Pass - So.	3016	10222	PROJECT	ITEM	18.7			83.7	75.7	1.007	0.930	C4
Gunnison East	3016	10088	PROJECT	ITEM	34.1			82.7	80.2	1.001	0.951	H1
South of Rangely	3014	10370	PROJECT	ITEM	20.5			88.8	86.1	1.018	0.996	C4
SH 40, SH 34 West	3018	93120	PROJECT	ITEM	26.2			88.4	88.1	1.015	0.981	A1
Junction SH 13 - West	3018	10555	PROJECT	ITEM	31.2			88.0	86.2	1.014	0.977	C4
S of Chipeta Dr - Co Ln	3016	10556	PROJECT	ITEM	57.3			86.4	86.7	1.007	0.963	U1
Two Bridges So of Malta	3063	93151	PROJECT	ITEM	8.8			88.6	88.8	1.018	1.027	H2
					196.84	Reg. 3	2	86.4	84.4	1.010	0.974	6
Ft Collins-Poudre River	4015	91457	PROJECT	ITEM	5.1			59.2	61.4	0.927	0.866	W2
Yuma & Wash, Counties	4011	10516	PROJECT	ITEM	30.9			82.6	81.8	0.999	0.956	P1
Cameron Pass E & W	4015	10220	PROJECT	ITEM	6.5			79.7	82.8	0.995	0.980	C3
Logan & Sedgew. Co.s	4011	10524	PROJECT	ITEM	18.0			85.2	84.6	1.006	0.977	P1
SH 52 - East	4015	10128	PROJECT	ITEM	22.9			87.3	87.3	1.014	0.976	B1
North of Anton	4011	10671	PROJECT	ITEM	90.7			91.3	88.2	1.021	0.985	G1
North of Wray	4011	10649	PROJECT	ITEM	16.7			89.4	90.1	1.018	1.015	P1
2 Locations, NE Reg 4	4011	10158	PROJECT	ITEM	6.7			91.1	94.6	1.023	1.035	P1
					197.45	Reg. 4	3	87.5	86.3	1.012	0.980	5
Blanca - La Veta Pass	5011	10507	PROJECT	ITEM	66.0			74.0	61.9	0.980	0.899	A4
East of Cortez	5012	93277	PROJECT	ITEM	55.3			70.0	69.9	0.957	0.910	N1
					121.33	Reg. 5	1	72.2	65.6	0.970	0.904	2
University & Dry Crk Rd	6016	10105	PROJECT	ITEM	8.6			80.4	79.6	0.994	0.993	B1
SH 287, I 70 - 74th Ave	6016	10155	PROJECT	ITEM	15.3			87.6	85.6	1.014	0.987	B3
Illiff & Santa Fe	6014	91433	PROJECT	ITEM	22.1			87.2	89.8	1.013	1.015	K1
					45.912	Reg. 6	4	86.1	86.5	1.010	1.001	3
SUMMARY FOR All 1995 QPM 1 PROJECTS					775.63			86.05	84.16	1.008	0.976	19

BOXES ABOVE REPRESENT SUMMARIES BY REGIONS

TABLE 4, Pg 1

HOT BITUMINOUS PAVEMENT QC/QA SUMMARY BY PROJECT FOR 1995 CONSTRUCTION SEASON USING QPM 2.**

PROJECT LOCATION	REG/ UNIT	SUBA NUM	PROC No.	ELE-MENT	ITEM $ BID/TN	TONS 1000	RESIDENT ENGINEER	QPM2 QL	QPM1 PF	QPM2 PF	Incent/ Disinc $	CNTR CODE
(Sorted by Subaccount Numbers, QL Not Ranked)												
Saguache-North	5011	10228	PROJECT	ITEM	$31.09	83.6	Schneider	91.6	1.023	1.019	$51,558	C4
Gunnison E - Co Line	3016	10554	PROJECT	ITEM	$32.72	29.2	Carlson	92.6	1.026	1.025	$23,664	E1
US 85 @ Bromley Lane	6011	10678	PROJECT	ITEM	$70.00	6.5	Basner	96.9	1.040	1.044	$9,936	A1
Parker Rd, Quincy - I 225	6013	10682	PROJECT	ITEM	$31.80	11.5	Eastwood	87.0	1.008	0.997	($989)	B3
Colfax Ave, Colo-Peoria	6013	10687	PROJECT	ITEM	$20.91	20.9	Eastwood	93.8	1.030	1.028	$12,223	K1
Georgetown West	1012	10772	PROJECT	ITEM	$31.60	37.9	Goff	84.2	0.999	0.980	($23,445)	A1
Antero Junction North	1012	10773	PROJECT	ITEM	$26.00	43.8	Goff	88.4	1.013	0.993	($7,511)	A1
Westcliffe North	2013	10958	PROJECT	ITEM	$29.70	31.8	Wrona	83.3	0.997	0.971	($27,584)	A2
SH36 Last Chance-Co. Line	1015	10959	PROJECT	ITEM	$30.00	18.5	Goetzcke	87.9	1.011	1.010	$5,298	W2
Agate - East & West	1015	10964	PROJECT	ITEM	$30.00	20.8	Goetzcke	96.7	1.039	1.042	$21,865	B1
Del Norte to Jct SH 285	5011	10984	PROJECT	ITEM	$29.17	23.5	Schnieder	88.9	1.011	1.003	$2,189	H1
SUMMARY FOR ALL 1995 QPM 2 PROJECTS					$30.34	327.88		89.5	1.016	1.007	$67,204	9
(Same Data as Above, Sorted by Contractors Codes, and Ranked by QL, 1 Being the Lowest)												
Georgetown West	1012	10772	PROJECT	ITEM	$31.60	37.9	RANK	84.2	0.999	0.980	($23,445)	A1
Antero Junction North	1012	10773	PROJECT	ITEM	$26.00	43.8		88.4	1.013	0.993	($7,511)	A1
US 85 @ Bromley Lane	6011	10678	PROJECT	ITEM	$70.00	6.5		96.9	1.040	1.044	$9,936	A1
					$31.66	88.2	3	87.2	1.009	0.992	($21,021)	A1
Westcliffe North	2013	10958	PROJECT	ITEM	$29.70	31.8	1	83.3	0.997	0.971	($27,584)	A2
Agate - East & West	1015	10964	PROJECT	ITEM	$30.00	20.8	9	96.7	1.039	1.042	$21,865	B1
Parker Rd, Quincy - I 225	6013	10682	PROJECT	ITEM	$31.80	11.5	2	87.0	1.008	0.997	($989)	B3
Saguache-North	5011	10228	PROJECT	ITEM	$31.09	83.6	6	91.6	1.023	1.019	$51,558	C4
Gunnison E - Co Line	3016	10554	PROJECT	ITEM	$32.72	29.2	7	92.6	1.026	1.025	$23,664	E1
Del Norte to Jct SH 285	5011	10984	PROJECT	ITEM	$29.17	23.5	5	88.9	1.011	1.003	$2,189	H1
Colfax Ave, Colo-Peoria	6013	10687	PROJECT	ITEM	$20.91	20.9	8	93.8	1.030	1.028	$12,223	K1
SH36 Last Chance-Co. Line	1015	10959	PROJECT	ITEM	$30.00	18.5	4	87.9	1.011	1.010	$5,298	W2
SUMMARY FOR ALL 1995 QPM 2 PROJECTS					$30.34	327.88		89.5	1.016	1.007	$67,204	9
(Same as Above, Sorted by Regions & Which are Ranked by QL with 1 Being the Lowest)												
Georgetown West	1012	10772	PROJECT	ITEM	$31.60	37.9	RANK	84.2	0.999	0.980	($23,445)	A1
SH36 Last Chance-Co. Line	1015	10959	PROJECT	ITEM	$30.00	18.5		87.9	1.011	1.010	$5,298	W2
Antero Junction North	1012	10773	PROJECT	ITEM	$26.00	43.8		88.4	1.013	0.993	($7,511)	A1
Agate - East & West	1015	10964	PROJECT	ITEM	$30.00	20.8		96.7	1.039	1.042	$21,865	B1
					$29.05	120.94	Reg. 1 2	88.4	1.013	1.000	($3,794)	4
Westcliffe North	2013	10958	PROJECT	ITEM	$29.70	31.8	Reg. 2 1	83.3	0.997	0.971	($27,584)	A2
Gunnison E - Co Line	3016	10554	PROJECT	ITEM	$32.72	29.2	Reg. 3 5	92.6	1.026	1.025	$23,664	E1
Del Norte to Jct SH 285	5011	10984	PROJECT	ITEM	$29.17	23.5		88.9	1.011	1.003	$2,189	H1
Saguache-North	5011	10228	PROJECT	ITEM	$31.09	83.6		91.7	1.023	1.019	$51,558	C4
					$30.67	107.08	Reg. 5 3	91.1	1.021	1.015	$53,747	2
Parker Rd, Quincy - I 225	6013	10682	PROJECT	ITEM	$31.80	11.5		87.0	1.008	0.997	($989)	B3
Colfax Ave, Colo-Peoria	6013	10687	PROJECT	ITEM	$20.91	20.9		93.8	1.030	1.028	$12,223	K1
US 85 @ Bromley Lane	6011	10678	PROJECT	ITEM	$70.00	6.5		96.9	1.040	1.044	$9,936	A1
					$32.33	38.91	Reg. 6 4	92.3	1.025	1.022	$21,170	3
SUMMARY FOR ALL 1995 QPM 2 PROJECTS					$30.34	327.88		89.5	1.016	1.007	$67,204	9

BOXES ABOVE REPRESENT SUMMARIES BY CONTRACTORS AND REGIONS

TABLE 5

HBP EVALUATION SUMMARIZED BY YEAR, 1991 HISTORICAL & 1992 - 1995 QC/QA

IDENTIFICATION YEAR	ELEMENT	TONS 1000s	TESTS "n"	STD DEV	MEAN - TARGET		QPM 2 QUAL LEV	QPM 1 PAY FACT	QPM 2 PAY FACT
Composites are element values weighted by "W" factors. Element data are process averages weighted $ tons. Gradation SD & Mean - Target are for #8 sieve.									
1991	Asphalt %	2000	4027	0.18	0.07	Abs	87.0	1.005	1.000
Historical	Density %	900	1865	1.05	1.00	Abs	84.0	1.002	0.960
Elements	Gradation	2000	2317	2.59	1.82	Abs	85.7	1.005	0.989
Composite	Item	2000					85.2	1.004	0.978
1992	Asphalt %	282	214	0.14	0.06	Abs	96.3	1.039	1.042
QPM 1	Density %	282	570	1.00	0.71	Abs	88.9	1.018	0.990
Elements	Gradation	282	180	2.11	1.21	Abs	90.0	1.020	1.014
Composite	Item	282					91.3	1.025	1.010
1993	Asphalt %	482	837	0.15	0.04	Abs	93.2	1.032	1.028
QPM1	Density %	482	969	0.96	0.48	Abs	92.4	1.028	1.018
Elements	Gradation	482	309	2.31	1.53	Abs	88.8	1.016	1.010
Composite	Item	482			ABS	ALGEB	91.9	1.027	1.019
1994	Asphalt %	1496	1277	0.15	0.06	0.01	90.6	1.034	1.022
QPM1	Density %	1400	2812	0.98	0.57	-0.47	90.3	1.023	1.007
Elements	Gradation	1496	1053	2.05	1.12	-0.93	88.3	1.021	1.014
Composite	Item	1496					90.0	1.026	1.013
1995	Asphalt %	776	764	0.17	0.09	0.03	86.1	1.017	0.993
QPM1	Density %	757	1378	1.14	0.97	-0.86	81.1	0.999	0.950
Elements	Gradation	776	547	2.10	1.18	-0.18	88.9	1.017	1.015
Composite	Item	776				'94&95	84.2	1.008	0.976
1991 - 1995	Asphalt %	3036	3092	0.15	0.07	0.02	90.4	1.030	1.017
Summary of	Density %	2921	5729	1.01	0.67	-0.60	88.1	1.017	0.992
QPM 1 Elements	Gradation	3036	2089	2.11	1.21	-0.67	88.7	1.019	1.014
SUMMARY QPM1 COMPOSITES		3036					88.9	1.021	1.004
1995	Asphalt %	328	342	0.18	0.05	0.02	86.7	1.014	1.000
QPM 2	Density %	314	625	0.99	0.48	-0.38	91.7	1.023	1.017
Elements	Gradation	328	191	2.76	1.19	0.55	85.1	1.003	0.990
Composite	Item	328					89.5	1.016	1.007
SUMMARY QC/QA PROJECTS		3364					89.0	1.021	1.004

