ATTACHMENT C

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Orange County
PMS Standardization Recommendations

Submitted to
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TABLE OF CONTENTS

INTRODUCTION

Orange County Transportation Authority (OCTA), through Nichols • Vallerga and Associates (NV&A) of Huntington Beach, recently completed the *Countywide Pavement Condition Assessment Study*. One of the study's objectives was to work with local agencies to recommend improvements to current pavement management plan procedures.

The report submitted to OCTA in March, 1998 recommended that agencies within Orange County should standardize the way pavement condition is assessed (including the types of data collected and the way pavement condition surveys are performed) as well as standardize basic reporting. To assist agencies in this regard, OCTA contracted NV&A to continue the work as recommended in the *Countywide Pavement Condition Assessment Study* final report. In particular NV&A was contracted to:

- Develop an inventory of systems currently used by agencies within Orange County;
- Identify information currently collected by agencies for pavement management system purposes;
- Identify minimum information needed for a implementing a pavement management system;
- Recommend options for standardizing data collection and assessment and basic reporting; and
- Identify and assess currently available pavement management system software packages.

This report provides details regarding these activities as well as standardization recommendations.

AGENCY SURVEY

Survey Overview

To determine what software package each agency is using, if any, and what information is currently being collected for PMS purposes NV&A developed, in collaboration with OCTA staff, a comprehensive questionnaire that was sent to each agency in Orange County (See Appendix A). The information that was requested included:

- Software package in use (e.g., Micro PAVER, MTC, etc.) and version as well as database type/file format (e.g., dBase, Access, FoxPro, etc.), reporting capabilities, export capabilities, etc.;
- Information currently collected including, but not limited to:
  1. Pavement section parameters (e.g., length, width, area, traffic level, functional classification, pavement surface type, pavement structure, etc.);
  2. Field data collected to determine condition (e.g., surface distress, ride quality, non-destructive testing, etc.);
  3. How condition index is determined. Is the condition index based solely on surface distress or are other parameters such as ride quality also included?;

4. Basis for determining a qualitative description of pavement condition (e.g., very good, good, fair, etc.).

In total, 29 agencies responded to the questionnaire. A summary of the findings are provided in Appendix B and narrated below.

Survey Results

Only one of the 29 agencies that responded to the questionnaire indicated that they do not use software for the purposes of pavement management. The survey results indicate that nearly half (14 of 29) of responding agencies use proprietary software for pavement management whereas a few use in-house systems (i.e., spreadsheets), and nearly one-third (9 of 29) use non-proprietary software (i.e., Micro PAVER or MTC). Nineteen of 23 agencies indicated that their system could export data to an ASCII format file.

Regarding the types of distresses collected during pavement condition surveys of asphalt concrete pavements, 27 agencies responded. Two-thirds of these (18) include alligator/fatigue cracking, longitudinal cracking, block cracking, edge cracking, transverse cracking, rutting, bleeding/flushing, raveling/weathering, and patching/utility cuts. Over half of the responding agencies also collect slippage cracking (15), depressions (16), and shoving (14). Less than half of the responding agencies collect corrugations (12), polished aggregate (9) and only a few responding agencies collect reflection cracking (3), shrinkage cracking (1), surface texture (2), bumps/sags (2), railroad crossings (2), lane/shoulder drop-off (2), swelling (2), excessive crown (1), and map cracking (1).

Regarding the types of distresses collected during pavement condition surveys of portland cement concrete pavements, 9 agencies responded. All of these (9) include longitudinal and transverse cracking and more than one-half include durability cracking (6), corner breaks (6), joint sealant damage (7), joint spalling (7), patching/utility cuts (8), faulting (7), popouts (7), shrinkage cracking, blowups (5), scaling (5), polished aggregate (5), settlement/punchouts (5), and shattered slab (5). Less than half include map cracking (4), pumping (4), divided slab (1), and raveling/distortion (1).

In addition to the above distresses, two agencies also include surface texture, 15 agencies include a ride/comfort index, five agencies include a drainage index, and one agency includes wavy pavement, specific crack location, skid resistance, structural adequacy, and deflection testing as additional information for rating pavement performance.

