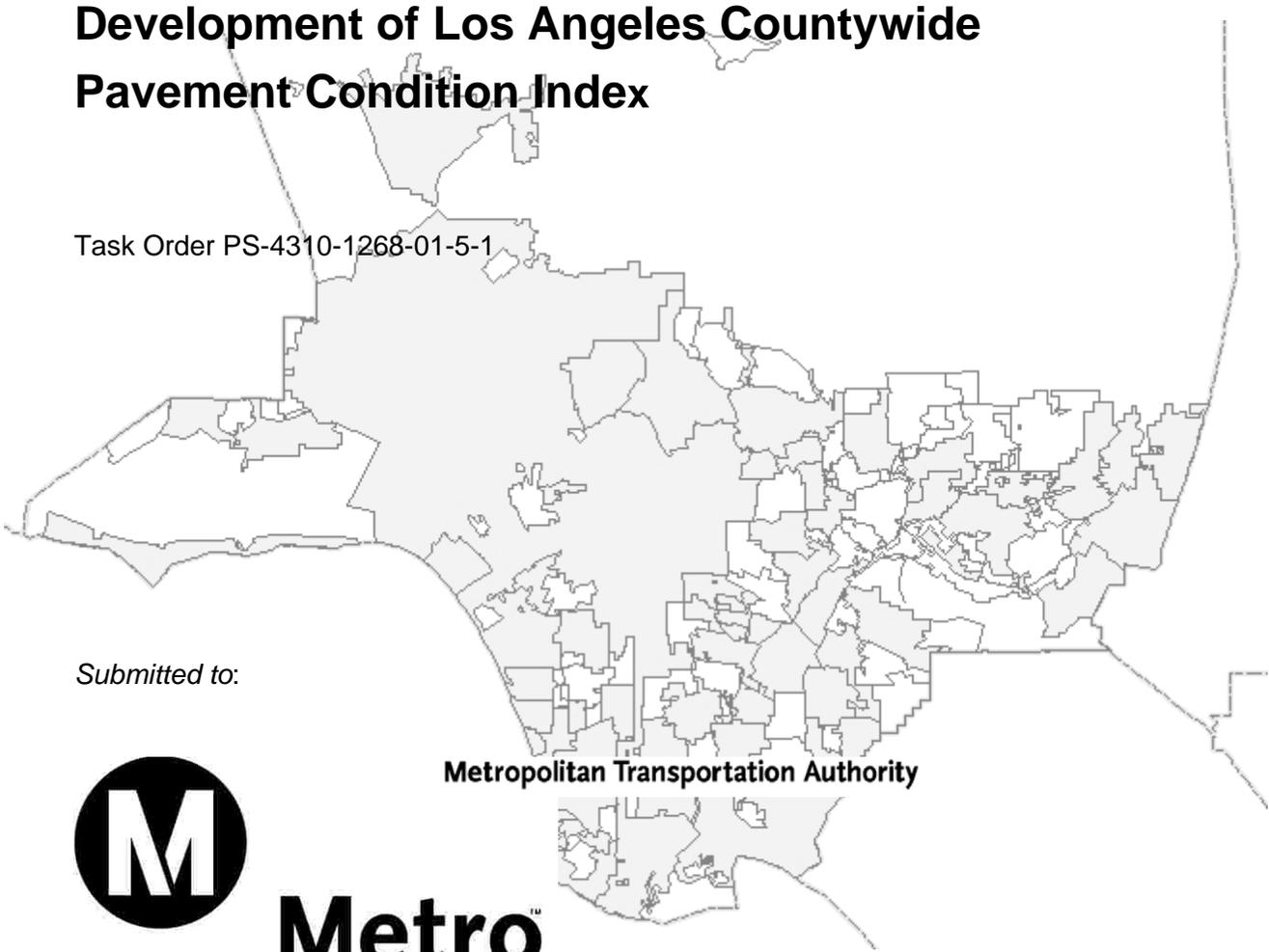# Development of Los Angeles Countywide Pavement Condition Index

Task Order PS-4310-1268-01-5-1

Submitted to:

Metropolitan Transportation Authority

Metro

Submitted by:

PARSONS BRINCKERHOFF

Charles Abbott Associates

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Contents

Executive Summary

This Project was undertaken by the Los Angeles County Metropolitan Transportation Authority (Metro) to standardize Pavement Condition Index (PCI) thresholds used by Los Angeles County's Local Jurisdictions. Data from a previous study, the Metro 2002 Capacity Enhancement/System Preservation Needs Assessment (2002 Needs Study) was used as the starting point for this study. The 2002 Needs Study provided data for each of the county's local jurisdictions with public streets (88) including, the backlog cost of rehabilitation, reconstruction, and resurfacing (3R) work on arterial streets. The threshold value, typically generated using a Pavement Management System (PMS), indicates the pavement condition at which 3R work should be initiated. The standardization process provides a method for "normalizing" the various PCI threshold values and subsequently for normalizing the 3R Backlog costs for the County's arterial streets as a whole. In other words, the normalization process provides a method for reporting needs of individual jurisdictions using a consistent measure.

This latest effort included a brief survey of local jurisdictions to obtain data on the PMS in use and the threshold pavement conditions (indicated by the PCI) triggering 3R work. The PMS typically uses a numeric scale, commonly 0-100, indicating the overall condition of the pavement. A PCI of 60 to 70 or less generally indicates conditions requiring 3R work. Given the survey data, the consultant team determined which PMSs could be correlated to a countywide system, and those for which a "surrogate" pavement condition threshold needed to be provided. Surrogates were provided based on the average thresholds of similar cities – those having similar traffic, soil, and topographic conditions. Taken all together the correlated and surrogate PCIs are the normalized PCIs and are termed "Countywide PCIs" or "CPCIs." The analysis uses the PCI's that were in place in 2002. Subsequently some of the jurisdictions may have changed their systems.

Field verification of the CPCI results and correlations was not part of this study. PCI correlations were variable as expected. In some instances, correlated ratings were significantly less than the jurisdiction's system rating. This does not imply that the street condition in that particular city is below average, rather, that the rating systems weigh defects differently. Similarly, surrogate ratings represent an estimate of the threshold ratings for cities with out correlatable PCIs. The surrogate ratings assigned are not intended to represent actual conditions for those jurisdictions. Thus, translations to the CPCI at the jurisdiction level may not be accurate and the correlation results should only be used at an aggregate county level of analysis.

For five of the systems in use, the PCIs could be directly translated to the CPCI. In six others, correlation curves were developed to translate individual system PCIs to the CPCI. For the remaining systems – or for jurisdictions without a PMS, surrogate ratings were applied. A "user-friendly" Correlation Tool (spreadsheet with drop down menus) was developed to facilitate conversion of PCI thresholds to the CPCI (normalized) threshold. Initially, the County average correlated threshold of 61 was used for the Countywide threshold. Other thresholds, such as the most commonly used value of 70 were also evaluated.

After converting the PCIs to the countywide system, reported backlog costs from the 2002 Needs Study were normalized by multiplying the 2002 backlog cost by the ratio of the jurisdictions CPCI over the average. When the normalized threshold is applied, the countywide backlog increases from $775 million to $815 million, in 2002 dollars, an

increase of $40.1 million over the total reported in 2002. Using the most common threshold value of 70, the backlog increases to $936 million, in 2002 dollars or $160.7 million over the 2002 backlog. It should be noted that these figures do not account for increases in the cost of materials or other escalation. Additionally, they do not capture work that may have been performed to reduce the backlog.

On an on-going basis, a Steering Committee composed of representatives from each of the County's sub-regions, as well as the City and County of Los Angeles was consulted as needed to provide review and technical input for the project.

Recommendations:

For future analysis Metro needs to be able to collect updated data from each jurisdiction in the county including updated backlog needs by jurisdiction. For the Correlation tool to be most effective, elements should be kept current. Each jurisdiction typically updates its PMS inventory on a 3 year cycle for arterials, according to GASB 34 and FHWA recommendations. Thus, the Correlation tool should be updated accordingly to reflect changes in PMSs in use and threshold PCIs. A routinely updated data base of each jurisdiction's contact person who has data on the PMS, threshold PCI and current average PCI for the jurisdiction and backlog costs should be maintained. Metro will need to establish a correlation approach for any new PMSs that are developed and used in the county. Although this project did not use lane mile data for the final analysis, it appears that the use of lane mile data with unit costs may provide an additional degree of refinement to projecting normalized backlogs. Future survey data would need to include the number of lane miles requiring backlog work. Field sampling of each jurisdiction's pavement condition inventory data would add a significant degree of accuracy to the normalization process.

1.0 Introduction

The Project Team (Team), Parsons Brinckerhoff, Charles Abbott Associates, with Diaz Yourman Associates and Metro staff developed an approach to correlate the Pavement Condition Indices (PCIs) generated by the over 20 Pavement Management Systems (PMSs) in use by local government jurisdictions throughout Los Angeles County. For this study, the PCI threshold value is the value triggering rehabilitation, reconstruction, and resurfacing (3R) work for arterial streets. The purpose of this correlation was to provide a procedure for computing a standardized or "normalized" PCI threshold and subsequently, for calculating normalized backlog costs (in 2002 dollars). The normalized cost would provide data to allow Metro staff and others to advocate for additional funding for 3R work on arterial streets.

Background:

In September 2002, -- the Metro Board received the Capacity Enhancement/System Preservation Needs Assessment Study Report (2002 Needs Study). Among the conclusions of this report were that, while Pavement Management Systems (PMSs) help determine pavement condition and assist jurisdictions in deciding when and how frequently streets should be resurfaced or rehabilitated, different systems result in different resurfacing and rehabilitation schedules. For Los Angeles County, the 2002 study reported that:

- There are more than 20 different Pavement Management Systems.

- The systems use various rating methods, scales and trigger [*threshold*] values to determine system preservation schedules. For example:

  - One rating system uses a PCI with a scale of 0 to 100, with 100 being the best; another uses a rating system with a scale of 1 to 5, with 1 being the best.

  - One rating system established a trigger value (the value at which the pavement should be maintained/resurfaced) of 86; another's trigger value is 70 – both using a scale of 0 to100.

  - Some systems use visual inspection as the method of rating the pavement; others use lasers and cameras or lasers and visual inspection to assess the pavement condition.

- The lack of standardization in PMS across the County means costs and schedules (i.e., reported system preservation needs) are not necessarily comparable.

Background - Pavement Management Systems

PMSs were developed largely from the United States Army Corps of Engineers (ACOE) work to evaluate airfield runways shortly after World War II. The evaluation was an attempt to analytically determine rehabilitation needs throughout the airfield system. The ACOE work developed a series of mathematical curves that relate the numerical pavement rating index that represents the relationship of the condition of a pavement section to the age of the pavement section. Having these curves allowed the ACOE to determine the remaining life expectancy of any pavement section that had a PCI derived from a field rating of the particular pavement deficiencies of the pavement section.

State Highway agencies realized the value of using the ACOE approach to evaluate highways beginning in the 1950s. Soon, PMSs were being developed and used to identify long-range funding needs as well as for short-range capital improvement projects. Most applications of PMSs include an identification of PCIs that indicate the need to rehabilitate pavements. Many different PMSs have been developed over the ensuing 40 years using varying degrees of sophistication of computer software and field inventory techniques.

Many agencies responsible for pavement maintenance and rehabilitation have developed a policy on the numerical value of the PCI at which the agency would fund rehabilitation projects. The most widely accepted PCI value at which rehabilitation is recommended is 70. This threshold may be established at other values depending upon the pavement condition the jurisdiction is willing to accept.

Over the past four decades there have been a number of different PMSs developed by groups such as:

- Academic institutions
- State highway agencies
- Private companies; and
- Combination of the three groups

The level of sophistication of the various PMSs varies greatly. Many systems have relied on the ACOE aging curves. On the other end of the spectrum, aging decisions are subjective at best. Some PMSs have developed electronic/photographic inventory systems; others rely on a survey using measurements; while others still use subjective windshield surveys. Relating the features of various systems to a common system was one of the primary goals of this study.