TABLE 6

HBP EVALUATION, NORMALIZED SUMMARY BY ELEMENT AND YEARLY COMPOSITES

1991 HISTORICAL AND 1992-95 QC/QA

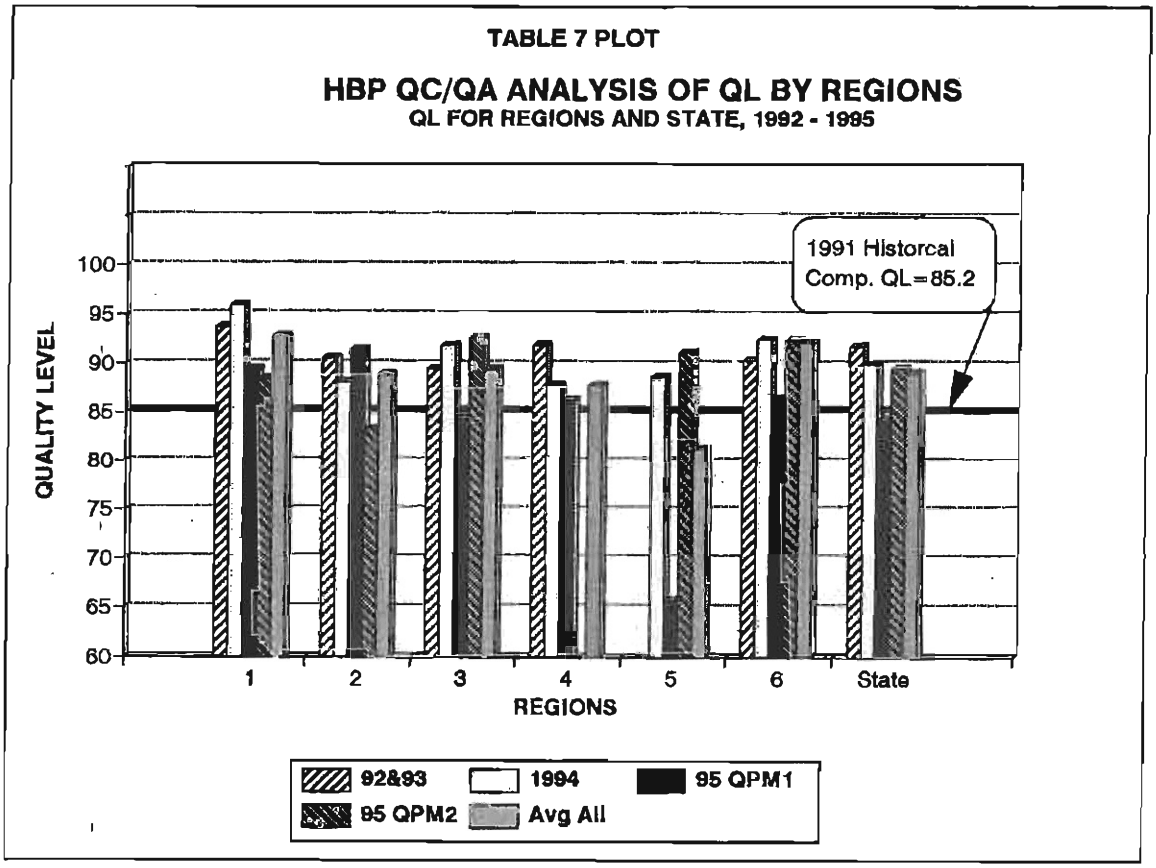
Average Values (Weighted by Tons) Normalized as Percent of 1991 Historical

Year &	Element or	Standard Deviation		Avg. Dist. to Target		QPM 2 Qual. Level		QPM 1 Pay Factor		QPM 2 Pay Factor	
Identity	Composite	Value	% of '91	Value	% of '91	Value	% of '91	Value	% of '91	Value	% of '91
'91 Hist.	Asphalt %	0.18	100.0	0.07	100.0	87.0	100.0	1.005	100.0	1.000	100.0
'92 QPM1	Asphalt %	0.14	77.8	0.06	85.7	96.3	110.7	1.039	103.4	1.042	104.2
'93 QPM1	Asphalt %	0.15	83.3	0.04	57.1	93.2	107.1	1.032	102.7	1.028	102.8
'94 QPM1	Asphalt %	0.15	83.3	0.06	80.0	90.6	104.1	1.034	102.9	1.022	102.2
'95 QPM1	Asphalt %	0.17	96.1	0.09	132.9	86.1	99.0	1.017	101.2	0.993	99.3
'95 QPM2	Asphalt %	0.18	99.4	0.05	77.1	88.6	101.8	1.014	100.9	1.000	100.0
All QC/QA	Asphalt %	0.16	87.4	0.06	89.0	90.2	103.7	1.028	102.3	1.016	101.6
'91 Hist.	Density %	1.05	100.0	1.00	100.0	84.0	100.0	1.002	100.0	0.960	100.0
'92 QPM1	Density %	1.00	95.2	0.71	71.0	88.9	105.8	1.018	101.6	0.990	103.1
'93 QPM1	Density %	0.96	91.4	0.48	48.0	92.4	110.0	1.028	102.6	1.018	106.0
'94 QPM1	Density %	0.96	91.4	0.57	57.0	90.3	107.5	1.023	102.1	1.007	104.9
'95 QPM1	Density %	1.14	108.9	0.97	97.2	81.1	96.5	0.999	99.7	0.949	98.9
'95 QPM2	Density %	0.99	94.3	0.46	46.4	91.7	109.2	1.023	102.1	1.017	105.9
All QC/QA	Density %	1.01	96.0	0.65	65.1	88.5	105.4	1.018	101.6	0.995	103.6
		Based on the N0. 8 Sieve				Based on Gradation (QPM Controlling Sieve)					
'91 Hist.	Gradation	2.59	100.0	1.82	100.0	85.7	100.0	1.005	100.0	0.989	100.0
'92 QPM1	Gradation	2.11	81.5	1.21	66.5	90.0	105.0	1.020	101.5	1.014	102.5
'93 QPM1	Gradation	2.31	89.2	1.53	84.1	88.8	103.6	1.016	101.1	1.010	102.1
'94 QPM1	Gradation	2.05	79.2	1.12	61.5	88.3	103.0	1.021	101.6	1.014	102.5
'95 QPM1	Gradation	2.10	81.1	1.18	64.0	88.9	103.7	1.018	101.2	1.016	102.8
'95 QPM2	Gradation	2.76	106.6	1.19	65.5	85.1	99.3	1.003	99.8	0.990	100.1
All QC/QA	Gradation	2.17	83.9	1.20	66.1	88.3	103.1	1.018	101.3	1.012	102.3
		Values Below Are Composites of Above Values, I.e, Elements Weighted by "W" Factors									
91 Hist.	Composite	—	100.0	—	100.0	85.2	100.0	1.004	100.0	0.978	100.0
92 QPM1	Composite	—	87.2	—	74.5	91.3	107.1	1.025	102.1	1.010	103.3
93 QPM1	Composite	—	88.6	—	58.0	91.9	107.9	1.027	102.3	1.019	104.3
94 QPM1	Composite	—	86.5	—	64.8	90.0	105.6	1.026	102.2	1.013	103.6
95 QPM1	Composite	—	99.5	—	101.2	84.2	98.7	1.008	100.5	0.976	99.8
95 QPM2	Composite	—	98.3	—	59.5	89.5	105.0	1.016	101.3	1.007	103.0
All QC/QA	Composite	—	91.0	—	72.5	89.0	104.4	1.021	101.7	1.005	102.7

TABLE 7

QC/QA HBP EVALUATION OF QUALITY LEVEL BY REGIONS FOR 1992 - 1995

	1992-93 COMBINED			1994			1995 QPM1			1995 QPM2			TOT. & AVG, '92-95		
REG No.	No of PROJ	TON 1000	QPM2 QL	No of PROJ	TON 1000	QPM2 QL	No of PROJ	TON 1000	QPM2 QL	No of PROJ	TON 1000	QPM2 QL	No of PROJ	TON 1000	QPM2 QL
1	8	276	93.6	5	173	95.9	4	83	89.3	4	121	88.4	21	653	92.7
2	7	132	90.5	14	453	88	5	131	91.4	1	32	83.3	27	748	88.8
3	5	183	89.5	14	388	91.8	7	197	84.4	1	29	92.8	27	797	89.5
4	4	71	91.9	11	234	87.8	8	197	86.3	0	0	NA	23	502	87.8
5	0	0	NA	3	117	88.6	2	121	65.6	2	107	91.1	7	345	81.3
6	4	102	90.3	11	131	92.4	3	46	86.5	3	39	92.3	21	318	92.1
State	28	764	91.7	58	1496	90	29	776	84.2	11	328	89.5	126	3364	89.0