Asked how these data are collected, six agencies indicated manual surveys only, 12 agencies indicated windshield surveys only, four agencies indicated both manual and windshield surveys, 2 agencies use a manual plus automated method, and two agencies use fully automated surveys.

In one question of the survey agencies were asked to rank specific features of pavement management software. The features indicated in the questionnaire were based on common

features provided by many PMS software programs as well as input from the Steering Committee. Agencies were asked to use a value of one (1) to represent most important and greater values to represent lesser importance. Agencies were also instructed to indicate those features being "not important" by assigning a value of zero (0) to the feature. The values provided by the 26 agencies that responded to the question were averaged and are provided in Table 1. Values equal to zero (0) were not included in the mean but are noted.

Table 1. Agency Ranking of Importance of PMS Software Features.

PMS Software Feature	Rank (Mean of Values Provided by Agencies)	Number of Agencies Indicating "Not Important"
Ease of use/operation	1 (1.7)	0
Ease of startup/ implementation	2 (2.9)	0
Ability to configure as desired	3 (4.4)	1
Technical support	4 (5.0)	0
Stability of software/ product support	5 (5.1)	0
Cost	6 (5.2)	0
Windows 95/Windows NT compatibility/ 32-bit architecture	7 (5.3)	0
Ability to link to GIS	8 (5.5)	1
Public domain software	9 (6.4)	7
Ability to include "roadway furniture"	10 (6.9)	0
User group meetings	11 (8.4)	7

The results indicate that, on average, agencies within Orange County regard ease of use/ operation, ease of startup/implementation, and ability to configure as desired as being the top three features, respectively, of PMS software packages. This is not surprising but it should be noted that being provided with the ability to configure the software as desired usually means that ease of startup/implementation is made more difficult. However, the results also indicate that cost is ranked as sixth out of a possible eleven which may indicate that the financial burden of

startup/implementation is regarded as part of the cost of purchasing the software package (i.e., the software vendor is made responsible for implementing the software package). Also, it is interesting to note that one agency regarded the ability to configure the software as desired as being not important.

Based on the results, technical support is also quite important, on average, to agencies in Orange County. Most software vendors charge a fee for such a service in terms of a service contract or an annual subscription fee; the former preferred by vendors of proprietary software, the latter preferred by vendors of public domain software. However, this feature also ranks, on average, as being of greater importance to cost. This most likely indicates that agencies are willing to pay an extra fee for technical support but does not indicate how much extra agencies are willing to pay. However, it should be noted that the cost of technical support service contracts can be substantial.

It is also interesting to note that, on average, agencies in Orange County regard stability of software/product support as being more important than cost, but only marginally so. This most likely indicates that agencies want a product that they can rely on and are willing to pay a bit extra for it. In other words, this may indicate a collective mentality of "you get what you pay for."

The ability of the PMS software package to be Windows 95/Windows NT/32-bit architecture was not, on average, regarded by agencies in Orange County as being as important as those features previously mentioned. However, this feature was ranked closely behind cost, stability of software/product support, and technical support, respectively.

The ability to link the database to a geographical information system (GIS) was also not regarded, on average, as being as important as those features previously mentioned. However, this feature was ranked closely behind Windows 95/Windows NT/32-bit architecture, cost, stability of software/product support, and technical support, respectively.

The results also indicate that, on average, public domain software, ability to include roadway furniture, and user group meetings are of least importance, respectively, to Orange County agencies.

PMS SOFTWARE

NV&A identified and objectively compared currently available PMS software packages as candidates for use by Orange County agencies. Comparison of the software included factors such as software cost, proprietary versus public domain, technical support, analysis methodology, and capabilities. The purpose of this assessment was to provide OCTA with a concise and objective comparison of available PMS software packages such that selection of a particular package could be made on an objective basis. A summary of this comparison is provided in Appendix C.

RECOMMENDATIONS

The ultimate goal of this project is to provide recommendations for standardizing the way agencies collect and assess data for the purposes of determining pavement condition throughout the County as well as to provide recommendations for standardizing the way these are reported. The following recommendations are made for consideration by OCTA Staff, the Steering Committee members, and Technical Advisory Committee members.