Project Approach
The project approach included extracting existing data from the 2002 Needs Assessment Study, collecting additional data on PMSs in use, researching the methodology used by the PMSs, and correlating the PCIs generated such that they could be converted to a Countywide PCI (CPCI). Backlog costs from the 2002 Needs Study were then normalized so that costs for each jurisdiction are comparable. Staff used the following specific tasks to accomplish the project goals:

- Surveyed each local jurisdiction having public roads to ascertain the PMS in use (in 2002 and 2004 – the time of the survey) and the threshold PCI used by the jurisdiction.

- Developed a method to correlate pavement condition data countywide. The methodology took into account a) differences in rating scales, and b) differences in pavement rating criteria.

- Estimated threshold ratings to serve as surrogate thresholds for jurisdictions that did not have translatable pavement condition ratings.

- Provided normalized pavement condition indices for all local jurisdictions and the county as a whole. The work did not include field inspection of pavement conditions to verify normalized values.

- Applied the relationship of the difference in each jurisdiction's normalized CPCI to the chosen comparison threshold CPCI to normalize the 2002 Needs Study backlog costs.

- Provided an easy to use spreadsheet tool to provide normalized data and backlog costs.

- Trained Metro staff in use of the tool for future updates

Each sub-section in this report elaborates on the tasks developed for the above approach and Appendix A contains the individual Technical Memorandums (TMs) documenting each task. In some instances information, reported in the technical memoranda has been superceded. These occurrences are identified on inserted sheets in front of the TMs. Appendix B provides a hard copy of the electronic Correlation Tool output.

2.0 Project Team

In addition to the Consultant Team and Metro staff, a project Steering Committee provided technical input and review of applicable draft technical memoranda. To provide continuity between the 2002 and current study, the Committee composition was consistent with that of the 2002 Needs Study. Members represented the Los Angeles County Sub-regions and the City and County of Los Angeles as follows:

- North Los Angeles County

- Gateways Cities COG

- Las Virgines/Malibu COG

- San Gabriel Valley COG

- Arroyo Verdugo Cities

- Los Angeles County (Unincorporated)

- South Bay Cities COG

- West Side Cities

- City of Los Angeles

3.0 Inventory of Pavement Management Systems

To gather additional data about the types of systems in use in Los Angeles County in 2002, a survey was conducted to obtain more detailed information on the PMSs and threshold ratings used at that time. Jurisdictions with no public roads were not surveyed. The pavement component conditions (e.g., raveling, cracks, etc) used to calculate the PCI were evaluated to develop mathematical relationships to convert an individual jurisdiction's PCI to the CPCI standard. The survey form is reproduced in Appendix A.

All of the county jurisdictions responded to the survey. PMS systems in use as of the 2002 Needs Assessment are shown in Table 1 below:

TABLE 1
PMS Systems in Use in Los Angeles County

PMS System	Number of Cities
5-Year Pavement Rehabilitation Program	1
Berryman and Henigar	1
CarteGraph	2
Charles Abbot Assoc	2
CHEC PMS Plus	1
Cititech Systems	1
Engineer's Judgment	1
Hansen's PMS	1
IMS	2
In House	7
Infra Manager by CHEC	3
LACDPW	2
Micro PAVER	20
MTC	13
Nichols Consulting Engineers	1
Pavement Condition Inventory	2
Pavement Management System Inc.	2
Pavementview Plus	2
Stantec	3
SuperPMS (ITX Stanley)	1
Willdan PMS	6
Total Jurisdictions with PMS Systems	**74**
Total Number of PMS Systems Types in Use	**31**
Total Jurisdictions – No PMS System	**14**
Number with all Private Roads	**1**
Total Jurisdictions	**89**

Figure 1 shows graphically the distribution of the systems.

Figure 1
Pavement Management Sysyems (PMSs)
In Use - Los Angeles County (2002)

Legend

- 5-Year Pavement Rehabilitation Program
- Berryman and Henigar
- CHEC PMS Plus
- CarteGraph
- Charles Abbot Assoc
- Cititech Systems
- Engineer's Judgement
- Hansen's PMS
- IMS
- In House
- Infra Manager by CHEC
- LACDPW
- MTC
- Micro PAVER
- Nichols Consulting Engineers
- No PMS System
- Pavement Condition Inventory
- Pavement Management System Inc.
- Pavementview Plus
- Stantec
- SuperPMS (ITX Stanley)
- Willdan PMS

Note: Avalon - No PMS

MTA PCI Team
November 2004

Source: Parsons Brinckerhoff
Created in ArcGIS 8 using ArcMap

4.0   Analysis of the Various Rating Systems and Pavement Condition Indices

Having established the systems in use, the next step was to compare the PMSs to determine if the ratings could be correlated to a normalized system.   Where a mathematical correlation was not achievable, a method was developed to provide "surrogate" ratings for normalization.   Three types of relationships were developed to normalize the PCIs: Directly Correlatable, Correlatable through a mathematical relationship, and through providing surrogate PCIs.

Directly Correlatable Systems

In general, the most common elements between the various PMSs in place is the use of a family of curves developed by the ACOE as described in Section 1.0, Introduction. These curves predict the pavement condition (represented by the condition index – PCI), relative to the age of the pavement being rated. A number of PMSs have been developed using the ACOE curves. PMSs based on these curves use similar rating approaches and provide similar results, and are therefore directly correlatable. Systems based on the ACOE curves are:

- All Versions of MicroPaver
- All Versions of MTC
- Cartegraph
- Inframanager
- CHEC

These families of PMSs use a PCI that ranges from 0 to 100, with 100 corresponding to a newly constructed pavement. That condition was developed by ACOE because the 100-point range was of sufficient breath that pavement sections could be accurately rated and ranked. Commonly, the 0 to 100 scale indicates the following conditions:

100- 90	Excellent Pavement Condition
80 – 89	Good Pavement Condition
70 – 79	Fair Pavement Condition
60 – 69	Poor Pavement Condition
< 60	Critical Pavement Condition

Many agencies adopt policies that when a PCI falls below 70 (or some other PCI within +/- 10 points of 70) the pavement section requires rehabilitation.

The team assumed that these families of PMSs were directly correlatable, a PCI of 70 in City A is exactly equal to a PCI of 70 in City B. That is, if two different PMSs are based on the ACOE aging curves and use a PCI range of 0 to 100, the results should be similar. In practice, the results can vary based on the quality of the pavement condition survey, the age of the data, and how the individual agency applies the PMS procedures.

Correlatable Systems

For PMSs that are not directly correlatable to the ACOE curves, a correlation was developed by comparing specific data points. This correlation is accomplished by comparing deduction values for the major pavement defects in each PMS. Figure 2

illustrates an example curve showing a correlation of the ACOE PCI and the non-ACOE PCI. A curve of "best fit" is obtained to allow a translation of any PCI in the non-ACOE PMS to a correlated PCI in the ACOE PMS. Figure 2 shows that a non-ACOE PCI of 70 would be correlated to a 35 in the ACOE based PCI rating. For each non-directly correlatable PMS, a separate translation curve is developed.

Large variations in PMS correlations were expected. In some instances, correlated ratings were significantly less than the jurisdiction's system rating. For example, a jurisdiction provided threshold of 70 could be correlated to a 45. This does not imply that the street condition in that city is below average; rather, that the rating systems weigh defects differently. For instance, "system A" may base 60 of 100 points on alligator cracking, while "system B" places only 30 points on this pavement defect.

The process for developing the correlation curves is described in more detail in TM 4.3, Analysis of Rating Systems, included in Appendix A. The TM presents an example of developing the data points for the correlation curves.

Figure 2. Non-ACOE vs. ACOE Deduct Curves
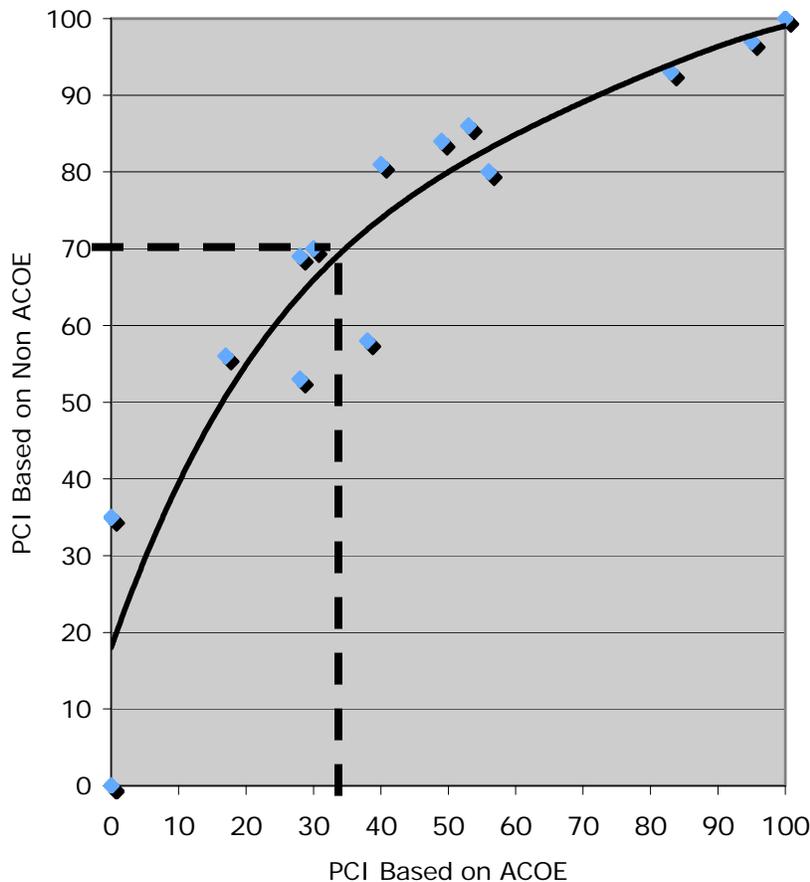
The following PMSs can be correlated using data points as illustrated in Figure 2. Separate correlation curves were developed for each system. Individual curves to correlate the various systems are included in Appendix B.

- ITX Stanley
- Charles Abbott
- IMS using only surface condition parameters
- Stantec's Surface Distress Index
- Cititech
- Barryman and Henigar

It should be noted that Correlated PCIs can vary depending on the individual system PCI for a number of reasons. These relate to the system itself and other factors including:

- Approaches to predicting pavement deterioration; rates of deterioration have a significant effect on correlating PCI between PMSs.
- Weighting of pavement defects – for example, if a particular PMS was developed in an area of higher moisture/rainfall than Southern California, the pavement defects relative to cracking may play a more prominent role than rutting and raveling, which are more significant in Southern California.
- Pavement inspection teams – the personnel performing condition surveys can have a large impact on PCIs and changes in team composition may change PCI evaluation judgment.

Non-Correlatable Systems

While many of the systems that are in use by the various local jurisdictions can be correlated using simple translations, there are several jurisdictions that either did not report a PMS or have a system that cannot be correlated. In some instances, there were no PCI values or no threshold PCI values stated by the jurisdiction. An example of no numerical values would be a system that reported pavement conditions in terms of "poor, good, or excellent." In other instances, jurisdictions may not have common data points, e.g., pavement defects are not common between the PMSs. As a result, a correlation curve could not be developed. These jurisdictions were termed "non-correlatable."

For the jurisdictions with non-correlatable systems, an approach was developed to include them in the countywide database, but not in the computation of the CPCI. This approach formulates a "surrogate" PCI threshold for each of these jurisdictions. The surrogate PCI threshold was developed by identifying at least two correlatable jurisdictions that had common and shared relevant characteristics with the jurisdiction that did not have a correlatable PCI. Common characteristics were general soil types, topographic characteristics, traffic volumes, and truck volumes. If two jurisdictions shared those characteristics, then it was assumed that the similar characteristics would yield a similar CPCI threshold.

The numerical average of the two correlatable PCI thresholds represents the surrogate PCI threshold for the non-correlatable jurisdiction. As the study progressed, some of the similar cities were reviewed and revised for inclusion in the PCI Correlation Tool. The final surrogates are presented in the PCI Correlation Tool, Appendix B.