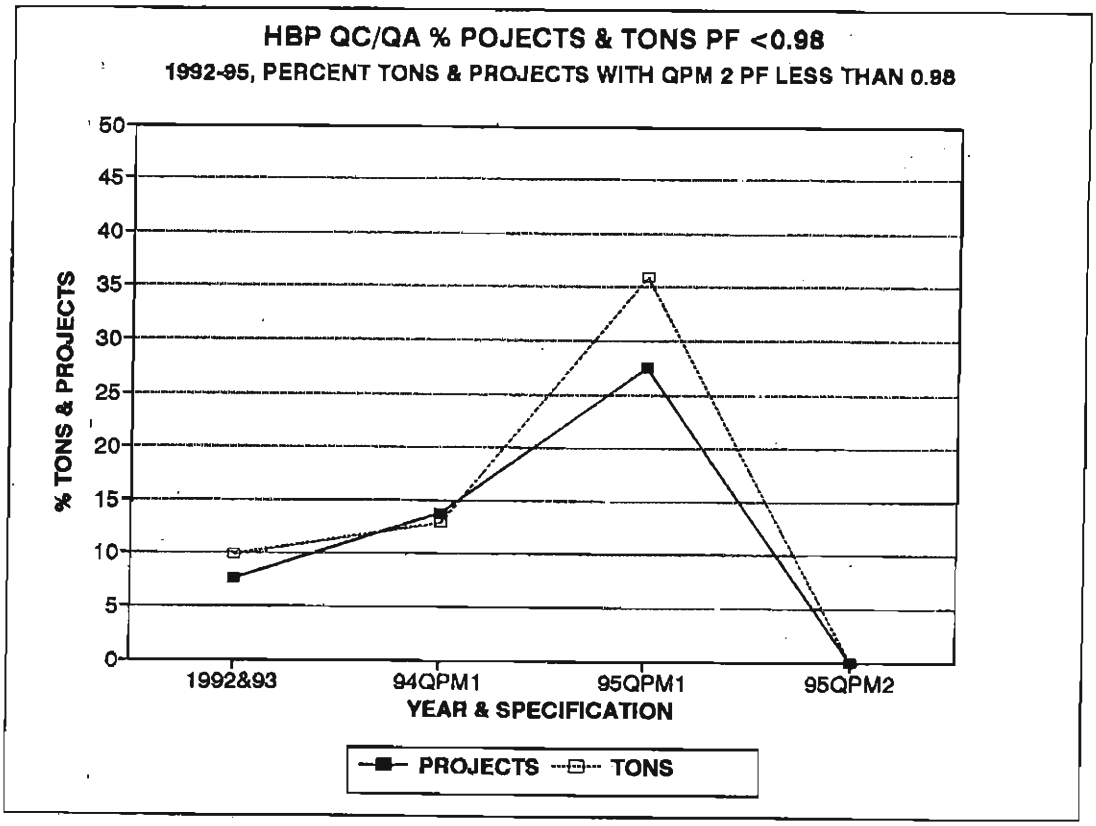


Figure 1

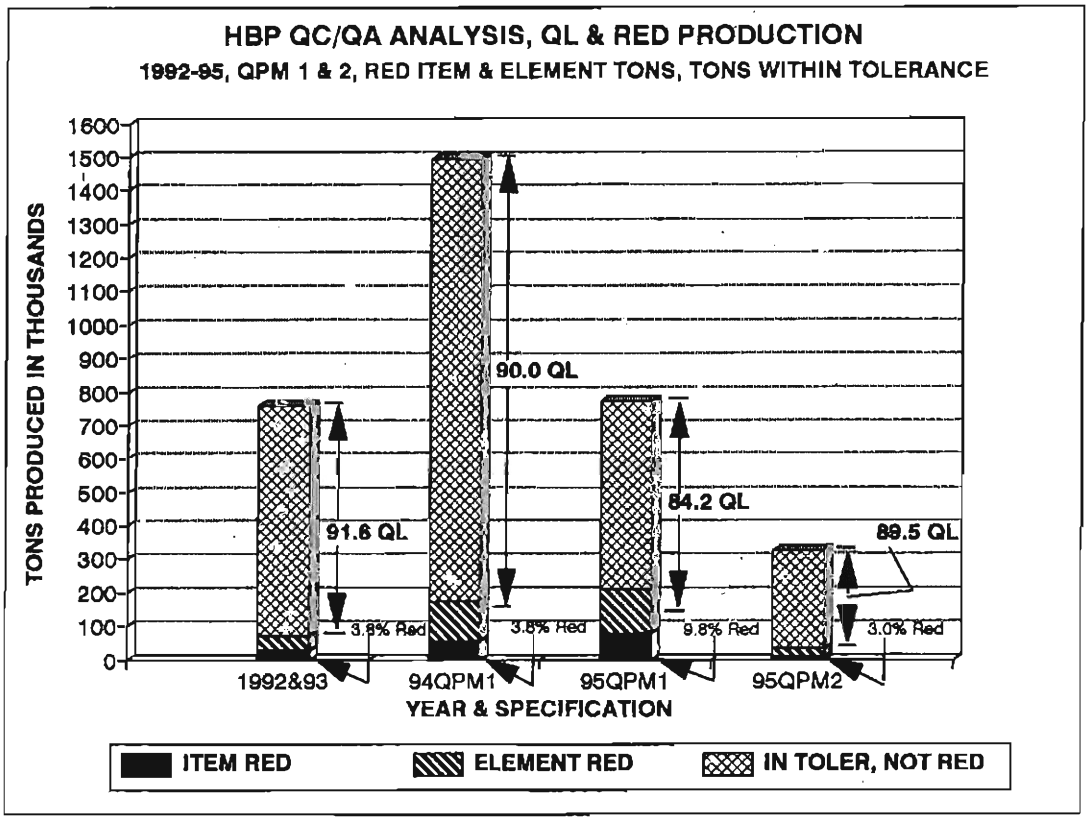
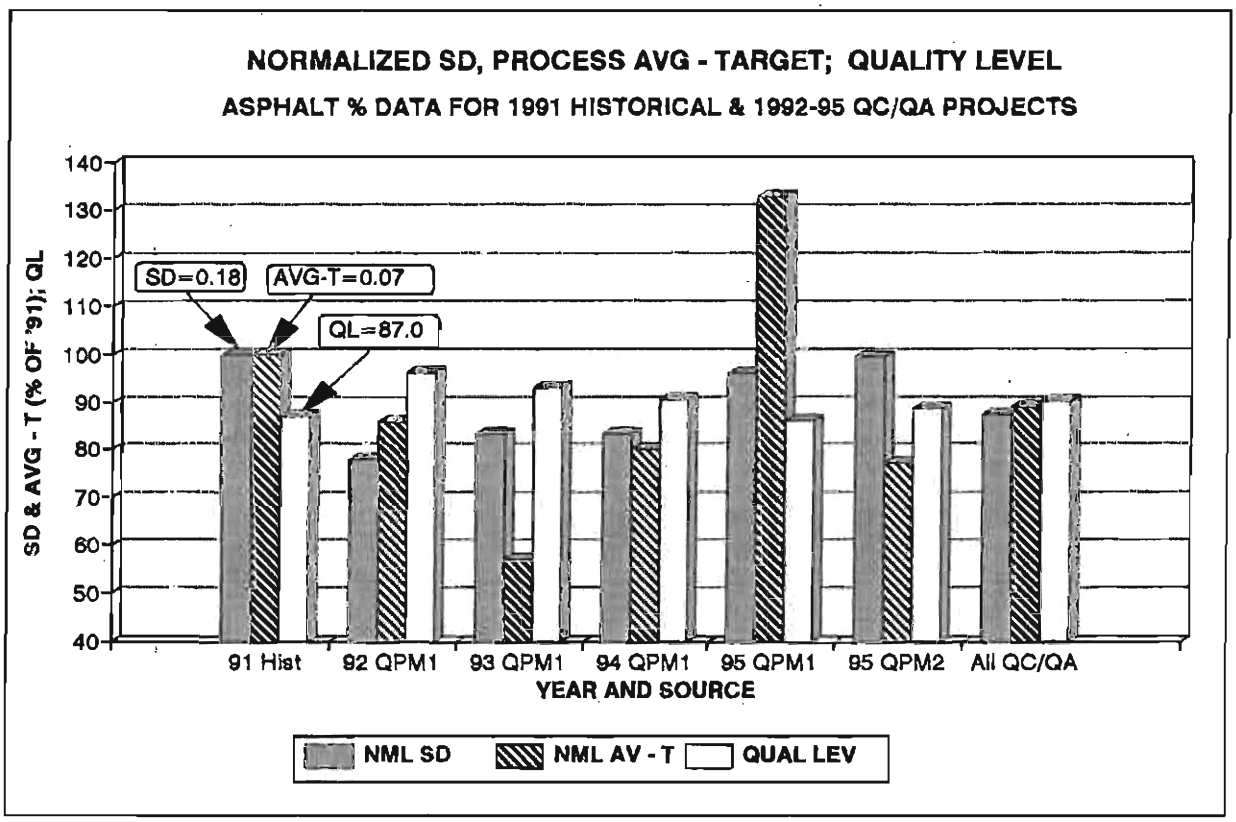


Figure 2



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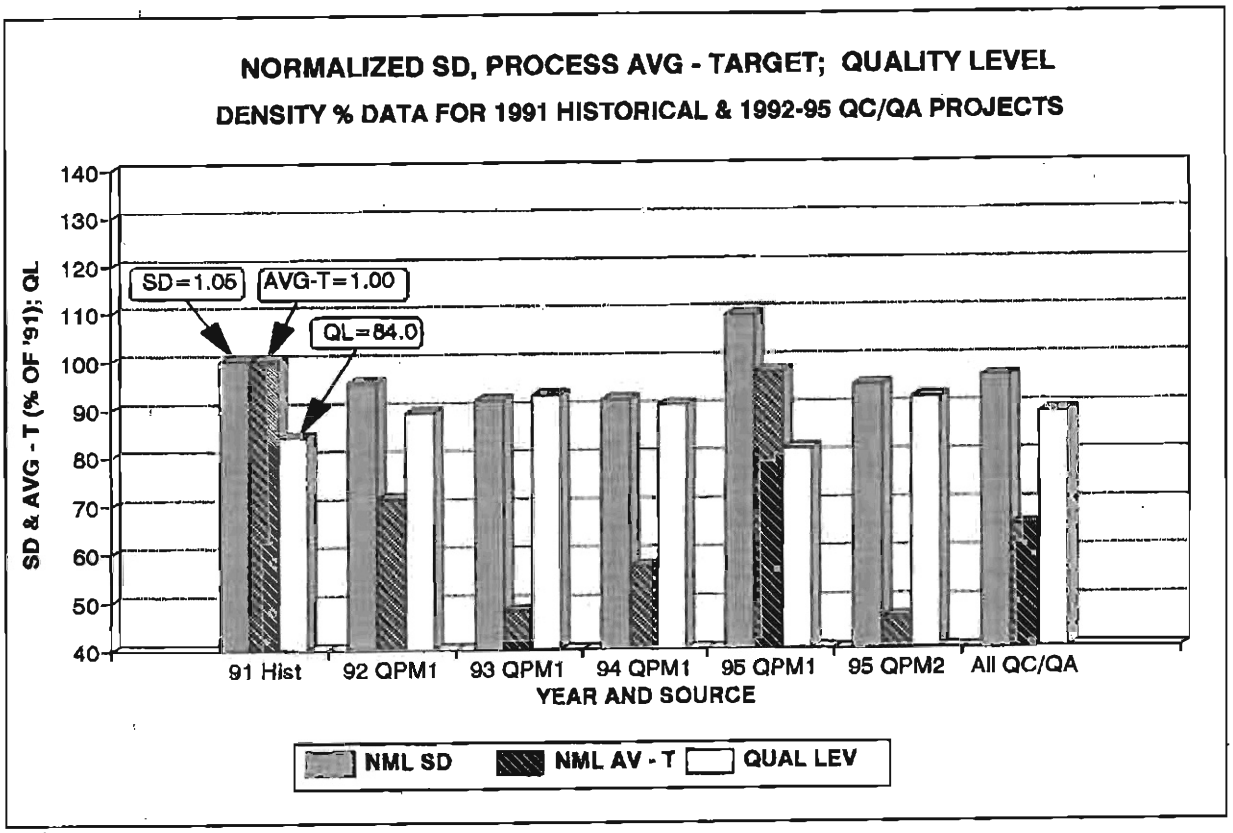

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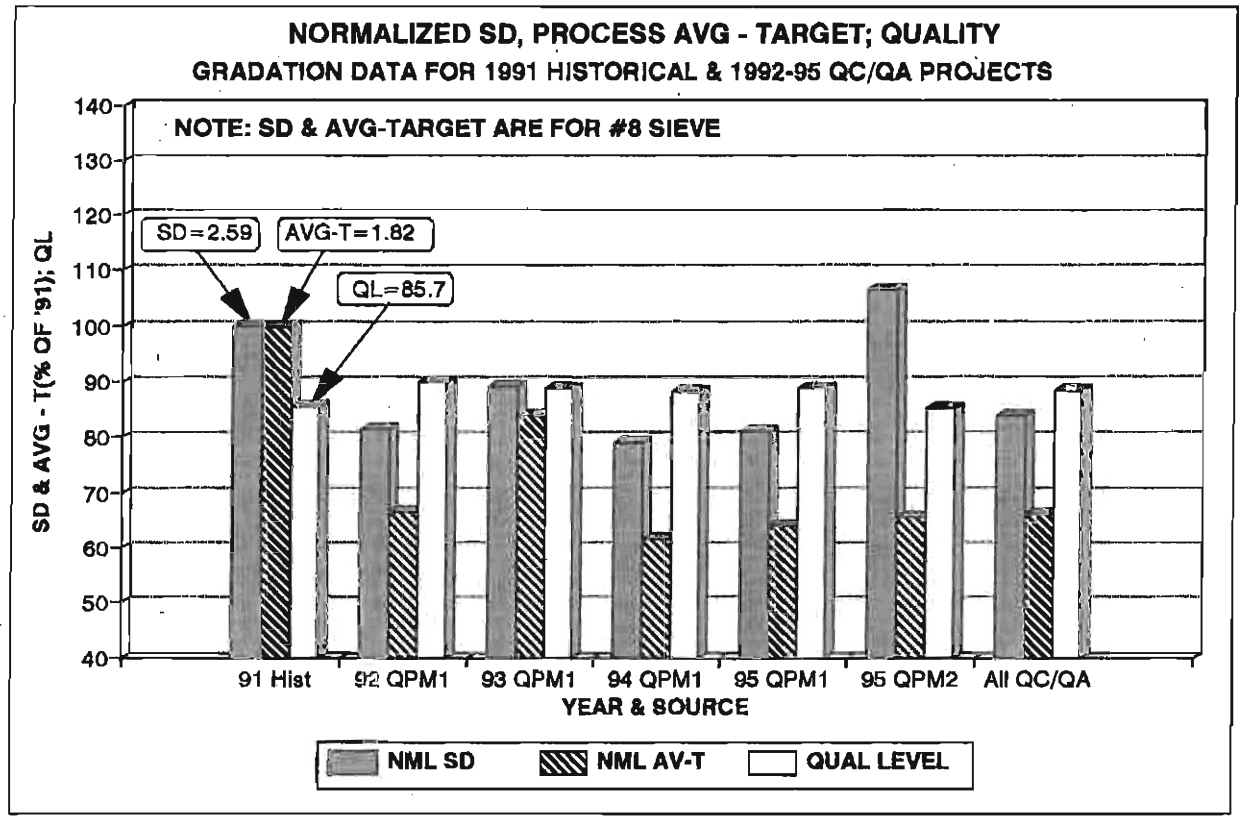