Data Collection

To assess the surface condition of any pavement, the type, severity, and extent of distresses present are needed. Thus, standardizing the way data is collected involves standardizing what types of distresses are to be considered, how severity of the distresses are determined, and how the extent (or quantity) of the distresses are determined.

Distress Types

Figure 1 shows the types of asphalt pavement distresses collected by the agencies in Orange County as well as the number of agencies (out of 27 who responded to the survey question) that collect each type of distress. Assuming these results represent the entire County, the majority of agencies collect the distresses listed in Table 2. Thus, based on these results, it is recommended that all agencies in Orange County collect at a minimum the distresses listed in Table 2 for asphalt pavements.

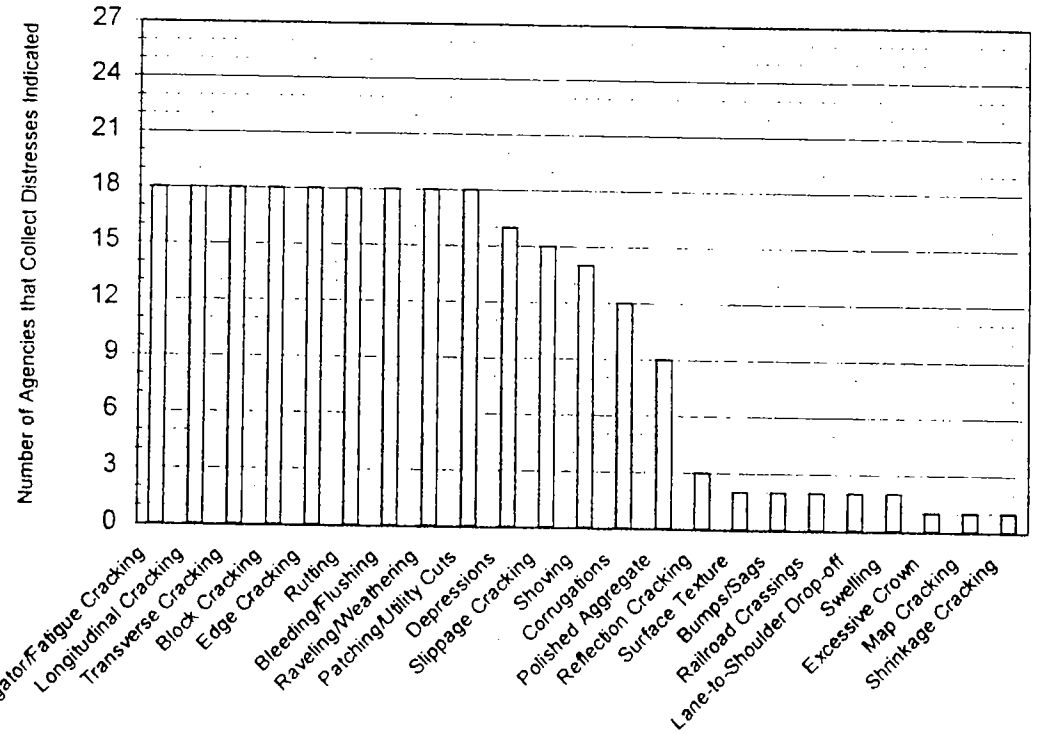

Figure 1. Number of agencies that collect the distresses indicated for asphalt pavements.

Table 4. Recommended Criteria for Determining Severity Levels and Extent of Distresses in Asphalt Pavements.