When surrogate PCIs are used the two numbers shown for the PCI thresholds have no mathematical relationship. The "in-house" PMSs in particular may have been developed based on different rating scales, pavement aging curves, and rating techniques (e.g., windshield surveys). In some cases, cities that appear to have the same provided threshold may have different correlated thresholds. This occurs because surrogates are derived from the threshold of other similar cities (having similar soil, topography and traffic conditions), not the correlation curves (or a mathematical relationship).

Limitations of Use

Because of the variations in these systems, and the correlation methods, the use of the CPCI data has limitations. Translations at the jurisdiction level may not be accurate. Correlation results should only be used at an aggregate county level of analysis.

5.0   Determine Threshold Ratings

The average CPCI threshold was computed as the starting point for comparing each jurisdiction's CPCI and indicating the need for 3R work. For Los Angeles County, the average normalized threshold was 61. The average was calculated using a simple mathematical average of existing threshold values in all jurisdictions that had both correlatable systems and reported thresholds. The surrogate cities CPCIs were a composite of other cities CPCIs and the Team determined that inclusion of the surrogate CPCIs was in effect double counting and did not include those cities in calculating the average.

Three other threshold PCI levels were selected for comparison with the County average PCI threshold to study the impacts of using the average value versus using a lower or higher threshold PCI. The three other threshold levels were chosen based on the range of threshold values in use and the professional judgment of the Team. As discussed above, the first threshold level was set at the countywide average of 61. The second threshold level was set at 55, which is considered a minimally acceptable system condition. The third threshold was set at 70, which is considered a generally accepted system condition (as well as the most common threshold throughout the county). The fourth threshold level was set at 80, which is considered an exceptional system condition.

Table 2, below, shows the results in terms of lane-miles affected due to varying the normalized threshold.

TABLE 2: Summary of Changes in Threshold Levels Countywide

Threshold Test Levels	Countywide 3R Impact (Percent of Lane Miles)	Local Jurisdictional Impact (Percent of Lane Miles)	
		Largest Increase	Largest Decrease
Countywide Average **61**	**2**	**78**	**(28)**
Minimally Acceptable System Condition **55**	**(8)**	**60**	**(35)**
Generally Accepted System Condition **70**	**17**	**105**	**(18)**
Exceptional System Condition **80**	**34**	**134**	**(6)**

6.0   Develop a Countywide Standard

To further develop the standard system, a user-friendly spreadsheet tool was prepared to apply and streamline the correlation methods. This tool, named the Metro PCI Correlation Tool, is herein referred to as the "Correlation Tool," and reproduced in Appendix B. The spreadsheet incorporates correlation methods for each PMS in use at the time of the 2002 Needs study. For each jurisdiction, the PMS is entered along with its PCI threshold. It then translates the correlateble systems using the developed curves or points to the similar cities and provides the average for a surrogate rating.

The Correlation Tool includes the interface where all the input and output data are shown. Figures 3 and 4 reproduce portions of the spreadsheet to illustrate the format. Figure 3 shows example correlations of PCIs while Figure 4 shows the drop-down menu for inputting the PMS in use by the jurisdiction. The first column lists, in alphabetical order, all the jurisdictions in Los Angeles County that maintain streets with public access. For each jurisdiction, the user can select a pavement management system in the second column and enter a PCI threshold value for the selected system in the third column. These two columns are highlighted. Users are only allowed to select from the list of available PMS systems. Once data is entered, the Correlation Tool automatically converts a jurisdiction's PCI threshold value to the CPCI and presents the CPCI value in the fourth column. The formulas developed to convert jurisdiction PCI threshold values to CPCI values are embedded in the Correlation Tool.

Figure 3: Example PCI Correlations from the tool.

Jurisdiction	Pavement Management Software (Local System)	Provided PCI Threshold[1]	Threshold Correlated to CPCI[2]
Agoura Hills	Willdan PMS (0-1 scale)	NS	70
Alhambra	In House	81	58
Arcadia	Micro PAVER	60	60
Artesia	No PMS System	NS	74
Avalon	No PMS System	NS	62
Azusa	In House	20	65
Baldwin Park	Pavement Management System Inc.	5.5	80
Bell	Nichols Consulting Engineers	50	50
Bell Garden	Micro PAVER	70	70
Bellflower	5-Year Pavement Rehabilitation	65	74
Beverly Hills	Hansen's PMS	6.5	58

Notes:

1. Values entered in this column, "Provided PCI Threshold," are taken from the 2004 Metro PCI survey data. Jurisdictions noted as "NS" indicates that the jurisdiction did not specify a threshold value for 3R work. In the case where jurisdictions provided ranges or levels for 3R work threshold, the midpoint of the range or the value best representing the level was entered as the Provided PCI Threshold.

2. PCI Threshold Normalized to Countywide PCI (CPCI). In some cases, CPCI thresholds may be different even if provided thresholds are the same, as CPCIs could be surrogate values or correlated using different correlation curves.

Figure 4: Example Screen showing Drop-Down Input menu

	A	B	C	D
1 2	Jurisdiction	Pavement Management Software (Local System)	Provided PCI Threshold[1]	Threshold Correlated to CPCI[2]
3	Agoura Hills	Willdan PMS (0-1 scale)	NS	70
4	Alhambra	In House	81	58
5	Arcadia	Micro PAVER	60	60
6	Artesia	Micro PAVER	NS	74
7	Avalon	Micro PAVER 5.1	NS	62
8	Azusa	Micro PAVER 5.2 / MTC PMS	20	65
9	Baldwin Park	MTC PMS 7.5	5.5	80
10	Bell	MTC StreetSaver Version 8	50	50
11	Bell Garden	Nichols Consulting Engineers	70	70
12	Bellflower	No PMS System	65	74
13	Beverly Hills	Hansen's PMS	6.5	58
14	Bradbury	No PMS System	NS	65
15	Burbank	CarteGraph	55	55
16	Calabasas	Willdan PMS (0-1 scale)	0.03	70
17	Carson	Check PMS Plus	2	63
18	Cerritos	Infrastructure Management Services	85	78

7.0 Develop Normalized Cost Estimates from 2002 Needs Assessment Study

To normalize the 2002 3R work backlog cost, the Correlation Tool was applied to the cost data from the 2002 Needs Study. The normalized 2002 backlog cost is calculated using the percent difference from the jurisdiction's CPCI to the average CPCI multiplied by the jurisdiction's 2002 backlog (or surplus) cost. Other thresholds, such as the most commonly used threshold value of 70, may also be applied to calculate a normalized backlog.

Table 3 illustrates the expanded Correlation tool that calculates the normalized backlog using the correlated PCI. The entire spreadsheet is included in Appendix B. In the example, the countywide average was used to calculate the backlog.

If all jurisdictions used 61 as the PCI threshold (the average of all CPCI thresholds countywide), then the overall backlog cost for 3R work for the county, as reported in 2002, would increase by $40.1 million to a total of $815.2 million. If the most common correlated threshold (70) were used, the 2002 cost of the backlog increases to $935.8 million, an increase of $160.7 million.

Lane miles impacted were included in the spreadsheet for future use in calculating the backlog using unit costs.

Table 3: Example Spreadsheet calculation of Normalized backlog

Jurisdiction	PMS System	Provided PCI Threshold	Correlated Threshold for 3R Work	Lane Miles[1]	% Difference to Selected or Average CPCI	Lane Mile Difference	Unfunded (+) Surplus (-) 2002 Backlog[2]	"Normalized" 2002 Backlog
Agoura Hills	Willdan PMS (0-1 scale)	NS	70	134	-13%	-17.3	$1,672,100	$1,456,594
Alhambra	In House	81	58	330	5%	16.9	$562,500	$591,383
Arcadia	Micro PAVER	60	60	500	2%	8.2	$0 [3]	$0
Artesia	No PMS System	NS	74	62	-18%	-10.9	$2,940,000	$2,422,645
Avalon	No PMS System	NS	62	12	-2%	-0.2	$165,842	$163,109
Azusa	In House	20	65	192	-6%	-11.9	$300,000	$281,438
Baldwin Park	Pavement Management System Inc.	5.5	80	229	-24%	-54.4	$3,162,045	$2,410,196
Bell	Nichols Consulting Engineers	50	50	86	22%	19.0	$1,194,059	$1,456,230
Bell Garden	Micro PAVER	70	70	101	-13%	-13.0	$1,986,440	$1,730,420
Bellflower	5-Year Pavement Rehabilitation	65	74	246	-18%	-43.3	$530,000	$436,735

Notes:

1. Lane miles given for major and secondary arterials only. One lane mile is 5,280 feet long by 12 feet wide.

2. Backlog data provided by jurisdictions in 2002 Survey. Normalized PCI thresholds may vary from the provided PCI threshold – in some cases over 10 points. Variations in PMS results are caused by many factors relative to the individual system correlated (either through correlation curves or surrogate cites. Refer to the project report and technical memoranda for additional discussion).

3. Some jurisdictions ether reported a surplus or no backlog in the 2002 survey. The normalized backlog is assumed to be 0 to reflect a reported zero value.

8.0 Summary

The following summarizes the results of the study and recommendations for future use of the Correlation Tool:

It is possible to develop normalized 3R backlog costs using each jurisdiction's reported backlog data knowing the specific PMS in use in each jurisdiction. The normalization is accomplished by correlating the PCI thresholds of the various PMSs in use in the county.

- Figure 5 illustrates the relationship of the normalized PCI threshold and the countywide backlog cost. The figure shows that as the PCI threshold increases, the backlog increases, which is the expected result. Restated, the higher the standard of pavement quality the higher the level of 3R funding neededto maintain the standard. For the 2002 Needs Assessment, a normalized PCI threshold of 61 results in an increase in the 2002 cost of the backlog by $40.1 million, a total backlog need of $815.2 million. Using the most common PCI threshold value of 70, the total 2002 backlog is $935.8 million, an increase of $160.7 over the 2002 Backlog cost.

Figure 5: PCI Threshold vs. Backlog Costs
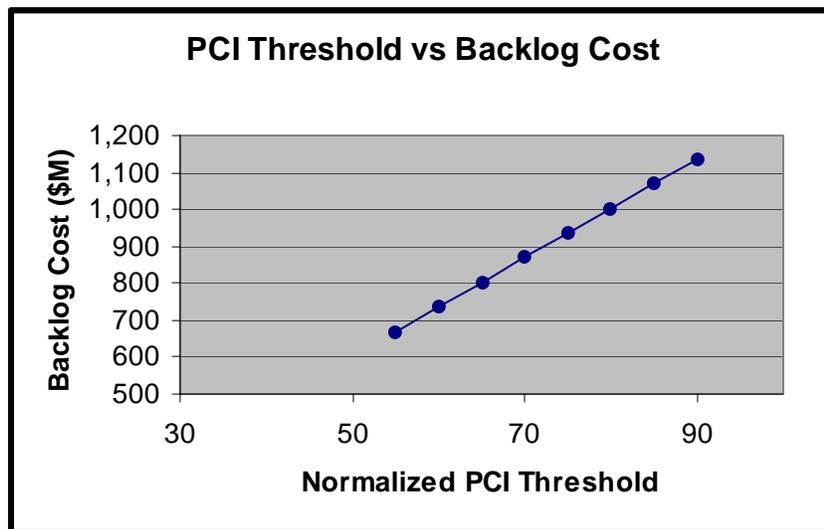
- The Correlation Tool developed for the project can be used for future backlog normalization and analysis. The basic data needed for future normalization and analysis may be updated backlog needs by jurisdiction. Cost escalation factors are not included, but may be applied separately. (*No cost escalation factors have been included in the Tool*).

- The Correlation tool provides Metro with a technique to normalize Arterial Street 3R Backlog costs for all jurisdictions that have public streets in Los Angeles County. During the development of this tool, several other conclusions were reached concerning future updates:

➢ For the Correlation tool to be most effective, elements should be kept current. Each jurisdiction typically updates its PMS inventory on a three year cycle for arterials, according to GASB 34 and FHWA recommendations. Thus, the Correlation tool should be updated accordingly to reflect changes in PMSs in use and threshold PCIs. Updates should include changes in the estimated backlog costs.