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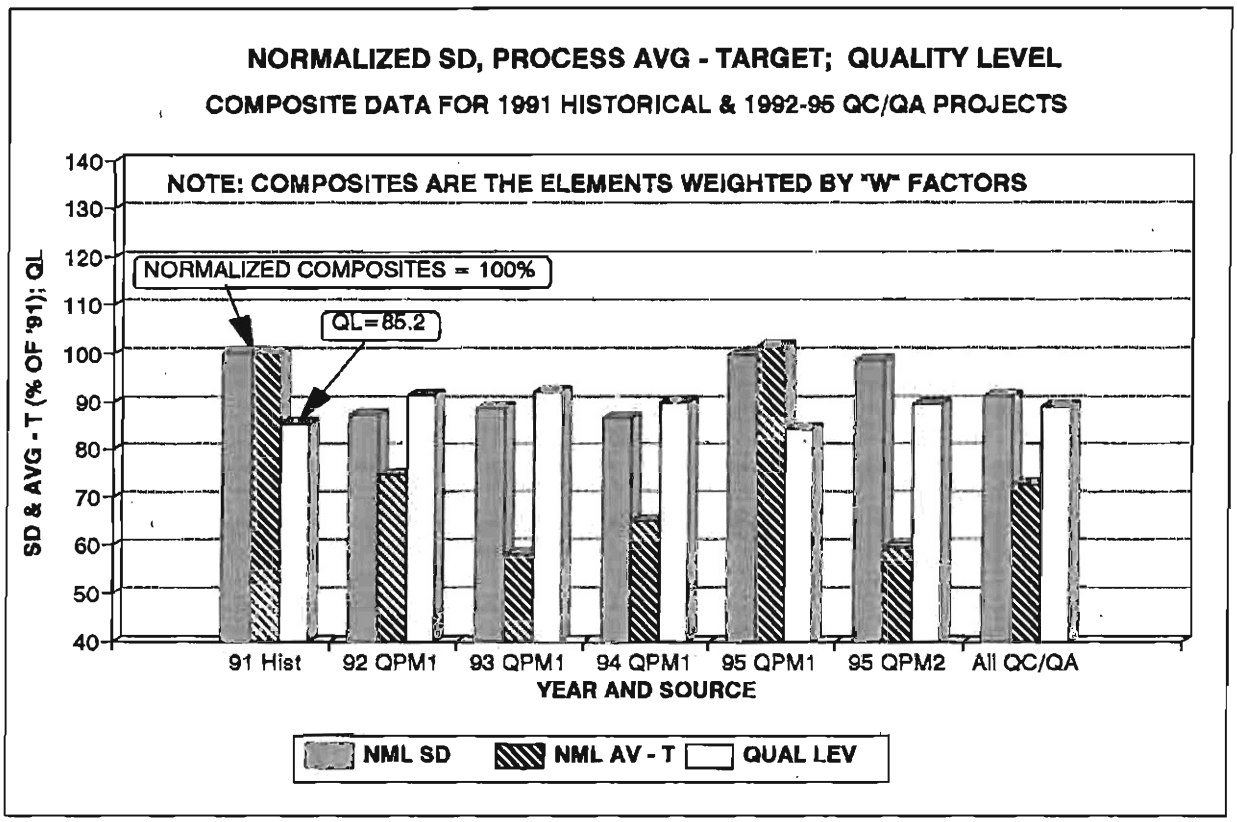
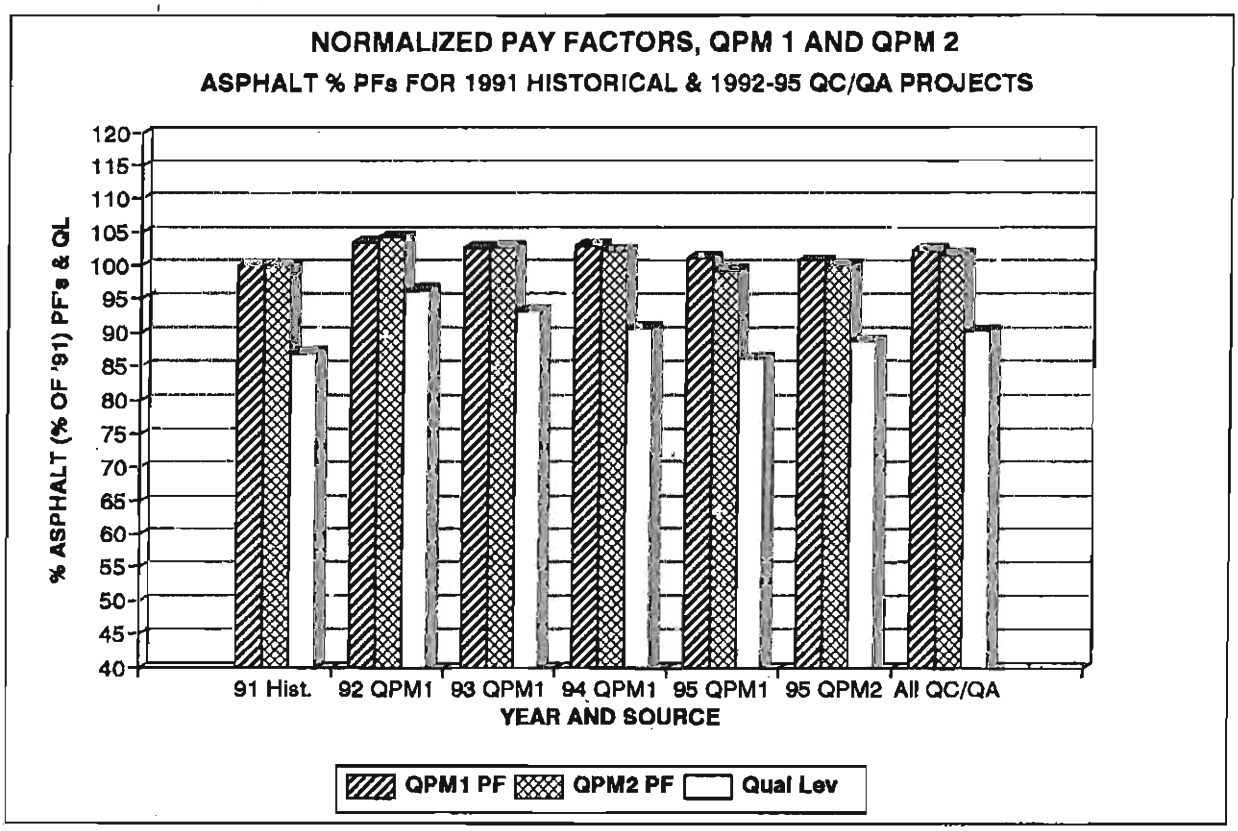


Figure 6



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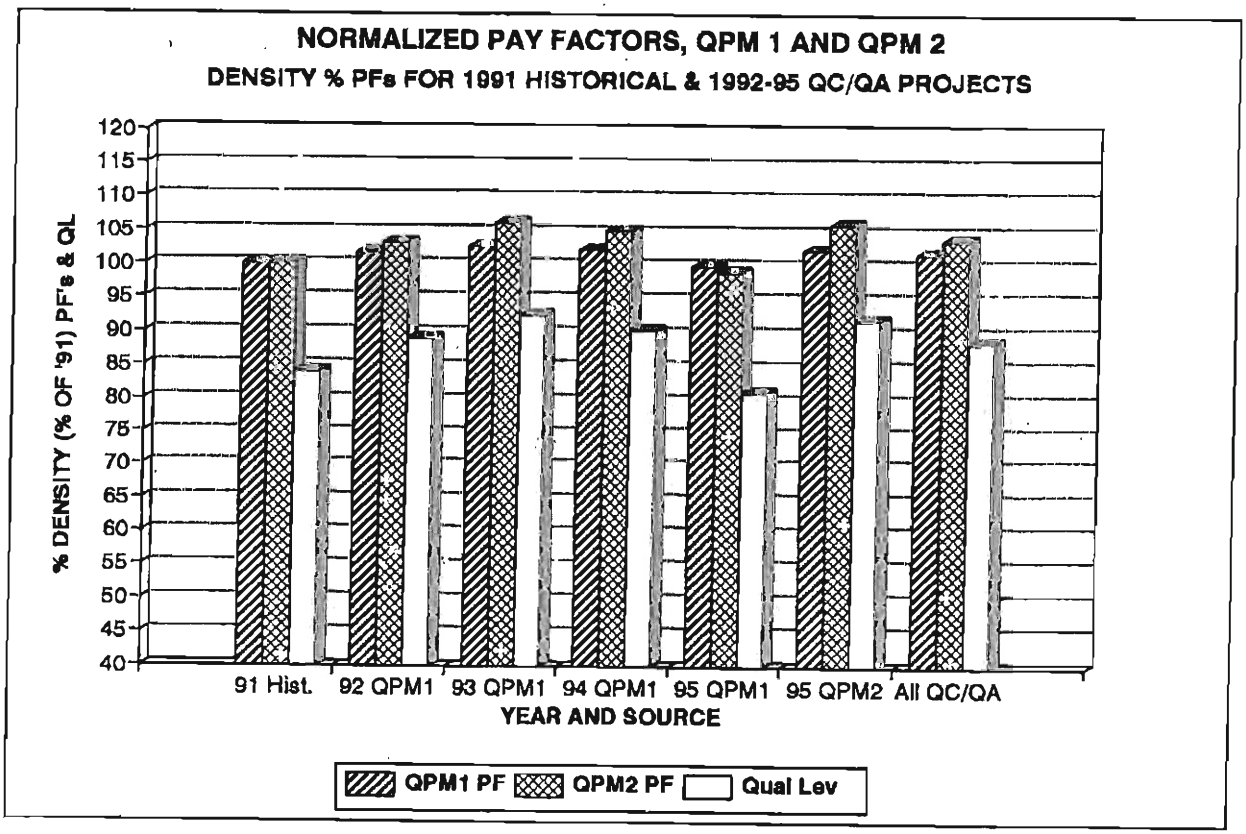

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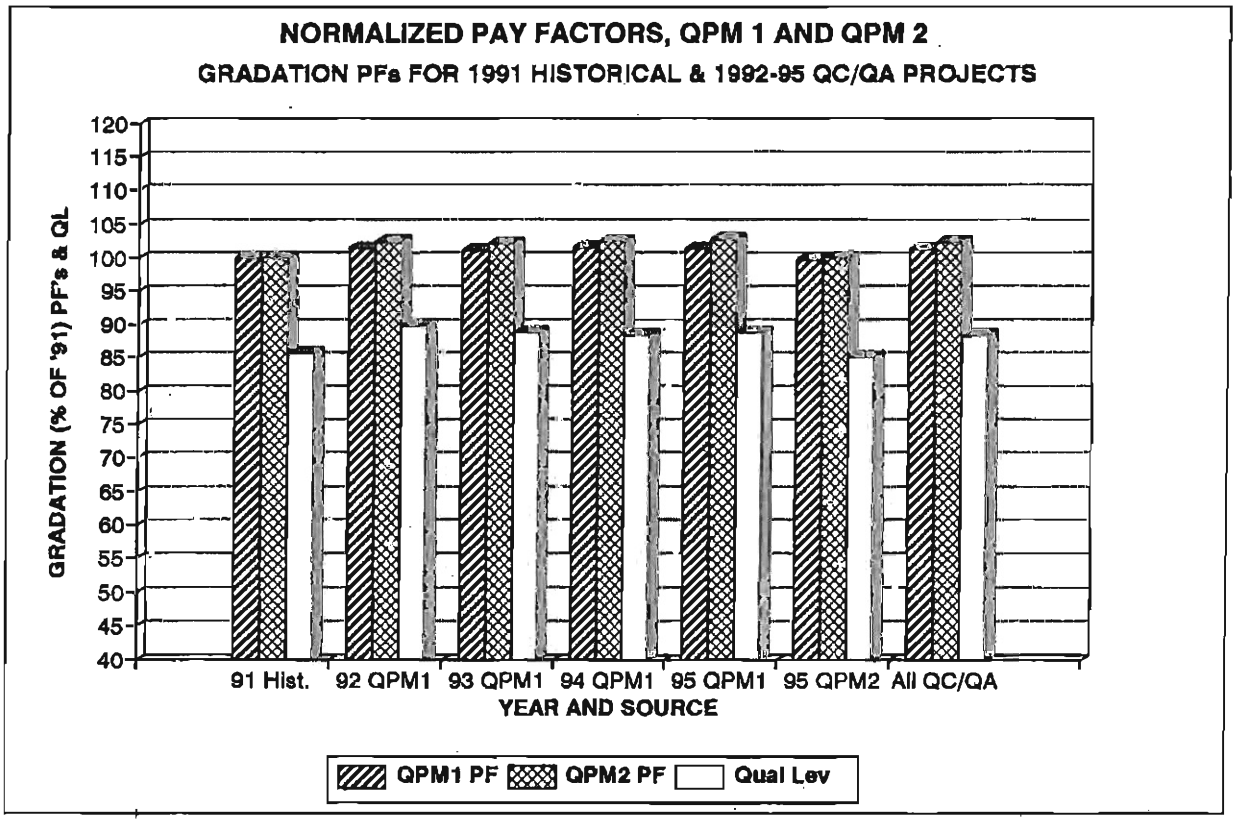