Distress Type	Low Severity	Moderate Severity	High Severity
Alligator/ Fatigue Cracking	An area of cracks with no or only a few interconnecting cracks. Cracks are not spalled. Pumping is not evident.	An area of interconnected cracks forming a complete pattern. Cracks may be lightly spalled or sealed. Pumping is not evident.	An area of moderately or severely spalled, interconnected cracks forming a complete pattern. Pieces may move when subjected to traffic. Cracks may be sealed. Pumping may be evident.
How to measure extent: Measured in square feet of surface area affected. If two or more severity levels exist and can be easily distinguished, they should be recorded separately. If they cannot be easily distinguished, the entire area should be rated at the highest severity present.			
Longitudinal/ Transverse Cracking	A crack with a mean width ≤3/8 in.; or a sealed crack of any width with sealant material in good condition.	Any non-filled crack with a width between 3/8 and 3 in.; or a non-filled crack with any width up to 3 in. surrounded by light and random cracking.	Any crack filled or non-filled surrounded by medium- or high-severity random cracking; or a non-filled crack > 3 in.; or a crack of any width where a few inches of pavement around the crack are severely broken.
How to measure extent: Measured in linear feet. Length and severity of each crack should be recorded. If crack has more than one severity, each portion of the crack should be recorded separately.			
Block Cracking	Blocks are defined by low-severity cracks. (Refer to Longitudinal/Transverse cracking definitions).	Blocks are defined by medium-severity cracks. (Refer to Longitudinal/ Transverse cracking definitions).	Blocks are defined by high-severity cracks. (Refer to Longitudinal/ Transverse cracking definitions).
How to measure extent: Measured in square feet of surface area affected. Usually occurs at one severity level in a given pavement section; however, any areas of the pavement section having distinctly different levels of severity should be measured and recorded separately.			
Edge Cracking	Low or medium cracking with no breakup or raveling.	Medium cracks with some breakup and raveling.	Considerable breakup or raveling along the edge.
How to measure extent: Measured in linear feet of length of pavement affected.			
Rutting	Mean Rut Depth between 1/4 in. and 1/2 in.	Mean Rut Depth between 1/2 in. and 1 in.	Mean Rut Depth > 1 in.
How to measure extent: Measured in square feet of surface area affected and its severity is determined by the mean depth of the rut.			

Table 4. Recommended Criteria for Determining Severity Levels and Extent of Distresses in Asphalt Pavements (Continued).

Distress Type	Low Severity	Moderate Severity	High Severity
Bleeding/ Flushing	Bleeding has occurred only to a very slight degree and is noticeable only during a few days of the year. Asphalt does not stick to shoes or vehicles.	Bleeding has occurred to the extent that asphalt sticks to shoes and vehicles during only a few weeks of the year.	Bleeding has occurred extensively and considerable asphalt sticks to shoes and vehicles during at least several weeks of the year.
How to measure extent: Measured in square feet of surface area affected. If bleeding is counted, polished aggregate should not be counted.			
Raveling/ Weathering	The aggregate or binder has begun to wear away but has not progresses significantly. Some loss of fine aggregate.	Aggregate and/or binder has worn away and the surface texture is becoming rough and pitted; loose particles generally exist; loss of fine aggregate and some loss of coarse aggregate.	Aggregate and/or binder has worn away considerably and the surface texture is very rough and severely pitted; pitted areas are <4 in. in diameter and <1/2 in deep; loss of coarse aggregate.
How to measure extent: Measured on square feet of surface area affected.			
Patching/Utility Cuts	Patch/utility cut possesses low severity distresses of any type.	Patch/utility cut possesses moderate severity distresses of any type.	Patch/utility cut possesses high severity distresses of any type.
How to measure extent: Measured in square feet of surface area affected. If a single patch has areas of differing severity, these areas should be measured and recorded separately. No other distresses are recorded within a patch.			

Table 5. Recommended Criteria for Determining Severity Levels and Extent of Distresses in PCC Pavements.

Distress Type	Low Severity	Moderate Severity	High Severity
Longitudinal/ Transverse Cracking (Non-reinforced slabs)	Non-filled cracks ≤ 1/2 in. or filled cracks of any width with filler in satisfactory condition. No faulting exists.	One of the following conditions exist: 1) Non-filled crack between 1/2 and 2 in. 2) Non-filled crack of any width up to 2 in. with < 3/8 in. of faulting or 3) Filled crack of any width with > 3/8 in. of faulting.	One of the following conditions exist: 1) Non-filled crack with a width > 2 in. 2) Filled or non-filled crack of any width with >3/8 in. faulting.