➢ Metro needs to be able to collect data from each jurisdiction in the county. A routinely updated data base of each jurisdiction's contact person who has data on the PMS, threshold PCI and current actual average PCI for the jurisdiction and backlog costs should be maintained. With all this information, Metro should be able to retrieve the critical data regarding 3R backlog and PMS identification information quickly.

- Metro will need to establish a correlation approach for any new PMSs that are developed and used in the county.

- Although this project did not use lane mile data for the final analysis, it appears that the use of lane mile data with unit costs may provide an additional degree of refinement to projecting normalized backlogs. The survey data would need to include the number of lane miles requiring backlog work.

- Field sampling of each jurisdiction's condition inventory data would add a significant degree of accuracy to the normalization process.

APPENDICIES

Appendix A
Survey Form
Technical Memoranda

Appendix B
Example Correlation Tool

Appendix A

Survey Form
Technical Memoranda

Survey Form

COUNTYWIDE PCI PROJECT
Pavement Management System Use
(Survey Form)

DATE: _____

CITY or JURISDICTION NAME: _____

CONTACT PERSON: _____

TITLE: _____

ADDRESS: _____

_____

TELEPHONE: _____

FAX: _____

EMAIL: _____

****

1. Is a Pavement Management System (PMS) and Pavement Condition Index (PCI) used to determine 3R needs for arterial streets? (Y or N) _____

   If "yes" to above

   a. Name of PMS _____

   b. What is the range of PCI values used in your PMS? (Also indicate if high value is best condition or not): _____

   c. What PCI value (threshold[1]) indicates 3R needs? _____

   d. Was this PCI threshold value used in the 2002 MTA Needs Assessment Study? _____

   e. Has the PMS changed since the 2002 Needs Assessment? _____

If yes to "e," above please provide information on both PMS systems. Include Names of PMS systems, range of PCI values, and threshold values. (space provided in Q #3)

---

[1] The pavement condition index value at which your jurisdiction determines that the street segment needs to be rehabilitated by asphalt treatment such as overlay, grind and overlay, etc.

     f.   What field rating method for rating pavement condition was used?

Visual survey with structural defect evaluation _____

Automated survey _____

Other _____

If "no PMS":

How are 3R needs established?

Supervisory judgment and knowledge _____

Windshield survey _____

Complaint based _____

Other method (please describe) _____

2. What year were arterial streets last rated using field methods to determine physical condition?

_____

3. Please provide any other information to describe your program for assessing 3R needs (for example any changes in the program or other methods you use to assess 3R needs):

_____

_____

_____

_____

_____

_____

Please email your response to Randy Lamm at **lammr@metro.net** . If you have any questions please call Randy Lamm at (213) 922-2470.

Technical Memoranda

This section of Appendix A reproduces the Technical Memoranda documenting each of the project tasks. As the project progressed, some changes were made in calculation methods and cities used to calculate surrogate ratings. The following summarizes changes in the final report from the technical memoranda, or technical memoranda herein from the original revision.

TM 4.3, Analysis of Rating Systems: Figure 1 updated for clarity and to reproduce in black and white format

TM 4.4, Document Threshold Ratings: Table 1, Summary of Results: Changing Threshold Levels Countywide was revised to account for method of calculating average threshold (cities with surrogate ratings not included in average) and changes in cities used for determining surrogates.

TM 4.5, Development of Standard PCI: Countywide average changed from 60 to 61. For one city that did not provide a threshold, the most common threshold was used rather than the average.

TM 4.6, Develop Normalized Cost Estimates from 2002 Needs Assessment Study: The Technical Memorandum was revised to correct a spreadsheet error.

Development of Los Angeles Countywide Pavement Condition Index
Task Order PS-4310-1268-01-5-1

TECHNICAL MEMORANDUM 1

TASK 4.3 ANALYSIS OF RATING SYSTMS
November 23, 2004

<u>Introduction</u>

The Parson Brinkerhoff Consultant Team (Team) is developing an approach to correlate the pavement management indices used by local government jurisdictions throughout Los Angeles County. The purpose of this correlation is to provide a standardized measure, which can be used to compare pavement repair needs for arterial streets throughout the county, and provide uniform pavement ratings to be used to advocate for additional funding for pavement preservation.

The steps that the PB Team used to develop this correlation are:

Step 1 Determine the Pavement Management Systems (PMS) in use in each of the local jurisdictions (88) with public roads in Los Angeles County during the 2002 Needs Study as well as the PMSs currently in use.

Step 2 Determine the Pavement Condition Indices' (PCI) components (for example, cracking, raveling and rutting) and the range of values for specific pavement defects which compose the PCI for each PMS in use in the County.

Step 3 Compare the PCIs between PMSs and correlate to a common PCI.

Step 4 For jurisdictions with non correlatable PMSs develop a surrogate PCI based on the PCI of similar jurisdictions.

<u>Step 1 – Determine Pavement Management Systems in Use</u>

All jurisdictions were surveyed for information regarding their current PMS. The questionnaire was reviewed by the Steering Committee and submitted as part of Task 4.2, Inventory of Pavement Management Systems. Individual telephone contacts were made by MTA staff to assure responses to the questionnaire. All jurisdictions with public roads in Los Angeles County provided input to the questionnaire. In cases where clarification to the data was necessary, consultant team members contacted cities for more information. Table 1 presents a list of all the PMSs in use in Los Angeles County. A map of Los Angeles County showing all PMSs by jurisdiction is shown in Figure 1. There are a total of 31 PMSs in use by 74 jurisdictions county wide, 14 cities have no PMS in place, and one city has all private roads and therefore is not part of this study.

Step 2 – Determine PCI Components

The Team examined the 31 PMSs in use in Los Angeles County to determine:

- If the PMS established a PCI for each pavement section (pavement segments or lengths as defined by the PMS)
- The components of the PCI;
- If there were common characteristics of the PCI components.

The Team contacted all PMS providers whose systems are being used in Los Angeles County to assist in determining the above three considerations. The Team also contacted a sampling of specific jurisdictions that are using the various PMSs to confirm the information from the PMS providers.

TABLE 1
PMS Systems in Use in LA County

PMS System	Number of Cities
5-Year Pavement Rehabilitation Program	1
Berryman and Henigar	1
CarteGraph	2
Charles Abbot Assoc	2
CHEC PMS Plus	1
Cititech Systems	1
Engineer's Judgment	1
Hansen's PMS	1
IMS	2
In House	7
Infra Manager by CHEC	3
LACDPW	2
Micro PAVER	20
MTC	13
Nichols Consulting Engineers	1
Pavement Condition Inventory	2
Pavement Management System Inc.	2
Pavementview Plus	2
Stantec	3
SuperPMS (ITX Stanley)	1
Willdan PMS	6
Total Jurisdictions with PMS Systems	**74**
Total Number of PMS Systems Types in Use	**31**
Total Jurisdictions – No PMS System	**14**
Number with all Private Roads	**1**
Total	**89**

Figure 1
Pavement Management Sysyems (PMSs)
In Use - Los Angeles County (2002)

Legend

Symbol	Description
	5-Year Pavement Rehabilitation Program
	Berryman and Henigar
	CHEC PMS Plus
	CarteGraph
	Charles Abbot Assoc
	Cititech Systems
	Engineer's Judgement
	Hansen's PMS
	IMS
	In House
	Infra Manager by CHEC
	LACDPW
	MTC
	Micro PAVER
	Nichols Consulting Engineers
	No PMS System
	Pavement Condition Inventory
	Pavement Management System Inc.
	Pavementview Plus
	Stantec
	SuperPMS (ITX Stanley)
	Willdan PMS

0   3   6   12
Miles

Metro PCI Team
November 2004

Source: Parsons Brinckerhoff
Created in ArcGIS 8 using ArcMap

Note: Avalon - No PMS

Step 3 – Compare PCI's for Correlation

In general, the most common denominator(s) between the various PMSs in place in Los Angeles County is the use of a family of curves developed by the US Army Corps of Engineers (CORPS) for predicting the PCI relative to the age of the particular asphalt pavement being rated. The CORPS determined that future placement conditions could be related to current pavement conditions and the elapsed time from construction. The CORPS curves have been tested in many locations and found to be valid, and a number of PMSs have been developed using the CORPS curves. For PMSs that are developed based on the CORPS curves, the PCIs are compatible. The following PMSs were developed based on the CORPS curves and the PCIs are proposed to be compatible between cities using these PMSs.

- All Versions of MicroPaver
- All Versions of MTC
- Cartegarph
- Infamanager
- CHEC

For translatable PMSs that are not correlated to the CORPS curves, a correlation of PCIs can be developed by comparison of specific data points. Figure 2 shows a computation both the CORPS PCI and the non CORPS PCI. A line of best fit is calculated which allows a direct translation on any PCI in the non CORPS PMS to an adjusted PCI in the CORPS PMS. Figure 2 shows that a non CORPS PCI of 70 would be correlated to a 35 in the CORPS based PCI rating. For each non correlateable PMS, a separate translation curve is developed.

An example calculation for one of the eleven data points is shown below. The data point can be seen in Figure 2 at a level of 93 on the non Corps scale and 83 on the Corps based scale (the point is circled on Figure 2). The computation of both the non Corps PCI and Corps based PCI is shown below. Table 2 displays deduct values for the various pavement conditions.

TABLE 2
Example Deduct Values

PAVER DEFECT	DESCRIPTION OF DEFECT/CONDITION	PAVER/MTC	Non Corps
Transverse/Longitudinal Cracking	None		
Alligator Cracking	None		
Ravelling	Low Severity and 60% Density	13	5
Patching	Low Severity and 2% Density	4	2
Rutting	None		
Total Deduct Value		17	7
Corrected Value (for PAVER/MTC only)		17	
PCI (100 – Deduct Value)		83	93

Figure 2. Non Corps vs. Army Corps Deduct Curves
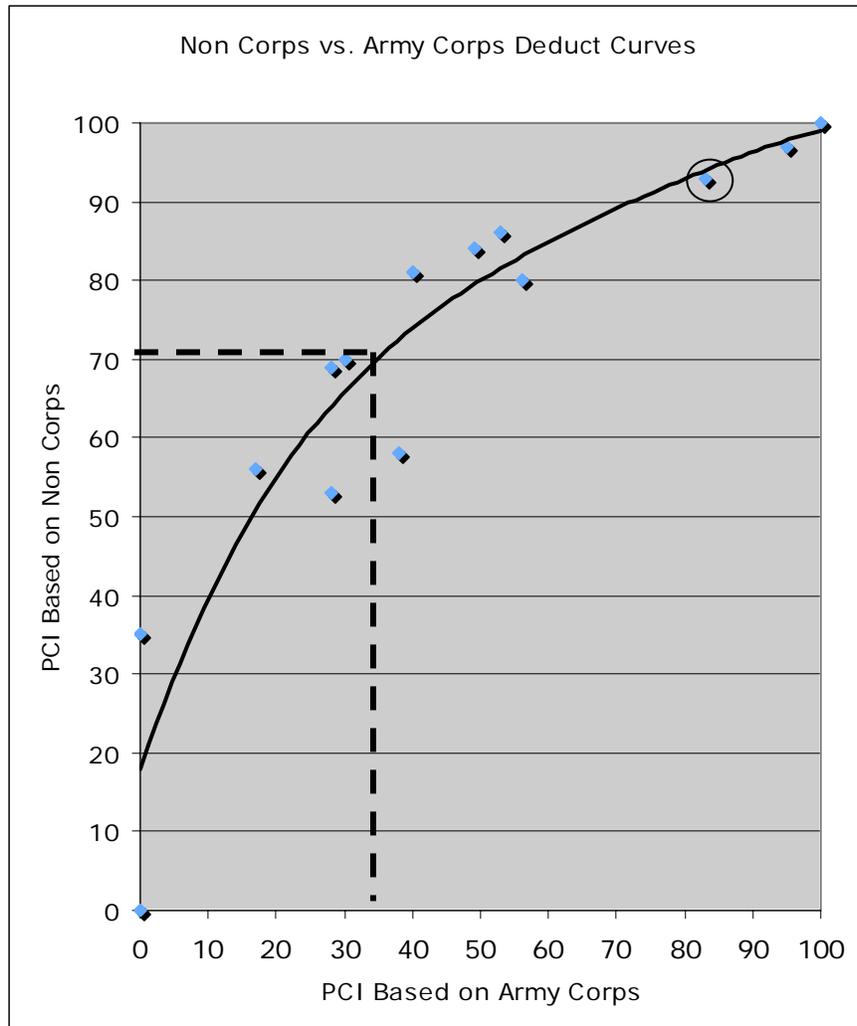
The following PMSs can be correlated using data points as illustrated in Figure 2.