Figure 9

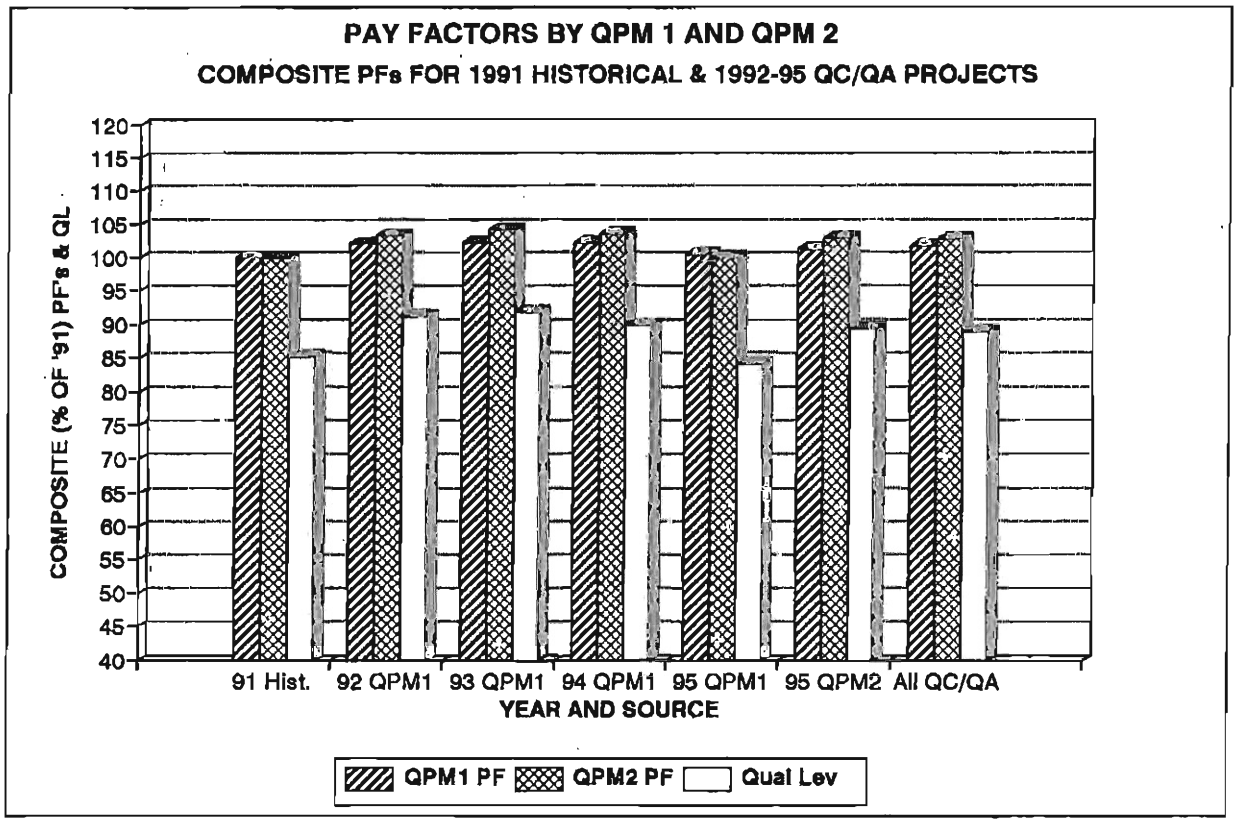

Figure 10

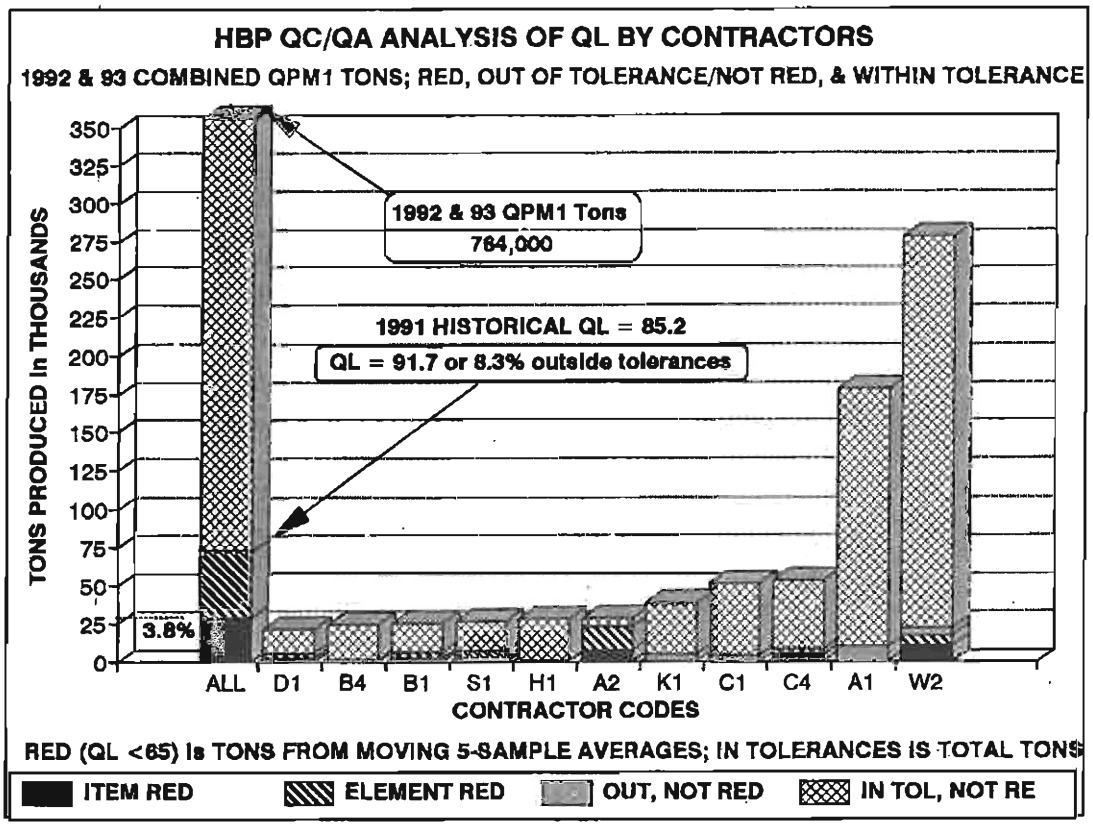

Figure 11

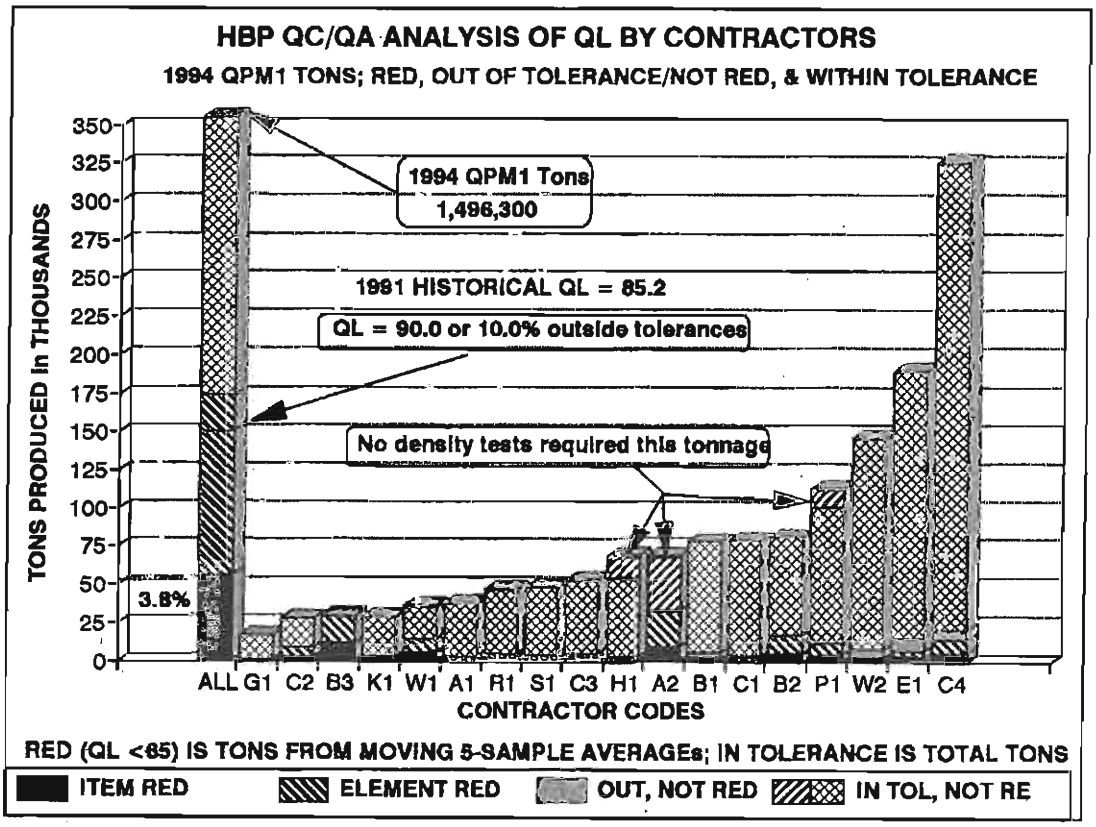

Figure 12

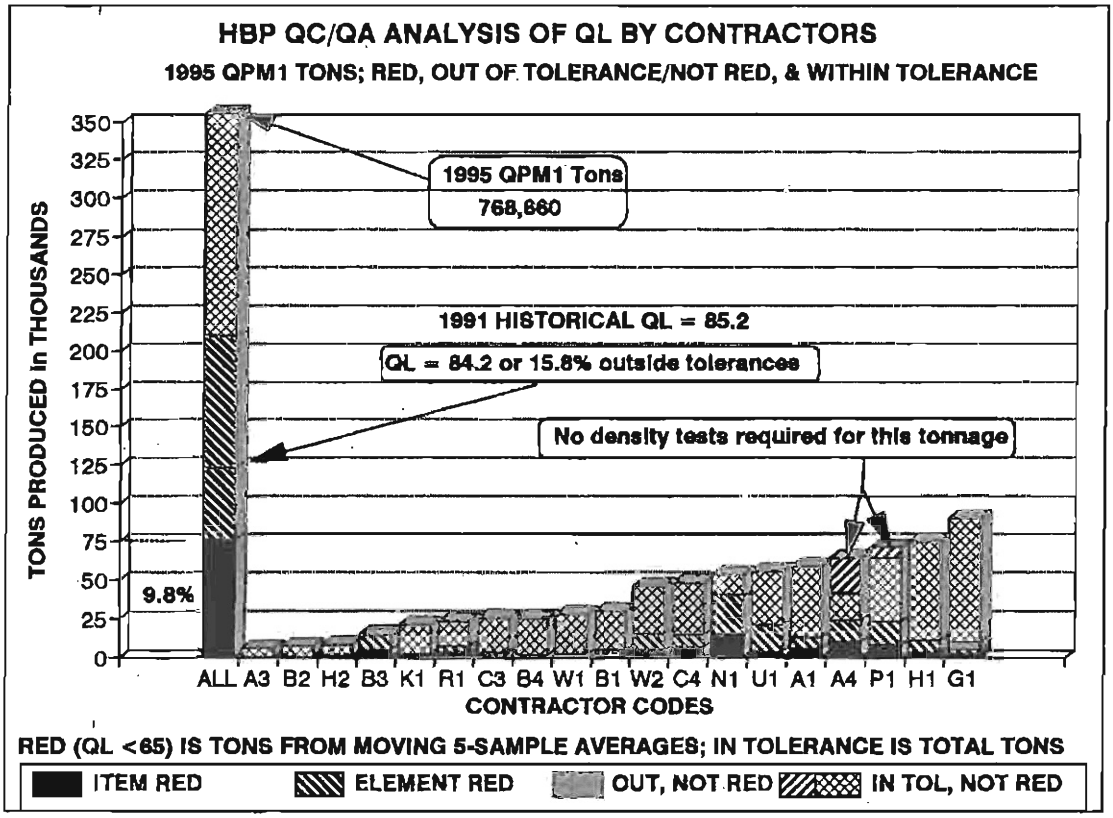

Figure 13

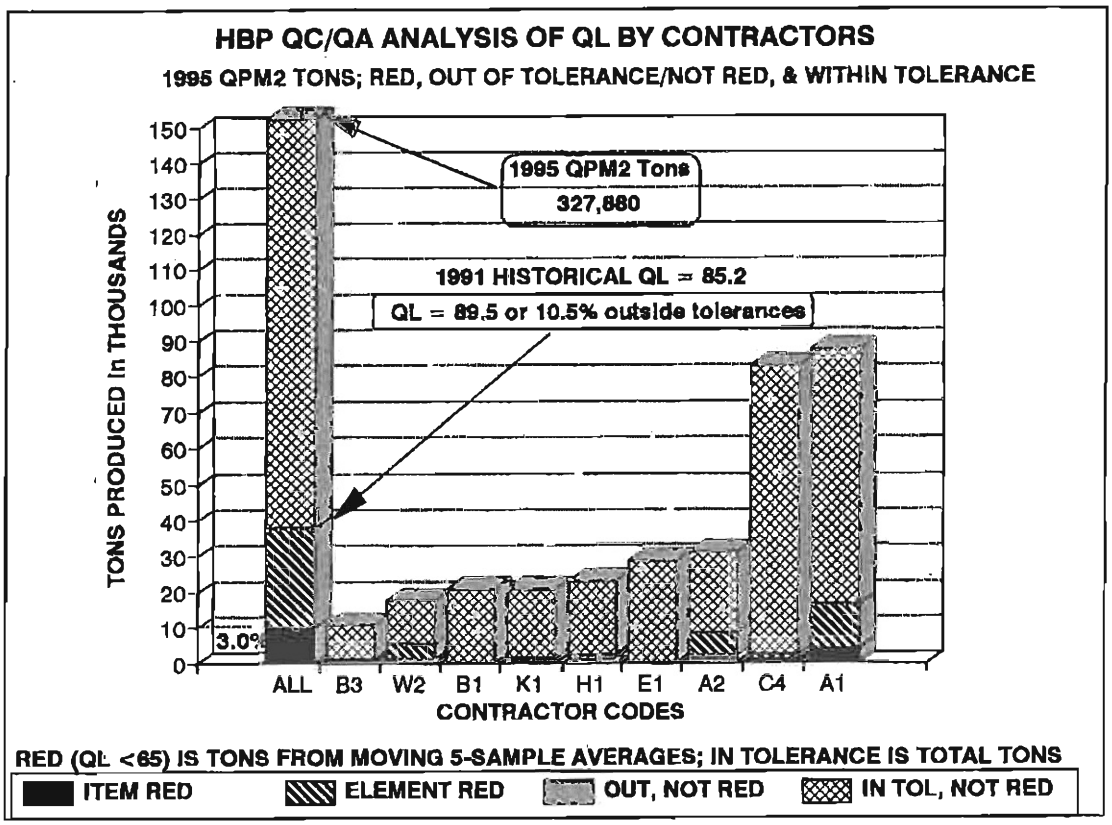

Figure 14

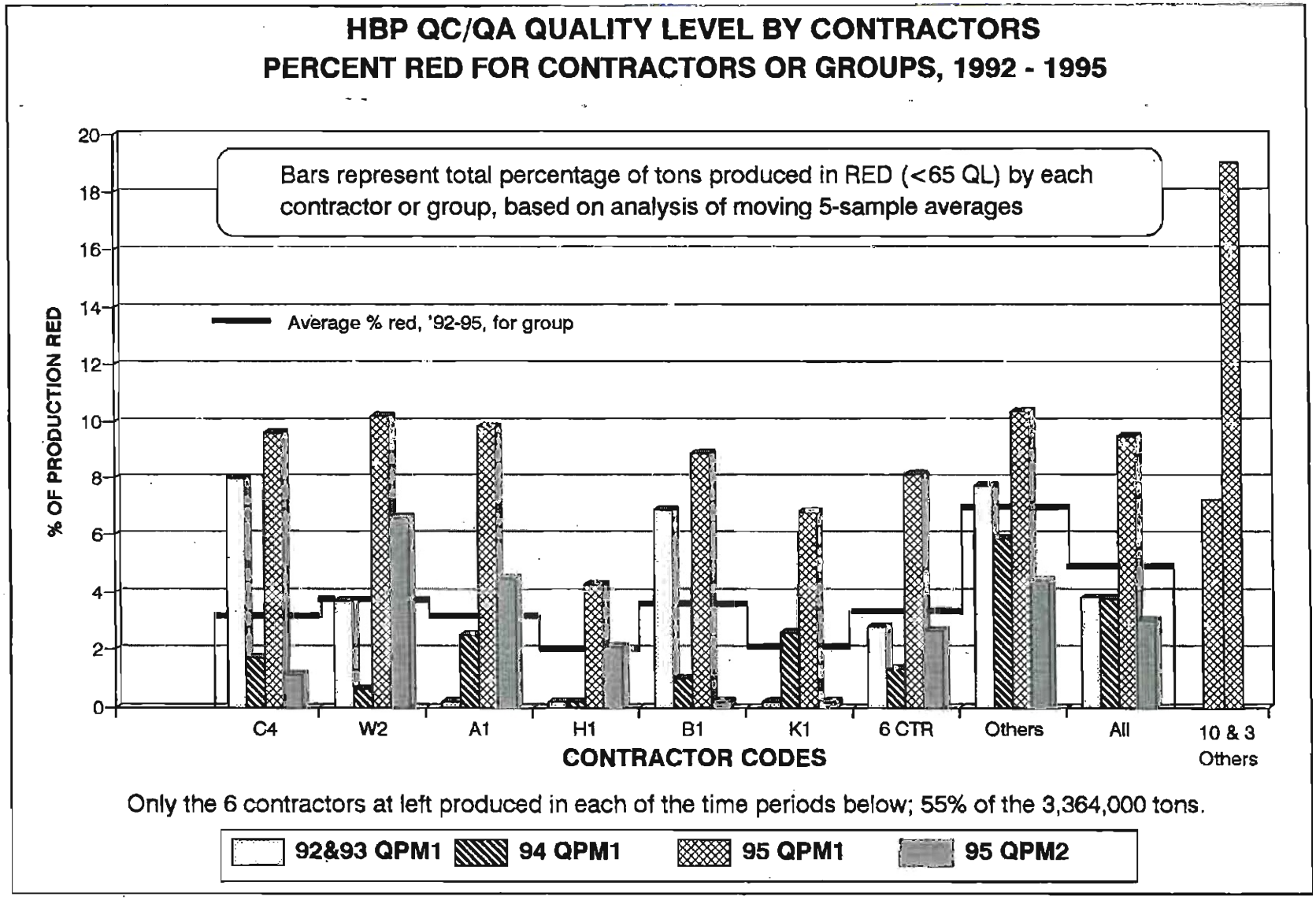
HBP QC/QA QUALITY LEVEL BY CONTRACTORS
PERCENT RED FOR CONTRACTORS OR GROUPS, 1992 - 1995
Bars represent total percentage of tons produced in RED (<65 QL) by each contractor or group, based on analysis of moving 5-sample averages
Average % red, '92-95, for group
% OF PRODUCTION RED
0
2
4
6
8
10
12
14
16
18
20
C4
W2
A1
H1
B1
K1
6 CTR
Others
All
10 & 3 Others
CONTRACTOR CODES