How to measure extent: Once the severity has been identified, the distress is recorded as one slab. If two medium-severity cracks are within one slab, the slab is counted as having one high-severity crack. Slabs divided into 4 or more pieces are counted as divided slabs. In reinforced slabs, cracks < 1/8 in. wide are counted as shrinkage cracks. Slabs longer than 30 ft are divided into approx. equal length "slabs" having imaginary joints assumed to be in perfect condition.

Longitudinal/ Transverse Cracking (Reinforced slabs)	Non-filled cracks 1/8 to 1 in. wide; filled crack of any width with the filler in satisfactory condition. No faulting exists.	One of the following conditions exist: 1) Non-filled crack between 1 and 3 in. 2) Non-filled crack of any width up to 3 in. with < 3/8 in. of faulting or 3) Filled crack of any width with > 3/8 in. of faulting.	One of the following conditions exist: 1) Non-filled crack with a width > 3 in. 2) Filled or non-filled crack of any width with >3/8 in. faulting.

How to measure extent: See Longitudinal/Transverse Cracking (Non-reinforced slabs).

Popouts	Not applicable; however, popouts must be extensive before they are counted as a distress. Average popout density must exceed approximately 3 popouts per square yard over the entire slab area.	N/A	N/A

How to measure extent: The density of the distress must be measured. If any doubt that the average is >3 popouts per square yard, at least 3 random 1 square yard areas should be checked. When the average is greater than this density, the slab should be counted.

Joint Sealant Damage	Sealant generally good condition throughout section. Sealant performs well with only minor amount of one of the following types of damage: 1)stripping of sealant, 2)extrusion of sealant, 3)weed growth, 4)hardening of filler, 5)loss of bond, and 6)lack or absence of sealant.	Sealant is in generally fair condition over the entire surveyed section, with one or more of the previously listed types of damage occurring to a moderate degree. Sealant needs replacement within 2 years.	Joint sealant is in generally poor condition over the entire surveyed section, with one or more of the previously listed types of damage occurring to a severe degree. Sealant needs immediate replacement.

How to measure extent: Joint sealant damage is not counted on a slab-by-slab basis, it is rated based on the overall condition of the sealant over the entire area.

Table 5. Recommended Criteria for Determining Severity Levels and Extent of Distresses in PCC Pavements (Continued).

Distress Type	Low Severity	Moderate Severity	High Severity
Shrinkage Cracking	Not applicable. No degrees of severity are defined. It is enough to indicate that shrinkage cracks are present.	N/A	N/A

How to measure extent: If one or more shrinkage cracks exist on a particular slab, the slab is counted as one slab with shrinkage cracks.

Joint Spalling	One of the following conditions exist: 1) Pieces of material cannot be easily removed. 2) If some pieces are missing and the length of the spall is <2 ft. 3) Most or all pieces are missing and the length of the spall is <2 ft. and the width of the spall is <4 in.	One of the following conditions exists: 1) Length of spall <2ft., most or all pieces are missing and the spall width>4 in. 2) Length of spall >2 ft, pieces can be removed or are missing, and the spall width <4 in.	Length of spall >2 ft. and width of spall >4in. with most or all pieces missing.

How to measure extent: If spall is along the edge of one slab, it is counted as one slab with joint spalling. If the spalling is on more than one edge of the slab, the edge having the highest severity is counted and recorded as one slab. If spalling is on the edges of two adjacent slabs, each slab is counted as having joint spalling.

Durability ("D") Cracking	"D" Cracks cover less than 15% of slab area. Most of the cracks are tight, but a few pieces may have popped out.	One of the following conditions exist: 1)"D" cracks cover <15% of the area and most pieces have popped out or could be easily removed. 2)"D" cracks cover >15% of the area. Most of the cracks are tight, but a few pieces may have popped out or could be removed easily.	"D" cracks cover >15% of the area and most of the pieces have come out or could be removed easily.

How to measure extent: When the distress is located and rated at one severity, it is counted as one slab. If more than one severity level exists, the slab is counted as having the higher severity distress.

Corner Breaks	Break is defined by a low-severity crack and the area between the break and the joints is not cracked or may be lightly cracked.	Break is defined by a medium-severity crack and/or the area between the break and the joints has a medium crack.	Break is defined by a high-severity crack and/or the area between the break and the joints is highly cracked.