- ITX Stanely
- Charles Abbott
- IMS using only surface condition parameters
- Stantec's Surface Distress Index factored by 10
- Cititech
- Barryman and Henigar factored by .5

Step 4 – Develop an Average PCI Based on Similar Jurisdictions

The PB Team is proposing to use the following approach to develop a surrogate PCI for each jurisdiction that does not have a PCI that produces translatable pavement condition rating data.

A. Identify the following characteristics for each jurisdiction that does not have translatable pavement rating data.
- i) General topographic condition (flat, hilly)
- ii) General soil condition (alluvial plain, coastal, non-erodible)
- iii) General traffic volumes (low, medium, high)
- iv) General truck volumes (low, medium, high)

B. Identify and select a minimum of 2 translatable jurisdictions that have the four similar characteristics.

C. Determine PCI ranges for similar jurisdictions (percentage of street mileage by PCI range (i.e. 10 percent have PCI of 90-100, 40 percent 80-89, etc.)

D. Using A-C above derive surrogate PCIs for each of the non translatable jurisdictions.

This will require a series of computations for jurisdictions having non translatable pavement rating. A list of the jurisdictions and status as to translatability of PMS is presented in Table 3: Figure 3 shows translatable systems graphically.

Figure 3. Areas with Correlatable PMSs in LA Co.

Ventura

Los Angeles

San Bernardino

Riverside

Orange

Los Angeles

Pavement Condition Index
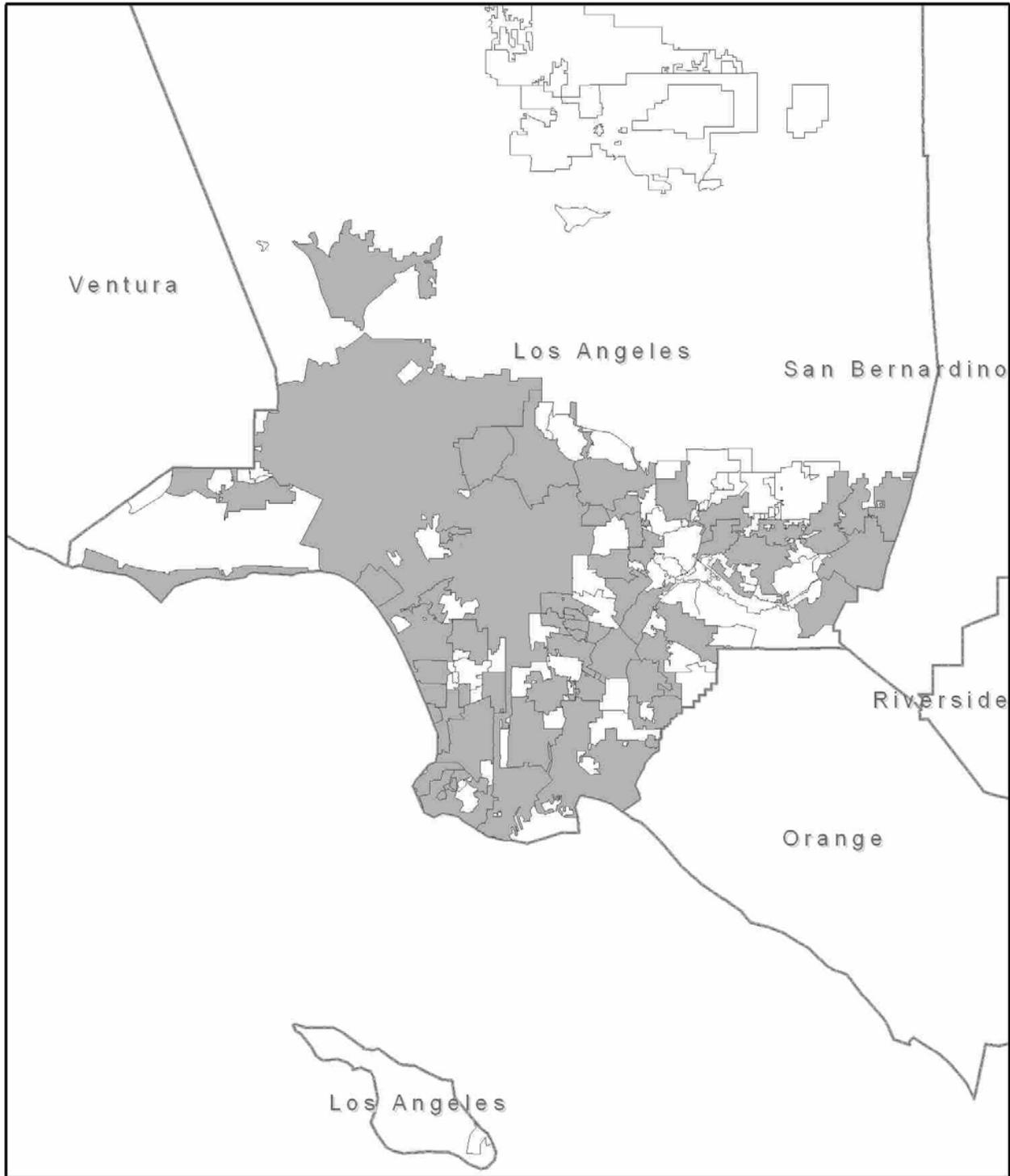
Legend

Jurisdictions in LA Co.

Correlatable

Not Correlatable

0   2.5   5   10   15
Miles

MTA PCI Team
November 2004

Source: Parsons Brinckerhoff
Created in ArcGIS 8 using ArcMap

N
W   E
S

Table 3
Jurisdictions by PMS Correlation Status

PMS Systems - Not Correlatable

5-Year Pavement Rehabilitation Program
        Bellflower
        Total: *1*

Cititech Systems
        Palmdale
        Total: *1*

Engineer's Judgment
        La Canada Flintridge
        Total: *1*

Hansen's PMS
        Beverly Hills
        Total: *1*

In House
        Lakewood
        San Fernando
        Alhambra
        Hawthorne
        Lynwood
        Sierra Madre
        Azusa
        Lancaster
        Total: *8*

LACDPW
        Temple City
        County of Los Angeles
        La Mirada
        Total: *3*

No PMS System
        Bradbury
        Avalon
        Walnut
        Artesia
        Commerce
        Hidden Hills
        Glendora
        Signal Hill
        South El Monte
        Lomita
        Westlake Village
        La Habra Heights
        Duarte
        Industry
        Total: *14*

Pavement Condition Inventory
        El Monte
        Monrovia
        Total: *2*
Total: **31**

Table 3 (continued)
PMS Systems - Correlatable

Berryman and Henigar

Monterey Park

Total: *1*

CarteGraph

Burbank
La Verne

Total: *2*

Charles Abbot Assoc

Norwalk
Whittier

Total: *2*

CHEC PMS Plus

Carson

Total: *1*

IMS

Cerritos
Downey

Total: *2*

Infra Manager by CHEC

Culver City
Covina
Pomona

Total: *3*

Micro PAVER

Paramount
Arcadia
Santa Monica
South Pasadena
South Gate
Santa Fe Springs
Bell Gardens
Rancho Palos Verdes
Compton
Palos Verdes Estates
Diamond Bar
Pasadena
Rosemead
Montebello
Claremont
El Segundo
Los Angeles
Long Beach
La Puente
Hermosa Beach

Total: *20*

MTC

Gardena
West Hollywood
West Covina
San Gabriel
Vernon
Malibu
Santa Clarita
San Marino
Irwindale
San Dimas
Torrance
Lawndale

Total: *12*

Nichols Consulting Engineers

Bell

Total: *1*

Pavement Management System Inc.

Inglewood
Baldwin Park

Total: *2*

Pavementview Plus

Huntington Park
Pico Rivera

Total: *2*

Stantec

Manhattan Beach
Redondo Beach

Total: *2*

SuperPMS (ITX Stanley)

Glendale

Total: *1*

Willdan PMS

Calabasas
Hawaiian Gardens
Rolling Hills Estates
Agoura Hills
Cudahy
Maywood

Total: *6*

Total: **57**

Total Responses: **88**

TECHNICAL MEMORANDUM

Development of Los Angeles Countywide Pavement Condition Index
Task Order PS-4310-1268-01-5-1

TECHNICAL MEMORANDUM 2

TASK 4.4 DOCUMENT THRESHOLD RATINGS

February 11, 2005

<u>**Introduction/Background**</u>

The Parsons Brinckerhoff Consultant Team (Team) has prepared this second Technical Memorandum (TM) for the MTA's Countywide Pavement Condition Index (PCI) Project. This memorandum presents PCI threshold ratings and "normalized" threshold rating for Los Angeles County jurisdictions. The Threshold PCI value is the numerical value (on a one to one hundred scale) that each agency determines is representative of pavement condition that has deteriorated to the point requiring rehabilitation work (3R). The normalized threshold represents the threshold rating correlated to a common or countywide scale. In the previous task, Task 4.3 (Analysis of Rating Systems and Pavement Condition Indices), the Team developed an approach to correlate the various pavement management indices used by the county jurisdictions to a uniform rating method. That correlation involved a 4-step approach that was defined in the first Technical Memorandum.

After normalization of the threshold rating for all jurisdictions within the county, the impact of creating a single PCI threshold was assessed by comparing each jurisdiction's normalized threshold to the countywide average normalized threshold. In addition, the impact on lane miles affected by varying the countywide threshold was evaluated. Subsequent sections of this memo describe the methods used and results of the task.

It should be noted that the threshold PCI value is not necessarily an absolute measure. Most jurisdictions temper the threshold PCI value with engineering judgment, their economic situation and public funding policy factors. A standard correlated PCI was calculated for each jurisdiction. Theoretically, by having a standard correlated PCI, the 3R needs for all jurisdictions could be normalized and the uniform funding needs could be identified using the MTA Needs Assessment. The countywide 3R needs represents a uniform level of pavement funding needs for each jurisdiction based on the 2002 MTA Needs Assessment.

Many of the systems that are in use in the county can be correlated using simple translations. These translations have been accomplished using the graphs that were developed in Task 4.3. However, there are several jurisdictions that either did not have a pavement management system or have a system that cannot be correlated. In some instances, there were no PCI values or no threshold PCI values stated by the jurisdiction. In other instances, jurisdictions have a threshold PCI that does not relate to the others and cannot be normalized.

For the jurisdictions with no reported pavement management systems or with non-correlatable systems, a normalization approach was developed in order to include them into the countywide database. The normalization approach, developed in Task 4.3, formulates a "surrogate" PCI threshold for each of these jurisdictions. The surrogate PCI threshold was developed by identifying at least two other correlatable jurisdictions which have common and shared relevant characteristics with the jurisdiction that does not have a correlatable PMS. The Team believes that if two jurisdictions share the following relative characteristics, then the PCI's for each of the jurisdictions would be similar:

- General soil types;
- Topographic characteristics;
- Traffic volumes; and
- Truck volumes.

The Team used the numerical average of the two correlatable PCI's thresholds to represent the surrogate PCI threshold for the non-correlatable jurisdiction.

Steps to Accomplish Task

The steps used to normalize the PCI threshold values and determine impacts to countywide pavement needs are summarized as follows.

Step 1 - Document existing threshold ratings for each local jurisdiction (done as a part of the original inventory Task 4.2).

Step 2 - Develop correlated Threshold PCI's using the methods developed in Task 4.3 and develop surrogate Threshold PCI's where necessary.

Step 3 - Calculate the average Threshold PCI for the entire county.

Step 4 - Calculate the percent change between each agency's Threshold PCI and the countywide average of 63, as well as percent changes if the countywide average was changed to 55, 70, and 80.