Only the 6 contractors at left produced in each of the time periods below; 55% of the 3,364,000 tons.
92&93 QPM1
94 QPM1
95 QPM1
95 QPM2

Figure 15

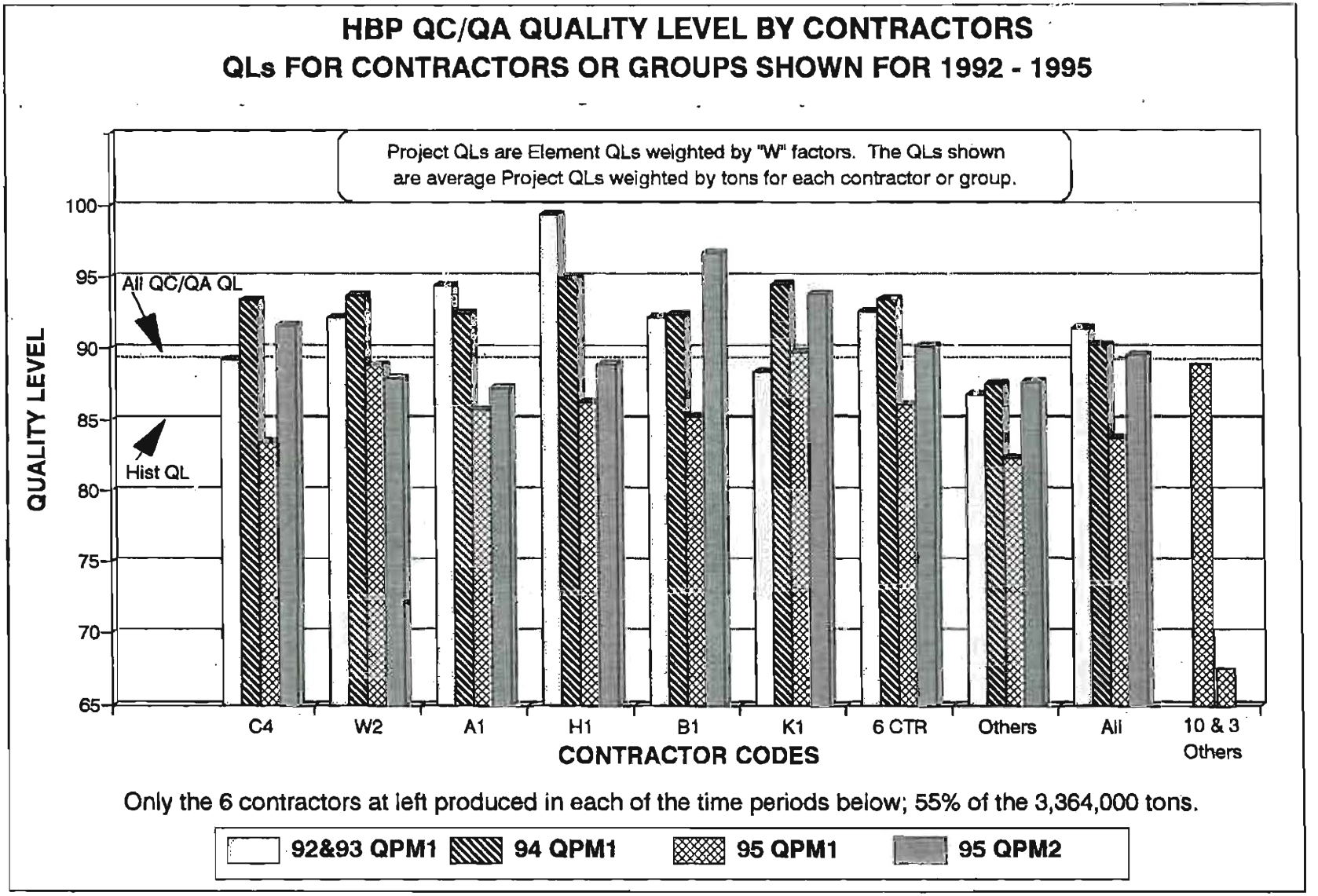
HBP QC/QA QUALITY LEVEL BY CONTRACTORS
QLs FOR CONTRACTORS OR GROUPS SHOWN FOR 1992 - 1995
Project QLs are Element QLs weighted by "W" factors. The QLs shown are average Project QLs weighted by tons for each contractor or group.
QUALITY LEVEL
100
95
90
85
80
75
70
65
All QC/QA QL
Hist QL
C4
W2
A1
H1
B1
K1
6 CTR
Others
All
10 & 3 Others
CONTRACTOR CODES
Only the 6 contractors at left produced in each of the time periods below; 55% of the 3,364,000 tons.
92&93 QPM1
94 QPM1
95 QPM1
95 QPM2