How to measure extent: Distressed slab is recorded as one slab if it contains a single corner break, contains more than one break of a particular severity, or contains two or more breaks of different severities (only the highest severity should be recorded).

Deduct Values and Condition Index Calculation

Not all agencies currently use the PCI method; however, 16 (at least half) of the agencies do. Thus, this is the procedure recommended for standardizing the way all agencies determine the condition index value of a pavement section.

Once distress types and quantities are accumulated and recorded, the quantity of distress (linear feet, square feet, or number of slabs) is divided by the total feet, area, or slabs in the sample unit. The values are then multiplied by 100 to obtain the percentage of density per sample unit for each distress type and severity. Deduct values are then determined for each distress through use of deduct curves located in Appendices B and C of *Pavement Management for Airports, Roads and Parking Lots*. These values are used to determine the corrected deduct value (CDV) which is subtracted from 100 to arrive at the PCI value. The procedure is explained in further detail with examples for AC, PCC and unsurfaced roads in the textbook.

Survey Form

Sample survey forms were prepared based on the distress codes used in Micro PAVER. Two forms for AC pavements and two forms for PCC pavements were prepared. One form for each pavement type contains all the distress types and codes that are used in the Micro PAVER software (Figures D1 and D3 in Appendix D). For both AC and PCC pavements, there are 19 distress types and codes. From these, one form for each pavement type (Figures D2 and D4 in Appendix D) was prepared based only on the distresses listed in Tables 2 and 3 that the majority of the agencies use. These forms allow the type, severity, and the quantity of each distress to be easily recorded in the field.

Pavement Quality Categories

The overall quality rating of a pavement section depends on the condition index value. The questionnaire asked each agency to provide condition index ranges for rating pavements in terms of the quality indicators of "very good," "good," "fair," "poor," and "very poor." Table B2 in Appendix B was generated to list each agency's index range corresponding to these quality indicators. It should be noted that the condition index ranges for some agencies were combined to fit into the five categories indicated above. For example, some agencies provided condition index ranges for seven pavement quality categories. In these cases, the two highest categories were combined, as were the two lowest categories. Also, some scales were mathematically converted from a scale other than a 0-100 scale to the 0-100 scale, but only if the conversion did not result in loss of accuracy.

The objective of this analysis is to develop a standardized PCI range for categorizing all pavement sections for every agency in Orange County. Based on the results of this analysis, it is recommended that the condition index ranges shown in Table 6 be used to represent the pavement quality categories for all future countywide analysis.

Figure B1 in Appendix B graphically represent the data listed in Table B2. These were prepared to graphically compare each agency's range for each category (i.e. "Very Good", "Good", "Fair", "Poor", and "Very Poor"). The bold horizontal lines indicate the minimum value of each range based on the survey results (Table 6).

Table 6. Recommended Condition Index Ranges for Pavement Quality Categories.

Pavement Quality Category	Ranges based on Survey Results	Recommended Ranges
Very Good	100 – 86	100 – 86
Good	85 – 74	85 – 75
Fair	73 – 58	74 – 60
Poor	57 – 41	59 – 41
Very Poor	40 – 0	40 – 0

In comparison to Table 2 of the *Countywide Pavement Condition Assessment Study* conducted previously, the condition index ranges are quite different. Table 2 of the previous study was generated based on only 4 individual agency's responses. In this study, there are 16 agencies that use a scale of 0-100 and 4 other agencies that use a 0-10 scale that can easily be converted to a scale of 0-100. As a result, Table 6 of this report was generated based on the responses of 20 agencies. Statistically, a data set of 20 responses is much more representative than a data set of 4 responses.

Table 2 in the previous study is considered more aggressive in terms of treatment trigger limits. The amount of backlog is the amount of money necessary to treat pavements that are currently in a "poor" or "very poor" category and improve their quality to "fair" or better. According to Table 2 in the previous study, any pavement that possesses a condition index value less than 72 falls into the backlog list and should be treated. The treatments to improve these sections are rehabilitation techniques such as thick overlays or complete reconstruction, both of which are very expensive.