Step 5 - Compute the percent change in lane miles of work and develop a method to determine cost impacts for 3R work in each jurisdiction if the normalized Threshold PCI was changed to 63, 55, 70, and 80.

Further details regarding each of the steps listed above are described below.

Step 1 – Document Threshold Ratings

Threshold Ratings for each jurisdiction were taken from survey results obtained earlier in the study (Task 4.2, Inventory of Pavement Management Systems). If a jurisdiction changed its Pavement Management System from that reported in 2002, then the ratings from the 2002 System Preservation Survey were used. Where systems were indicated in

the survey to have changed since 2002, additional correlations will be provided in the final project report.

Step 2 – Develop Correlated and Surrogate Threshold PCI Values

Using the threshold ratings from the survey (Task 4.2), the Team developed PCI threshold values correlated to a normalized system. PCI threshold values were developed using the approach for each individual jurisdiction detailed in the Technical Memorandum for Task 4.3. Threshold PCI values were developed for each correlatable jurisdiction. Surrogate Threshold PCI's were developed for jurisdictions with non-correlatable systems and for jurisdictions with no reported pavement management systems. Appendix A shows the cities for which surrogates were developed and the similar cities used to develop surrogate PCI threshold values. Note that as work on this project has progressed, the jurisdictions requiring a surrogate Threshold PCI have been refined. The list of cities in Appendix A do not exactly correspond to the list of cites with no PCI or non-correlatable PCIs as reported in Technical Memorandum for Task 4.3. Further analysis removed some jurisdictions from the list and added other jurisdictions to the list. In Task 4.3, for example, 31 jurisdictions were listed as non-correlatable. Appendix A in this memo lists 37 jurisdictions which are either non-correlatable or did not report a threshold.

Step 3 – Calculate Average Countywide Threshold PCI and Normalize Jurisdictions to Various Threshold Levels

The average Countywide PCI Threshold was computed as the "starting point" for comparing thresholds between jurisdictions and for indicating the need for 3R work. For Los Angeles County, the average normalized threshold was 63. The average was calculated using a simple mathematical average of existing threshold values in all jurisdictions that had established PCI Thresholds. The average was not weighted for street miles. Two jurisdictions in the county that have correlatable systems do not use a specific Threshold PCI to determine 3R needs. These two jurisdictions were eliminated from the calculation for the purpose of calculating countywide averages.

Three other Threshold PCI levels were selected for comparison with the average Countywide PCI Threshold in order to study the impacts of using the average value versus using a lower or higher Threshold PCI level. The three other threshold levels were chosen based on the range of Threshold values in use and the professional judgment of the Team. As discussed above, the first threshold level was set at the countywide average of 63 for each jurisdiction. The second threshold level was set at 55, which is considered a minimally acceptable system condition. The third threshold was set at 70, which is considered a generally accepted system condition (as well as the most common threshold throughout the county). The fourth threshold level was set at 80, which is considered an exceptional system condition.

Step 4 – Calculate Percent Change Between Jurisdiction Threshold PCI and Four Selected Thresholds

The Team computed the difference in magnitude between each jurisdiction's Threshold PCI and the four identified Threshold PCI levels of 63, 55, 70, and 80. All of the jurisdictions were within 40 percent of the average PCI. Forty-four jurisdictions or approximately 50 percent of the cities were within 10 percent of the average threshold. Eighteen jurisdictions or approximately 20 percent of the cities were within 5 percent of the average threshold. This shows that the variation in threshold values is significant. The variation can likely be attributed to:

- Use of various PMSs
- Variation in funding for pavement
- Variations In the existing pavement conditions

Step 5 – Compute Differences in Lane Miles for Adjusted PCI Thresholds

The Team computed the differences in lane miles impacted by adjusting the PCI threshold values. Lane miles impacted were calculated using the percent change in PCI times the total number of lane miles. Table 1 summarizes the results of varying the threshold ratings in terms of lane miles impacted.

The first column of the table is the selected Threshold PCI level. The second column shows the average change in percent of lane miles that occurs for the county when Threshold PCIs from all jurisdictions are normalized. For example, if all jurisdictions used the county average Threshold PCI of 63, then, on average, all jurisdictions would experience a 5 percent increase in lane miles needing 3R work. The third and fourth columns show the maximum increases and decreases in percent of lane miles needing 3R work for an individual jurisdiction. Again by way of example, if all jurisdictions used the county average Threshold PCI of 63, the jurisdiction with the largest increase in work would see a 66 percent increase in lane miles of work. Similarly, the jurisdiction with the largest decrease in work would see a 26 percent decrease in lane miles of work.

A method for determining the related Impacts on costs was developed and will be further developed in a subsequent task, Task 4.6, Developing Normalized Cost estimates from the 2002 Needs Assessment.

Summary and Implications

Modifying the Threshold PCI for a jurisdiction creates a predictable outcome. For example, it would be expected that if a lower PCI threshold were used, less 3R work would be required and conversely if a higher PCI threshold were used more 3R work would be required. This expectation is based on the fact that more lane miles of streets would be identified as the threshold PCI were raised.

Given this understanding, some might see a great cost benefit in creating a lower countywide Threshold PCI, but this would be a false conclusion. The long-term effect of lowering the PCI threshold would be to set a lower level of acceptability for condition of streets and reduce the funding for 3R. The countywide street network would have a correspondingly higher backlog of needed maintenance as well as total reconstruction costs. The longer a street is left in a deteriorating condition, the higher the costs will be when it comes to improving that street up to a specified point. The total cost of reconstructing a street would be much greater than the cost of performing 3R work. However, once a street has gotten to the point of needing reconstruction, the cost will not increase over time. When needed, the cost of reconstruction will be the same at any point of deterioration. In addition, vehicle operating costs are a function of street condition, with vehicle operating costs rising as the PCI declines. Additionally, the ramifications of lowering the acceptable condition of streets need to be considered. Taxpayers expect a certain level of performance from their streets and will insist that the level be at least maintained or increased.

Pavement management systems are tools to allow a jurisdiction to determine how its pavement conditions respond to funding policy decisions. The 2002 Needs Assessment was a "snapshot" at a point in time. PMSs must be used over several evaluation and funding cycles to allow managers to have a clear picture of the impact of funding policies.

**Table 1: SUMMARY OF RESULTS:
CHANGING THRESHOLD LEVELS COUNTYWIDE**

Threshold Test Levels	Countywide 3R Impact (Percent of Lane Miles)	Local Jurisdictional Impact (Percent of Lane Miles)	
		Largest Increase	**Largest Decrease**
Countywide Average 63	5	66	(26)
Minimally Acceptable System Condition 55	(9)	45	(35)
Generally Accepted System Condition 70	17	84	(18)
Exceptional System Condition 80	33	111	(6)

Notes:

Lowest Threshold	38
Highest Threshold	85
Average Threshold	63
Most Common Threshold	70

APPENDIX A

CITY	CITIES WITH SIMILAR CONDITIONS				Two Cities for Comparison	3R Threshold of "Surrogate" Cities (Already Correlated)
	Soil Type	**+ Topographic Condition**	**+Traffic Volumes**	**+Truck Volumes**		
Agoura Hills	South Pasadena, Alhambra, Palmdale, Palos Verdes Estates	South Pasadena, Alhambra, Palmdale, Palos Verdes Estates	South Pasadena, Palmdale	South Pasadena, Palmdale	South Pasadena Palmdale	70 70
Alhambra	Whittier, South Pasadena	Whittier, South Pasadena	Whittier, South Pasadena	Whittier, South Pasadena	Whittier South Pasadena	42 70
Artesia	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Cerritos, Downey, Paramount, South Gate	Cerritos, Downey, Paramount, South Gate	Cerritos, Downey, Paramount, South Gate	Cerritos Downey	80 70
Avalon	USE SYSTEM-WIDE AVERAGE					
Azusa	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas La Verne	75 55
Baldwin Park	Covina, San Dimas, La Verne	Covina, San Dimas, La Verne	Covina, San Dimas, La Verne	Covina, San Dimas, La Verne	Covina San Dimas	85 75
Bellflower	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Paramount, South Gate	Bell, Bell Gardens, Cerritos, Downey, Paramount, South Gate	Bell, Bell Gardens, Cerritos, Downey, Paramount, South Gate	Cerritos Downey	80 70
Beverly Hills	Arcadia, Burbank, Glendale, Pasadena	Arcadia, Burbank, Pasadena	Burbank, Pasadena	Burbank, Pasadena	Burbank Pasadena	55 40
Bradbury	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas La Verne	75 55
Calabasas	South Pasadena, Alhambra, Palmdale, Palos Verdes Estates	South Pasadena, Alhambra, Palmdale, Palos Verdes Estates	South Pasadena	South Pasadena	South Pasadena Palmdale	70 70
Carson	Compton, Gardena, Hawthorne, Long Beach	Compton, Gardena, Hawthorne	Gardena, Hawthorne	Gardena, Hawthorne	Gardena Hawthorne	55 70

CITY	CITIES WITH SIMILAR CONDITIONS				Two Cities for Comparison	3R Threshold of "Surrogate" Cities (Already Correlated)
	Soil Type	+ Topographic Condition	+Traffic Volumes	+Truck Volumes		
Commerce	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk Santa Fe Springs	38 70
County of Los Angeles	Diamond Bar, Palmdale, Torrance	Diamond Bar, Palmdale, Torrance	Diamond Bar, Palmdale, Torrance	Diamond Bar, Palmdale, Torrance	Diamond Bar Palmdale	70 70
Cudahy	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Cerritos Downey	80 70
Duarte	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont San Dimas	65 75
El Monte	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera Santa Fe Springs	40 70
Glendora	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont San Dimas	65 75
Hawaiian Gardens	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Cerritos, Paramount	Cerritos, Paramount	Cerritos, Paramount	Cerritos Paramount	80 70
Industry	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera Santa Fe Springs	40 70
Inglewood	Compton, Gardena, Hawthorne, Long Beach	Compton, Gardena, Hawthorne	Compton, Gardena, Hawthorne	Compton, Gardena	Compton Gardena	70 55
La Canada-Flintridge	Arcadia, Glendale, Pasadena, West Hollywood	Arcadia, Pasadena, West Hollywood	Pasadena, West Hollywood	Pasadena, West Hollywood	Pasadena West Hollywood	40 50
La Habra Heights	Whittier, South Pasadena	Whittier, South Pasadena	Whittier, South Pasadena	Whittier, South Pasadena	Whittier South Pasadena	42 70

CITY	CITIES WITH SIMILAR CONDITIONS				Two Cities for Comparison	3R Threshold of "Surrogate" Cities (Already Correlated)
	Soil Type	+ Topographic Condition	+Traffic Volumes	+Truck Volumes		
La Mirada	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk Santa Fe Springs	25 70
Lakewood	Compton, Gardena, Hawthorne, Long Beach	Compton, Gardena, Hawthorne	Gardena, Hawthorne	Gardena, Hawthorne	Gardena Hawthorne	55 70
Lancaster	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Palmdale, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Palmdale, South Gate	Palmdale, Bell	Palmdale, Bell	Palmdale Bell	70 50
Lomita	El Segundo, Torrance	El Segundo, Torrance	El Segundo, Torrance	El Segundo, Torrance	El Segundo Torrance	65 Not Given
Lynwood	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Cerritos Downey	80 70
Maywood	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Cerritos Downey	80 70
Monrovia	Arcadia, Burbank, Glendale, Pasadena	Arcadia, Burbank, Pasadena	Arcadia, Burbank	Arcadia, Burbank	Arcadia Burbank	60 55
Rolling Hills Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar Palos Verdes Estates	70 80
San Fernando	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Palmdale, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Palmdale, South Gate	Palmdale, Huntington Park	Palmdale, Huntington Park	Palmdale Huntington Park	70 50
Sierra Madre	Arcadia, Glendale, Pasadena, West Hollywood	Arcadia, Burbank, Pasadena	Burbank, Pasadena	Burbank, Pasadena	Burbank Pasadena	55 40