Figure 16

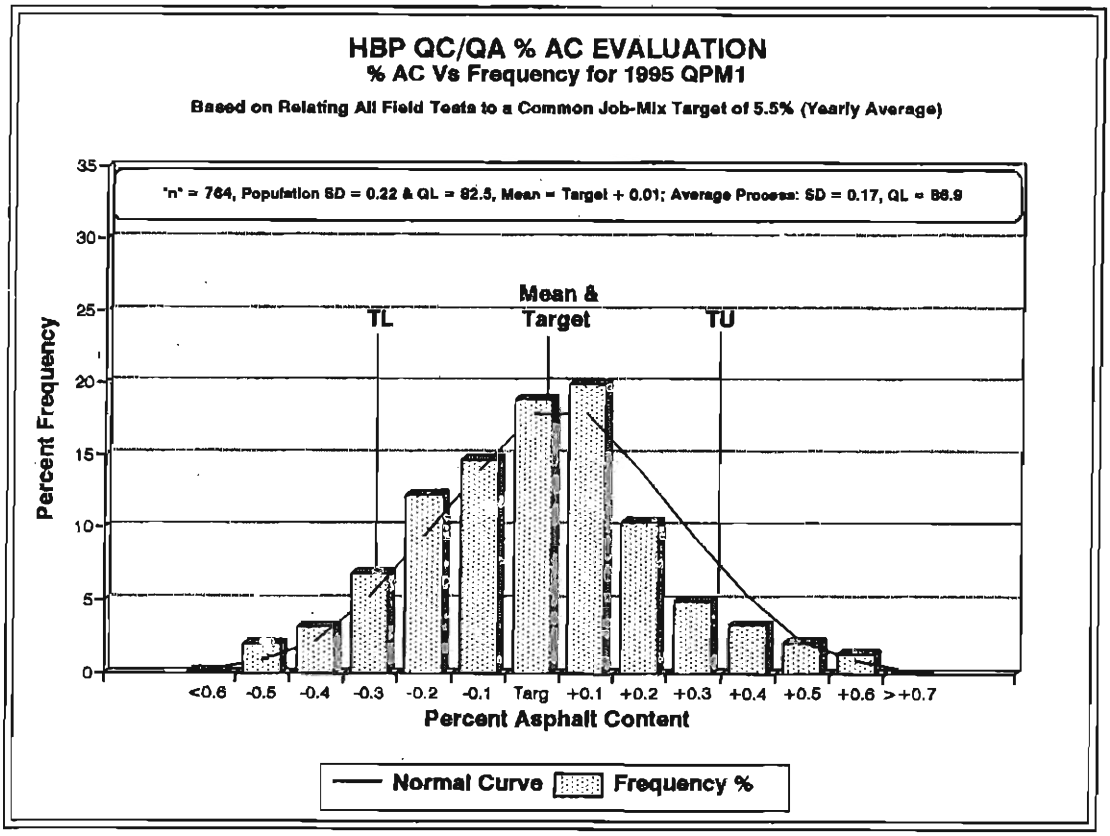

Figure 17

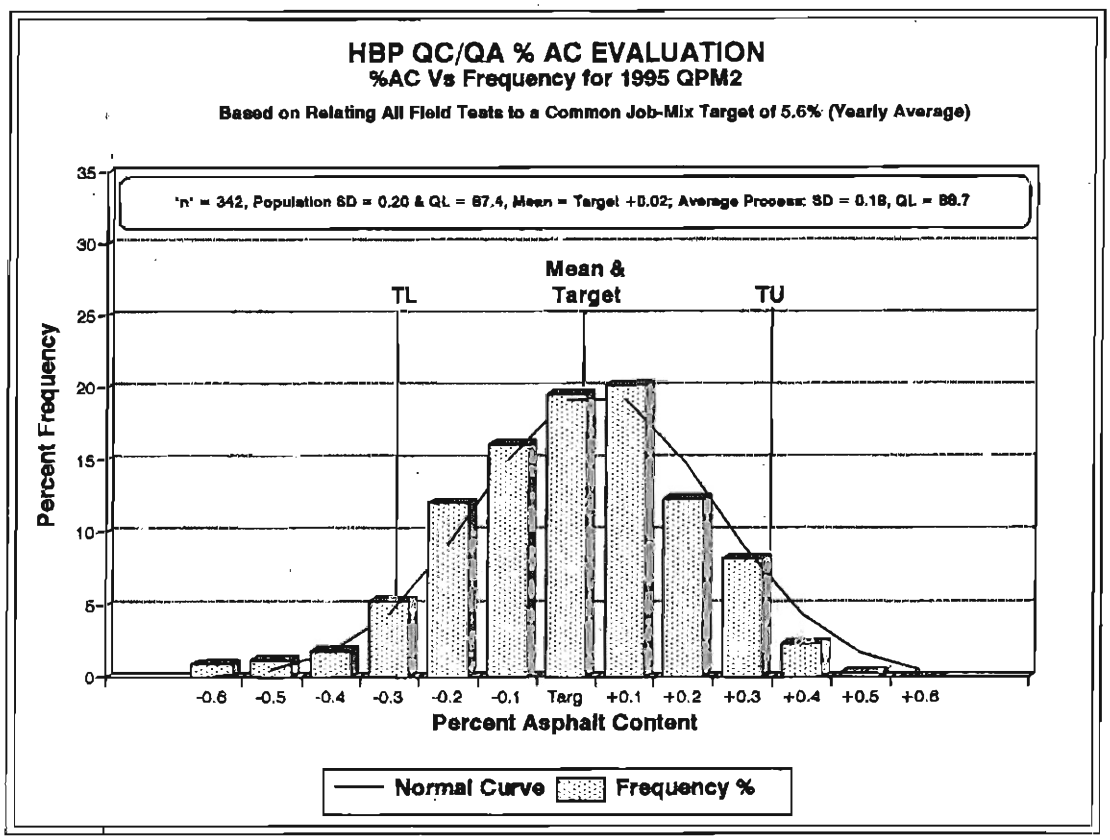

Figure 18

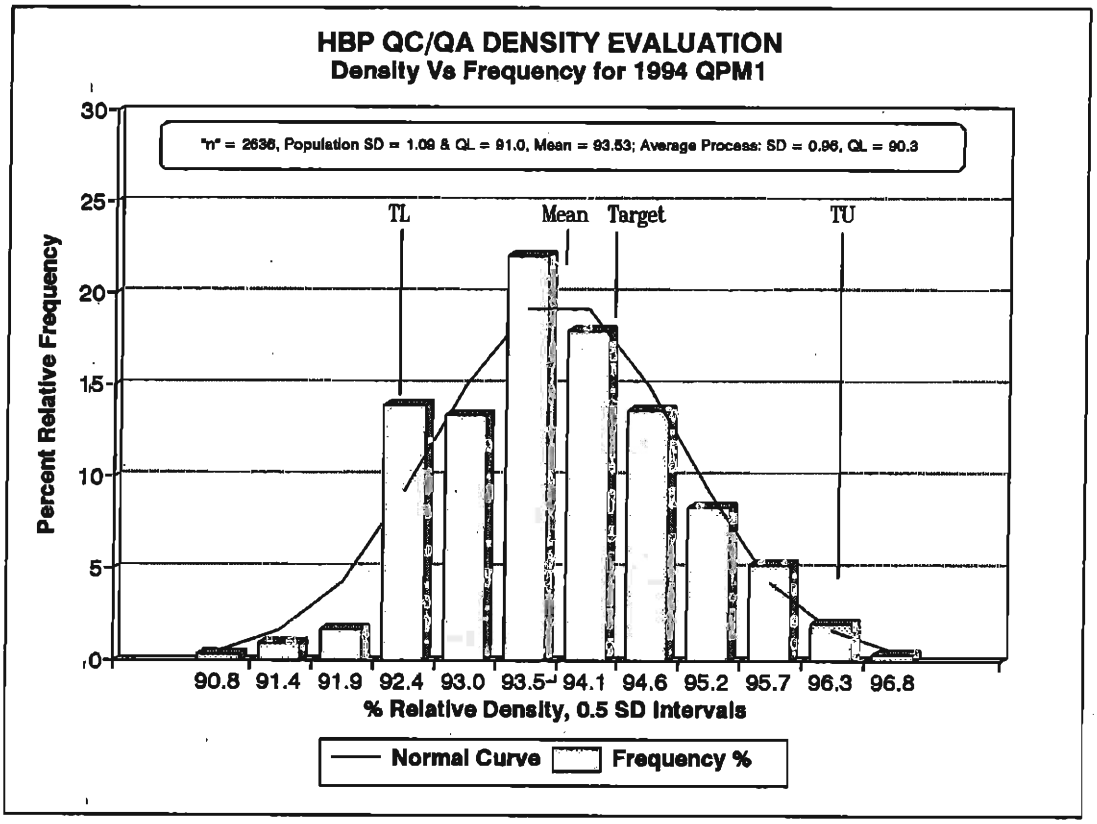

Figure 19

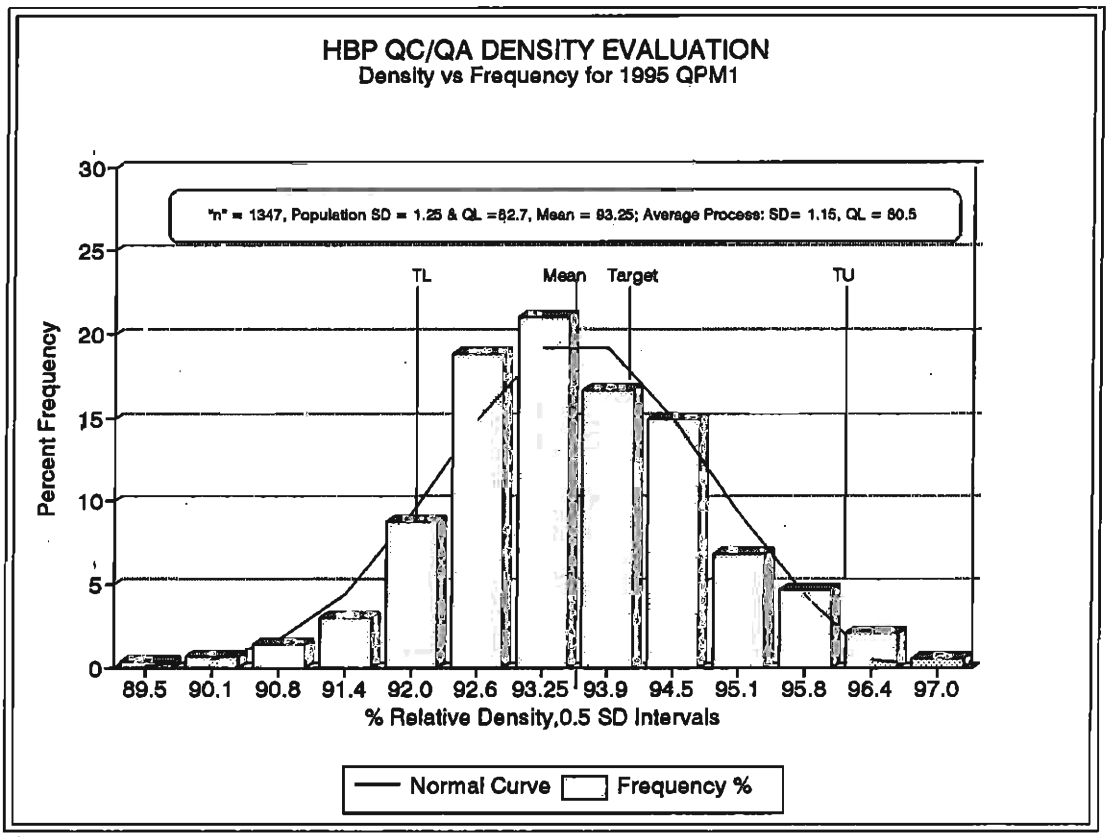