Table 6 in this study suggests that pavements possessing condition index ranges less than 57 will fall into the backlog list. Using this value instead of a value of 72 would result in substantially less money required to eliminate backlog as reported in the previous study.

Converting Non-Standard Scales

For those agencies that do not presently use a 0 to 100 scale (or a 0 to 10 scale with at least one decimal point), a conversion method will need to be implemented in order to standardize the condition categories. If the condition indices from various management systems are to be compared with each other, they should be normalized based on some actual data.
To accomplish this, it is recommended that several sections be established in the vicinity of the

communities to be included in the comparison. The surface condition of these sections should vary between very poor and very good. Each of the participating agencies should then rate the sections using their rating procedure. The condition indices generated by each system could then be compared statistically to develop conversion factors or equations. This calibration procedure should be performed periodically to refine the conversion factors/equations with time. The procedure would also need to be kept as simple as possible to foster participation amongst the various agencies needing to convert their scale to the 0 to 100 scale.

Alternatives to this recommendation should also be considered by agencies in Orange County. However, as a minimum, it is strongly recommended that all agencies adopt a standard pavement condition scale of 0 to 100. A few options are discussed in further detail in the following paragraphs.

One possible alternative is adoption of the 0 to 100 scale without adoption of standardized deduct values. This option would allow agencies discretion in determining how the condition index is calculated. For example, if ride quality were considered important to a particular agency, this option would allow that agency to include ride quality as a determining factor in calculating the overall condition index. Another example would be inclusion of some sort of structural adequacy factor in determining the overall condition index of pavement sections. This option would minimize the effort afforded by agencies to conform to some form of standardization. Conformance could be as simple as mathematically converting non-standard scales to the (standard) 0 to 100 scale. Although this would be (theoretically) relatively simple, it would require various assumptions that may lead to inaccurate conversion factors or equations. It should be noted that this option would not necessarily facilitate easy (or representative) comparison of the condition indices reported by one agency with the condition indices reported by another agency if either different methods of assessing condition or simple mathematical conversions are employed.

A simple improvement on this option would be to have all agencies adopt the 0 to 100 scale as the standard scale plus base the condition index on only those distresses listed in Tables 2 and 3 of this report. Even if agencies used different deduct values for the various distresses, this option would, potentially, provide for more accurate comparison of pavement quality amongst agencies. This option would allow agencies to collect information about distresses in addition to those listed in Tables 2 and 3, but would require that the condition indices of pavement sections reported to OCTA be based on only those distresses listed in Table 2 and 3.

Still another option could be that agencies retain their current system but also maintain a second system that complies with that adopted by all agencies within Orange County for the purposes of reporting network health to OCTA. Although this option may require agencies to maintain dual systems, it would allow agencies to retain and maintain systems they currently use that are different from that adopted as the "standard system."

Reporting Standards

Effective and efficient assessment of countywide pavement conditions requires that certain information be provided by all agencies in a standardized manner. As a minimum, this would entail reporting the percent of the agency's network, by area, in each pavement quality category by functional classification (e.g., the percent area of arterial streets in "good" condition, the percent are of local roads in "poor" condition, etc.). Pavement quality categories should be based on the 0 to 100 scale and uniform amongst all agencies as proposed in Table 6 of this report.

Alternatively, agencies could simply provide a report indicating the condition (on a scale of 0 to 100) of all pavement sections within the agency's network. However, with this type of report, additional minimum information would be required including functional classification (either local or arterial road) and area of each pavement section.

Wherever possible, it is also recommended that agencies in Orange County report separately the condition of pavements in the agency's jurisdiction that are part of the Master Plan for Arterial Highways (MPAH).

It is further recommended that reports be generated in both paper and electronic format. Reports in electronic format should be comma or tab delimited ASCII text files.

Software

Most agencies in Orange County have a software package that is used for pavement management purposes. However, not all software packages conform to the recommendations made above. Based on these recommendations, options are presented below and the software used by agencies should conform to the option selected. Appendix C provides a comparison of software packages so that an agency can quickly and objectively choose a particular package that conforms to the option selected.