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CITY	CITIES WITH SIMILAR CONDITIONS				Two Cities for Comparison	3R Threshold of "Surrogate" Cities (Already Correlated)
	Soil Type	+ Topographic Condition	+Traffic Volumes	+Truck Volumes		
Signal Hill	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar Palos Verdes Est	70 80
South El Monte	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, Paramount, South Gate, Vernon	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Bell, Bell Gardens, Cerritos, Downey, Huntington Park, South Gate	Cerritos Downey	80 70
Temple City	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel	Norwalk, Pico Rivera, San Gabriel	Norwalk, Pico Rivera, San Gabriel	Pico Rivera San Gabriel	40 42
Walnut	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont San Dimas	65 75
Westlake Village	South Pasadena, Alhambra, Palmdale, Palos Verdes Estates	South Pasadena, Alhambra, Palmdale, Palos Verdes Estates	South Pasadena, Palmdale	South Pasadena, Palmdale	South Pasadena Palmdale	70 70

Development of Los Angeles Countywide Pavement Condition Index
Task Order PS-4310-1268-01-5-1

TECHNICAL MEMORANDUM 3

TASK 4.5 Development of a Standard Pavement Condition Index

April 12, 2005

Introduction/Background

The Parsons Brinckerhoff Consultant Team (PB Team) has prepared this third Technical Memorandum (TM) for the MTA's Countywide Pavement Condition Index (PCI) Project to report the results of Task 4.5 Development of a Standard Pavement Condition Index. In a previous task, Task 4.3 Analysis of Rating Systems and Pavement Condition Indices, the Team developed methods to correlate disparate pavement management indices used by local county jurisdictions to a countywide, standard PCI. This standardized PCI is herein referred to as the Countywide PCI (CPCI). In this task, Task 4.5, a user-friendly spreadsheet tool was developed to apply and streamline the correlation methods developed in Task 4.3. This tool, named the MTA PCI Correlation Tool, is herein referred to as the Correlation Tool. This Memorandum presents a draft version of this tool with a summary and additional documentation of the methods used in the tool. In the next task, cost data will be applied to lane miles requiring (3R) work using the CPCI threshold.

Draft MTA PCI Correlation Tool

The MTA PCI Correlation Tool is a user-friendly spreadsheet created for the MTA's use in converting jurisdiction PCIs to the CPCI and ultimately for use in estimating a countywide PCI threshold for 3R needs and funding. For each county jurisdiction, a pavement management system is selected in the second column and a PCI value for the selected system is entered in the third column of the spreadsheet. It should be noted that users are only allowed to select from the list of available PMS systems. The entered PC threshold value is then correlated to the Countywide PCI and presented in the fourth column. Formulas developed to convert the entered PCI threshold value to the CPCI are embedded into the Correlation Tool. Table 1 below presents an example output from the MTA PCI Correlation Tool.

TABLE 1			
Example Spreadsheet – PCI Threshold Normalized to County PCI			
Jurisdiction	Pavement Management Software (Local System)	Provided PCI Threshold	Normalized[1] to CPCI
Agoura Hills	Willdan PMS	NS	70
Alhambra	In House	81	58
Arcadia	Micro PAVER	60	60
Artesia	No PMS System	NS	74
Avalon	No PMS System	NS	62
Azusa	In House	20	65
Baldwin Park	Pavement Management System Inc.	5.5	80
Bell	Nichols Consulting Engineers	50	50
Bell Gardens	Micro PAVER	70	70
Bellflower	5-Year Pavement Rehabilitation	65	74
Beverly Hills	Hansen's PMS	6.5	58
Bradbury	No PMS System	NS	65
Burbank	CarteGraph	55	55
Calabasas	Willdan PMS	0.03	70
Carson	Check PMS Plus	2	63
Cerritos	Infrastructure Management Services	85	78
Los Angeles City	Micro PAVER	60	60
Claremont	Micro PAVER	65	65
Commerce	No PMS System	NS	55
Compton	Micro PAVER	70	70
County of Los Angeles	LACDPW	3	70
Covina	Infra Manager by CHEC	85	85
Cudahy	Willdan PMS	50	74
Culver City	Infra Manager by CHEC	40	40
Diamond Bar	Micro PAVER 5.2	70	70
Downey	Infrastructure Management Services	80	71
Duarte	No PMS System	NS	70
El Monte	Pavement Condition Inventory	2	55
El Segundo	Micro PAVER 5.1	65	65
Gardena	MTC PMS	55	55
Glendale	SuperPMS (ITX Stanley)	7	70
Glendora	No PMS System	NS	70
Hawaiian Gardens	Willdan PMS	0.03	74
Hawthorne	In House	70	70
Hermosa Beach	Micro PAVER 5.1	40	40
Huntington Park	Pavementview Plus	50	50
Industry	No PMS System	NS	55
Inglewood	Pavement Management System Inc.	41	63
Irwindale	MTC PMS	60	60
La Canada-Flintridge	Engineer's judgment	NS	55

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TABLE 1 Example Spreadsheet – PCI Threshold Normalized to County PCI			
Jurisdiction	Pavement Management Software (Local System)	Provided PCI Threshold	Normalized[1] to CPCI
La Habra Heights	No PMS System	NS	58
La Mirada	L.A. County Road Dep.	4	55
La Puente	Micro PAVER 5.2	40	40
La Verne	CarteGraph	55	55
Lakewood	In House	70	63
Lancaster	In House	2.1	60
Lawndale	MTC PMS 7.5	65	65
Lomita	No PMS System	NS	53
Long Beach	Micro PAVER 5.2	55	55
Lynwood	In House	3	74
Malibu	MTC PMS	50	50
Manhattan Beach	PMS (Stantec)	5	50
Maywood	Willdan PMS	0.03	74
Monrovia	Pavement Condition Inventory	92	58
Montebello	Micro PAVER	55	55
Monterey Park	Berryman & Henigar	60	70
Norwalk	Charles Abbot Assoc	61	34
Palmdale	Cititech	53	71
Palos Verdes	Micro PAVER 5.1	80	80
Paramount	Micro PAVER	70	70
Pasadena	In House	26	37
Pico Rivera	Pavementview Plus	40	40
Pomona	Infra Manager by CHEC	80	80
Rancho Palos Verdes	Micro PAVER	60	60
Redondo Beach	Stantec Super PMS	7	70
Rolling Hills Estates	Willdan PMS	0.03	75
Rosemead	Micro PAVER	70	70
San Dimas	MTC StreetSaver Version 8	75	75
San Fernando	In House	65	60
San Gabriel	MTC PMS	42	42
San Marino	MTC PMS 7.5	70	70
Santa Clarita	MTC PMS	60	60
Santa Fe Springs	Micro PAVER	70	70
Santa Monica	Micro PAVER	70	70
Sierra Madre	In House	82	58
Signal Hill	No PMS System	NS	75
South El Monte	No PMS System	NS	74
South Gate	Micro PAVER 5.2	70	70
South Pasadena	Micro PAVER	70	70
Temple City	L.A. County Road Dep.	NS	55
Torrance	MTC PMS	40	40

TABLE 1 Example Spreadsheet – PCI Threshold Normalized to County PCI			
Jurisdiction	**Pavement Management Software (Local System)**	**Provided PCI Threshold**	**Normalized[1] to CPCI**
Vernon	MTC PMS	65	65
Walnut	No PMS System	NS	70
West Covina	MTC StreetSaver Version 8	70	70
West Hollywood	MTC PMS 7.5	50	50
Westlake Village	No PMS System	NS	70
Whittier	Charles Abbot Assoc	70	45
1 – PCI Threshold Normalized to Countywide PCI (CPCI) 2 – For cities with no PMS, a surrogate value was determined using the PCI threshold value from other similar cities 3 – NS means Not Specified. The jurisdiction did not specify a PCI threshold.			

For documentation purposes, the following summarizes the processes used to develop the CPCI, also described in previous memoranda.

All county jurisdictions were surveyed to determine Pavement Management Systems in use, and threshold values used to establish reconstruction and rehabilitation work. Thirty-one systems (including variations of software versions) were found to be in use. For each reported system, the team contacted the PMS provider or, for each jurisdiction having an "in-house" system, the team contacted the jurisdiction to determine the methodology behind their system and if there were common characteristics of the components. The most common methodology used by the various PMSs in place in the county was the use of a family of curves developed by the US Army Corps of Engineers (USACE), which relate future pavement conditions to current conditions and time elapsed. Systems found to be directly correlatable to the USACE curves were:

- All Versions of MicroPaver
- All Versions of MTC
- Cartegarph
- Infamanager
- CHEC

Where systems could not be correlatable directly to the USACE curves, a correlation to the PCI was developed by comparing specific data points related to pavement conditions. An example system correlation, reproduced from Technical Memorandum 1, is shown below. This example curve was developed using eleven data points. An example data point is circled on Figure 1 at a level of 93 on the non-USACE based scale and 83 on the USACE based scale. A line of best fit was calculated using 2nd order polynomial regression, allowing a direct translation of a given PCI in the non-USACE PMS to a correlatable PCI in the USACE PMS. Figure 1 shows that, in this instance, a non-USACE based PCI of 70 would be correlatable to a 35 in the USACE based PCI rating.

For each non-directly correlateable PMS, a separate translation curve was developed using data points similar to those illustrated in Figure 1. The correlation curves for the

following PMSs were calculated and presented in the spreadsheet tab labeled "Data –
Correlation Curves" in the Correlation Tool.

- ITX Stanley
- Charles Abbott & Associates
- Infrastructure Management Services (IMS) using only surface condition
  parameters
- Stantec's Surface Distress Index
- Cititech Systems
- Berryman and Henigar

FIGURE 1
Non-USACE vs. Army Corps Deduct Curves
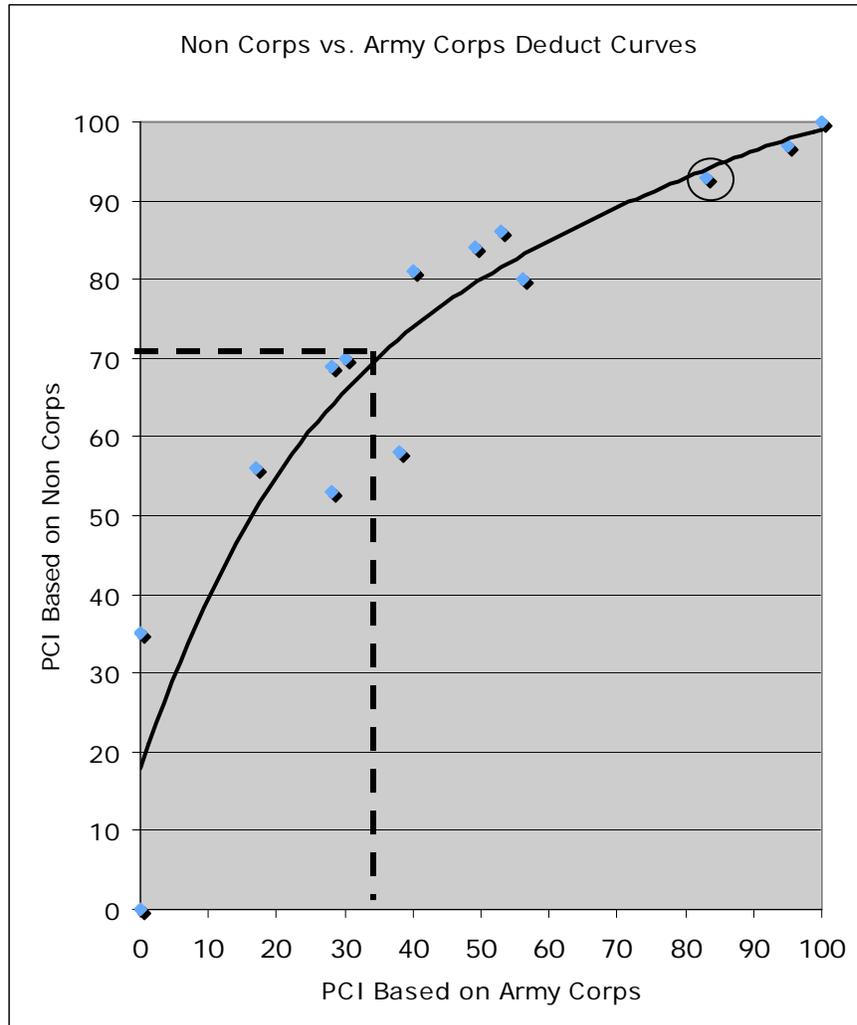
Where jurisdictions reported no pavement management system in use or where systems in use were non-correlatable, the numerical average of PCI threshold values from two surrogate jurisdictions was used to represent the PCI threshold value of the non-correlatable jurisdiction. For each non-correlatable jurisdiction, two jurisdictions with already correlatable PCI threshold values were selected as surrogates for estimating a PCI threshold. The two surrogate jurisdictions were selected from a list of correlatable jurisdictions that are found to be similar to the non-correlatable jurisdiction in the following categories:

- General topographic conditions (flat, hilly)
- General soil conditions (alluvial plain, coastal, non-erodible)
- General traffic volumes (low, medium, high)
- General truck volumes (low, medium, high)

The PCI threshold values of jurisdictions that were estimated by averaging the PCI's of surrogate jurisdictions are presented in the spreadsheet tab labeled "Data – Surrogate Cities". This list of non-correlatable jurisdictions updates the list of non-correlatable jurisdictions that was presented in Appendix A in Technical Memorandum 2.