Figure 20

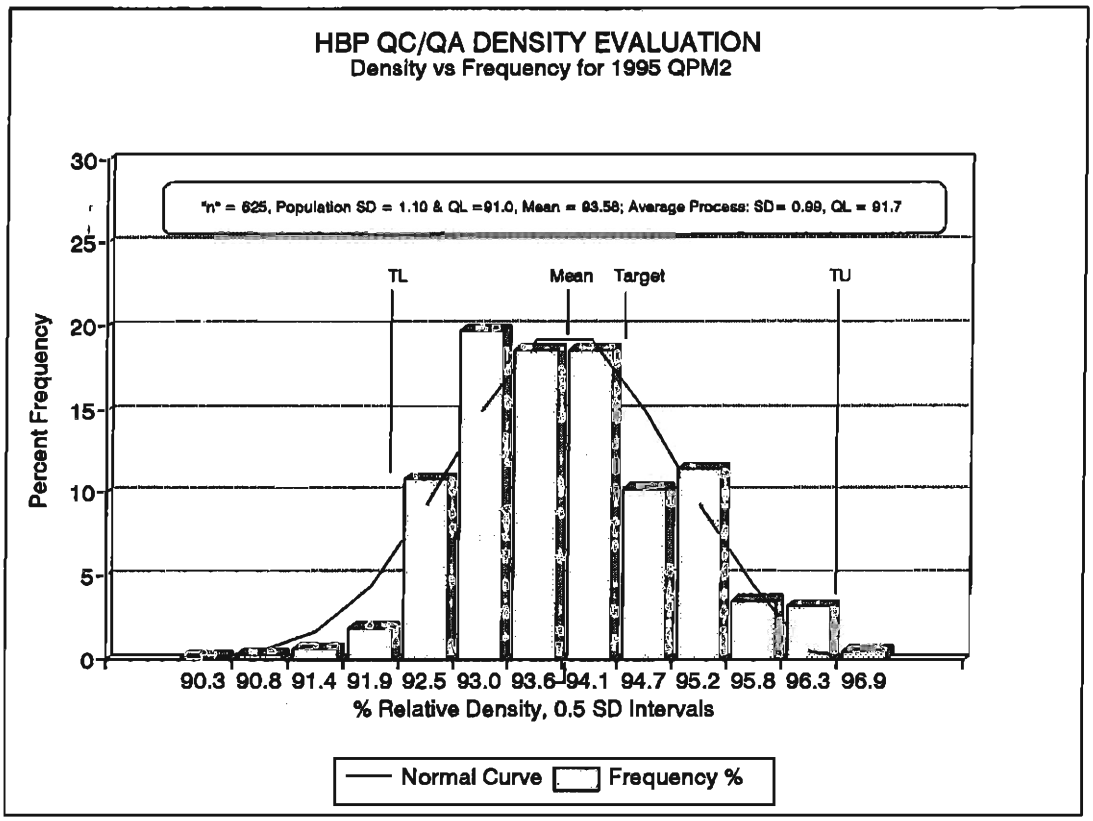

Figure 21

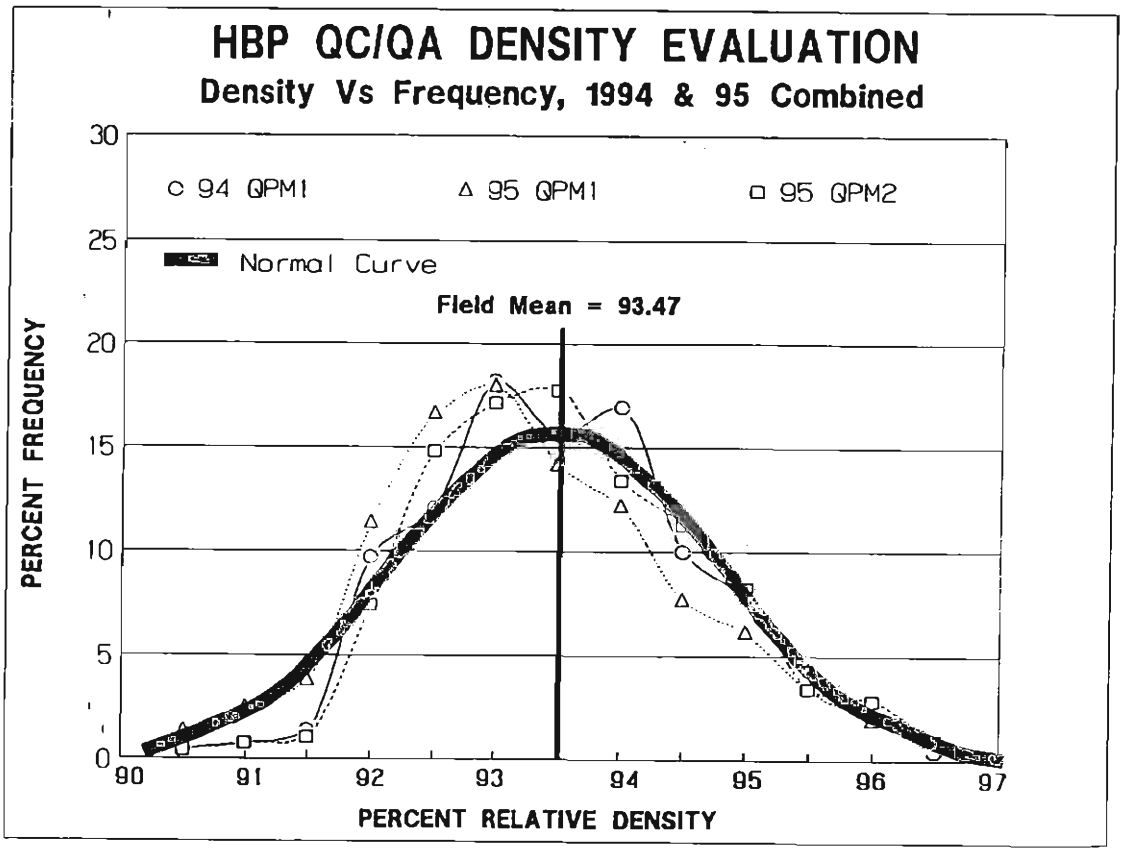

Figure 22

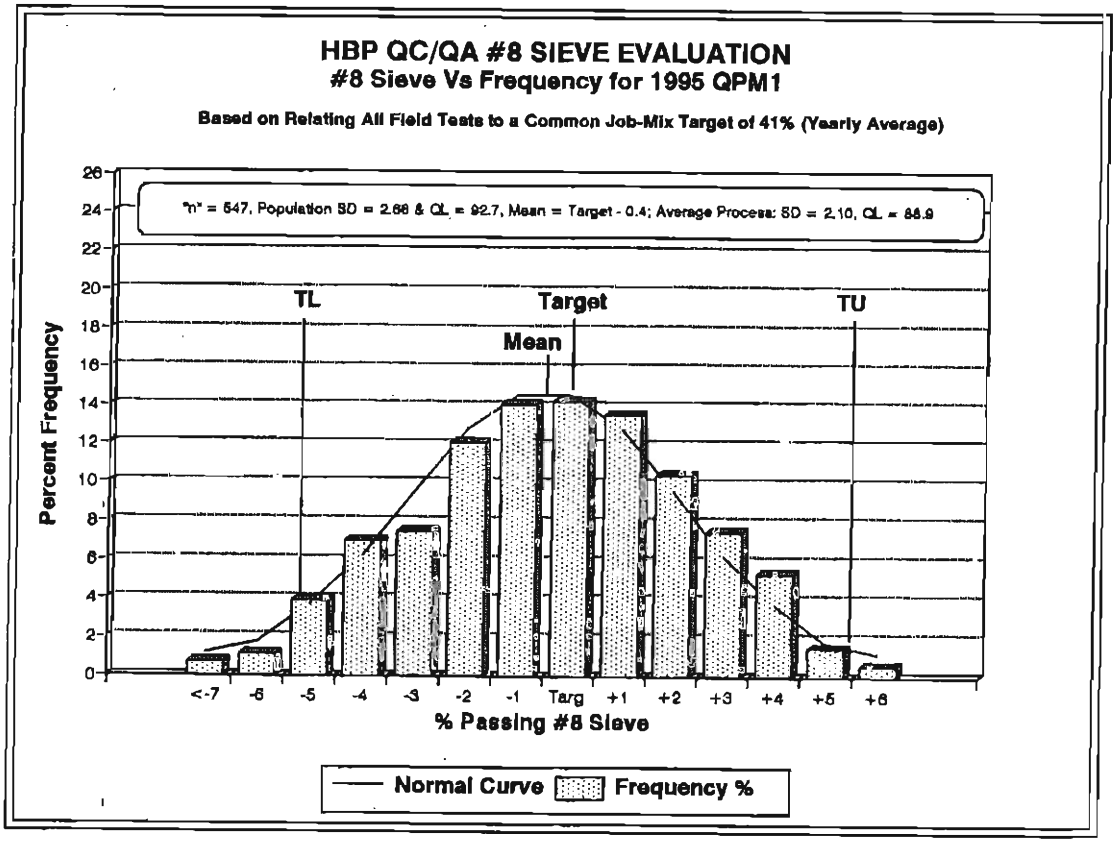

Figure 23

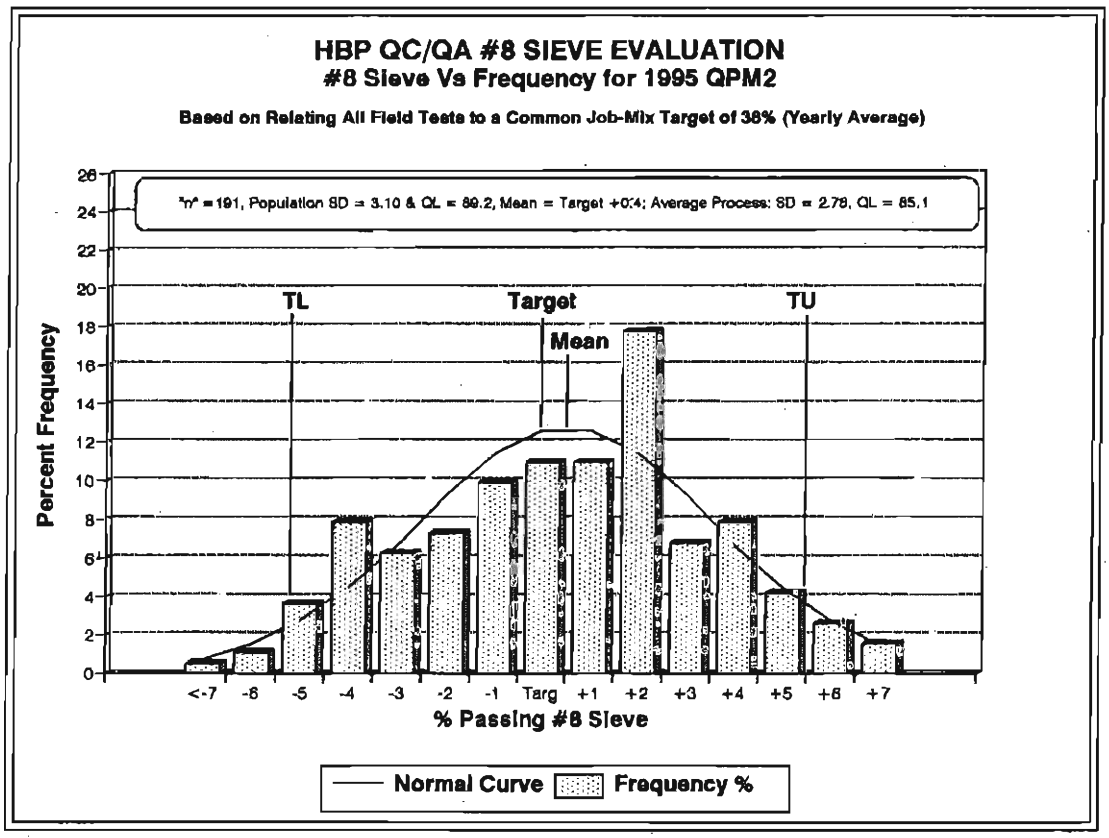

Figure 24