CONCLUSIONS

Numerous recommendations have been made in this report regarding standardizing the way agencies in Orange County assess and report pavement conditions. Recommendations have been made for standardizing the types of distresses agencies should evaluate during a survey, the way in which these distresses should be quantified, the way this information should be evaluated, and the way this information should be reported. Options for implementing these recommendations are as follows:

Option 1: Utilize 100 Point Scale

Under this option all agencies in Orange County would adopt the 100-point scale (i.e., 0 to 100) for pavement condition assessment. This option would allow agencies discretion in determining how the condition index is calculated (e.g., this option would allow inclusion of factors other than surface distresses such as ride quality).

Although it is realized that this would require some agencies to modify their current pavement condition assessment methodology and PMS software, adoption of the 100-point scale would facilitate easy and objective comparison of pavement condition indices amongst all agencies in the County.

Option 2: Utilize 100 Point Scale Plus Common Distress Types/Deduct Values

Under this option all agencies would base overall pavement condition on a common set of pavement distresses and deduct values as well as adopt the 100-point scale. Further, based on the questionnaire results, the distress types considered, as a minimum, should be those listed in Tables 2 and 3. Agencies would not be constrained to collection of only those distresses listed in Tables 2 and 3 (i.e., agencies could collect additional distresses). However, the pavement condition indices reported to OCTA would need to be based on only those distresses listed in Tables 2 and 3 and a common set of deduct values for these distresses.

As with Option 1, this option would require some agencies to modify their current pavement condition assessment methodology and PMS software. Also, this option requires consensus amongst all agencies regarding the deduct values for each distress type. In other words, this option would not allow one agency to weight a particular distress differently from another agency.

Option 3: Utilize Common Software and Assessment Methodology

Under this option all agencies would utilize common software as well as a common condition assessment methodology. Although this option would be optimal for OCTA as it would allow easy analysis and interpretation countywide, it would be the most disruptive to agencies that do not presently own the "standard" software package selected.

Option 4: Do Nothing

Agencies should also consider the "do nothing" option. Although this option would be the least disruptive to agencies, it would also represent lack of progress towards improving the way pavement condition is assessed countywide. It would also require that subjectivity be used in normalizing data when making comparisons amongst agencies with differing systems.

Recommended Option

Of the four options presented above, NV&A recommend that the agencies in Orange County adopt Option 1 as a minimum. Adoption of Option 2 would be an improvement over Option 1, but it would require more effort on the part of agencies that do not presently collect all the distresses listed in Tables 2 and 3.

Although Option 3 would be best for OCTA, NV&A realize that this option is not realistic and, therefore, is not recommended. Option 4 is also not recommended, as this would represent lack of progress towards improving the way condition is assessed countywide.

Reporting Pavement Quality

NV&A recommend that the agencies in Orange County adopt the condition index ranges listed in Table 6 for the purposes of reporting pavement quality to OCTA. It should be noted that this recommendation does not imply that agencies need to adopt these ranges for their own purposes, but it would require that these ranges be used whenever pavement quality is reported to OCTA.

APPENDIX A
Questionnaire

PAVEMENT MANAGEMENT SYSTEM QUESTIONNAIRE

INTRODUCTION

The Orange County Transportation Authority (OCTA), through Nichols•Vallerga & Associates (NV&A) of Huntington Beach, is conducting a study for developing pavement management system standardization recommendations. The objectives of this study are to:

1. Develop an inventory of systems currently used by agencies within Orange County;
2. Identify information currently collected by agencies for pavement management system purposes;
3. Identify minimum information needed for a implementing a pavement management system;
4. Recommend options for standardizing data collection and assessment and basic reporting; and
5. Identify and compare currently available pavement management system software packages.

To assist the OCTA in accomplishing the first two objectives, your agency is respectfully requested to complete and fax this questionnaire to Paul Rodriguez by **May 27, 1998**.

Paul Rodriguez
Orange County Transportation Authority
550 South Main Street
P.O. Box 14184
Orange, California
92863-1584
Fax: (714) 560-5794

Please note that information provided is for research purposes and will not affect funding in any way.

QUESTIONS

1. Please provide the following details about yourself:

   Name: _____

   Position: _____

   Agency: _____

   Phone number: _____

   Fax number: _____