It should be noted that the surrogate PCI threshold can serve only as an estimated threshold value for a given non-correlatable jurisdiction. It does not serve to represent the actual PCI condition of a jurisdiction. A specific PCI for a given piece of pavement is only valid for that location and should not be used to assume the condition of another jurisdiction.

Summary

The above discussion summarizes the process to obtain the Countywide PCI (CPCI). With the methods in place to normalize the PCIs, the team developed a Correlation Tool in Microsoft Excel spreadsheet format to correlate jurisdiction PCI threshold values to the CPCI. The Correlation Tool may be used by MTA in the future to evaluate the impacts of a normalized PCI.

The current version of the Correlation Tool is provided to MTA with this Technical Memorandum. More information and instructions about the tool are provided in the tab sheet labeled "Instructions." The PB Team is scheduled to provide training in the use of the Correlation Tool in a later stage of this project.

Development of Los Angeles Countywide Pavement Condition Index
Task Order PS-4310-1268-01-5-1

TECHNICAL MEMORANDUM 4

TASK 4.6 Develop Normalized Cost Estimates from 2002 Needs Assessment Study
June 21, 2005 (Revised)

Introduction/Background

The Parsons Brinckerhoff Consultant Team (PB Team) has prepared this fourth Technical Memorandum (TM) for Metro's Countywide Pavement Condition Index (PCI) Project to report the results of Task 4.6 Develop Normalized Cost Estimates from the 2002 Needs Assessment Study. This task builds on the work of previous tasks. In a previous task, Task 4.5, a user-friendly spreadsheet tool, called the PCI Correlator, was developed to correlate pavement condition indices from the different pavement management systems used by local jurisdictions in the county. Threshold PCIs (the index at which the need for pavement rehabilitation, reconstruction and resurfacing (3R) is triggered) for each jurisdiction were correlated to the countywide index. The normalized (correlated) PCI is herein referred to as the Countywide PCI (CPCI). In this task, all cost data for the 3R work backlog was taken from the 2002 Survey[1]. The data was then applied to the backlog of lane miles requiring 3R work as reported in 2002, using the standardized CPCI threshold.

Normalization of Backlog Cost Estimates by Jurisdiction

In the previous technical memorandum, a spreadsheet was created to correlate threshold PCIs from the jurisdictions systems to the Countywide System (the PCI Correlator tool). In this task, a new spreadsheet tab, labeled "Cost Estimates," was created in the PCI Correlator Tool to calculate cost estimates for 3R work based on the normalized scale. This spreadsheet tab combines information from several sources including the PCI Correlator Tab and the Metro 2002 Survey cost backlog. A Cost Estimate Spreadsheet example is included at the end of this memorandum. Spreadsheet columns (by column heading and number) are described below.

Column 1 – Jurisdiction
This column lists all jurisdictions in Los Angeles County having public roads.

Column 2 – PMS System
The PMS System for each jurisdiction in the Cost Estimates Tab is the same PMS System as entered into the PCI Correlator Tab, and corresponds to the system that each jurisdiction reported that it used in the 2002 Survey. If a jurisdiction's PMS System as entered into the PCI Correlator Tab is altered, that change is automatically reflected in

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[1] 2002 Metro Capacity Enhancement and System Preservation Needs Assessment Survey (2002 Survey)

the Cost Estimates Tab. Should systems be changed in the future, the new system can be selected from pull-down menus of systems in use at the time of the 2002 survey.

Column 3 – Provided PCI Threshold.

This column reproduces the PCI threshold that triggered 3R work as provided by the jurisdiction in the 2002 Survey for its pavement management system. It is the number that is then correlated to the countywide threshold.

Column 4 – Correlated Threshold for 3R Work

The values in this column are the correlated PCI threshold values that trigger the need for 3R work for each jurisdiction. The column 4 value in the next to last row is the average correlated PCI that was determined in the PCI Correlator Tab.

Correlated PCIs can vary depending on the individual system PCI for a number of reasons. These relate to the system itself as well as use of surrogates to provide correlated PCI thresholds. In the case of correlated thresholds, factors include:

- Approaches to predicting pavement deterioration; rates of deterioration have significant effect on correlating PCI between PMSs.

- Weighting of pavement defects – for example, if a particular PMS was developed in an area of higher moisture/rainfall than Southern California, the pavement defects relative to cracking may play a more prominent role than rutting and raveling, which are more significant in Southern California.

- Pavement inspection teams – the personnel performing condition surveys can have a large impact on PCIs and changes in team composition may completely change PCI evaluation judgment.

The variations in PMS results can be even greater because of environmental factors such as soil conditions and climate as well as the number of heavy vehicles such as trucks. In some instances, correlated ratings may seem significantly less than the jurisdiction's system rating. For example on Table 1, the provided threshold for the City of Whittier is 70 while the correlated threshold is 45. This does not imply that the street condition in Whittier is below average, rather that the rating systems weight defects differently.

When surrogate PCIs are used it should be understood that the two numbers shown for the PCI thresholds have no mathematical relationship. The normalized PCIs are derived from correlatable PCIs in similar cities. Similar cities are considered those with similar soil conditions, traffic patterns, topography, and truck traffic. The "in house" PMSs in particular may have been developed based on different rating scales, pavement aging curves, and rating techniques (e.g., windshield surveys). In some cases, cities that appear to have the same provided threshold may have different correlated thresholds. This occurs because surrogates are derived from the threshold of other similar cities (having similar soil, topography and traffic conditions), not the correlation curves (or a mathematical relationship).

Because of these variations, the use of the countywide PMS and CPCI data has limitations. Making judgments at the local jurisdiction level will not be accurate and the correlation tool should only be used at the aggregate county level - and even that should be used with caution.

Column 5 – Lane Miles
This column presents the number of major and secondary arterial lane miles for each jurisdiction as reported in the 2002 Survey.

Column 6 – Percent Difference to CPCI
This column calculates, in percent, the difference between a jurisdiction's correlated PCI threshold and the countywide PCI threshold value. The countywide value is taken as the average of correlatable thresholds. The percent difference represents the percent difference of arterial lane miles in need of 3R work if the jurisdiction used the CPCI threshold instead of their system threshold. Thresholds other than the county average may also be used as input to calculate the percent difference in lane miles.

Column 7 – Lane Mile Difference
This column multiplies the number of lane miles by the percent difference to the CPCI. It represents the change in lane miles impacted when the normalized PCI system is used. This column presents the number of major and secondary arterial lane miles for each jurisdiction as reported in the 2002 Survey.

Column 8 – Unfunded (+)/Surplus (-) Backlog (2002)
As with the lane mile data, this column presents the backlog data reported by each jurisdiction in the 2002 Survey. To complete the data set for a countywide assessment, backlog data for non-respondents (23 cities) was extrapolated as part of the 2002 study.

Column 9 – Normalized 2002 Backlog
This column calculates the "normalized backlog" based on the 2002 backlog and the Normalized PCI threshold for each jurisdiction. The calculation is the percent difference to the CPCI (Column 6) times the unfunded surplus or backlog (column 8). The normalized backlog for each jurisdiction is highly dependent on the total lane miles a jurisdiction maintains, the provided backlog, and the percent difference to the CPCI. This is why, for example we see a change from the 2002 backlog of $**7.4** million for the **County** of Los Angeles, but only a $**64,000** change for Compton – both cities being within **13** percent of the CPCI.

Summary

The above discussion summarizes the process developed to determine the normalized 3R backlog cost for Los Angeles County. The information used to calculate the normalized costs came from both the jurisdiction's correlated PCI threshold and stated backlog. If all jurisdictions used ~~60~~ **61** as their threshold (the average of all PCI thresholds countywide), then the overall backlog for the county would increase by $**40.1** million to a total backlog

of **$815.2** million. This indicates that overall there are more lane miles existing at a
correlated PCI that is less than the countywide average.

The methods, tools, and data developed as part of this task fulfills the goals of the project
– to normalize the 2002 backlog cost for 3R work. The tools provided will enable Metro
to conduct future updates to the data as jurisdictions may change their systems, PCI
threshold values, and cost data. The remaining task in the project is for the PB Team to
train Metro staff in the use of the PCI Correlator and Cost Estimation tools.

Table 1 – Normalized Backlog Cost Estimates Based on 2002 Needs[4]

Selected Threshold: **Countywide Average**

(1) Jurisdiction	(2) PMS System	(3) Provided PCI Threshold	(4) Correlated Threshold for 3R Work	(5) Lane Miles[1]	(6) % Difference to Selected or Average CPCI	(7) Lane Mile Difference	(8) Unfunded (+) / Surplus (-) 2002 Backlog[2]	(9) "Normalized" 2002 Backlog[3]
Agoura Hills	Willdan PMS (0-1 scale)	NS	70	134	-13%	-17.3	$1,672,100	$1,456,594
Alhambra	In House	81	58	330	5%	16.9	$562,500	$591,383
Arcadia	Micro PAVER	60	60	500	2%	8.2	$0	$0
Artesia	No PMS System	NS	74	62	-18%	-10.9	$2,940,000	$2,422,645
Avalon	No PMS System	NS	62	12	-2%	-0.2	$165,842	$163,109
Azusa	In House	20	65	192	-6%	-11.9	$300,000	$281,438
Baldwin Park	Pavement Management System Inc.	5.5	80	229	-24%	-54.4	$3,162,045	$2,410,196
Bell	Nichols Consulting Engineers	50	50	86	22%	19.0	$1,194,059	$1,456,230
Bell Garden	Micro PAVER	70	70	101	-13%	-13.0	$1,986,440	$1,730,420
Bellflower	5-Year Pavement Rehabilitation	65	74	246	-18%	-43.3	$530,000	$436,735
Beverly Hills	Hansen's PMS	6.5	58	214	5%	11.0	$0	$0
Bradbury	No PMS System	NS	65	6	-6%	-0.4	$88,449	$82,976
Burbank	CarteGraph	55	55	546	11%	59.3	$7,545,790	$8,365,968
Calabasas	Willdan PMS (0-1 scale)	0.03	70	164	-13%	-21.1	$651,700	$567,707
Carson	Check PMS Plus	2	63	420	-3%	-13.5	$2,792,000	$2,702,396
Cerritos	Infrastructure Management Services (IMS)	85	78	364	-22%	-79.6	$0	$0
City of Los Angeles	Micro PAVER	60	60	23,014	2%	375.2	$380,775,500	$386,983,045
Claremont	Micro PAVER	65	65	231	-6%	-14.3	$1,585,840	$1,487,717
Commerce	No PMS System	NS	55	153	11%	16.6	$2,114,480	$2,344,310
Compton	Micro PAVER	70	70	415	-13%	-53.5	$500,000	$435,558
County of Los Angeles	LACDPW	3	70	3,131	-13%	-403.5	$57,500,000	$50,089,189
Covina	Infra Manager by CHEC	85	85	274	-28%	-77.4	$3,786,715	$2,716,551
Cudahy	Willdan PMS (0-100 scale)	50	74	62	-18%	-10.9	$1,450,132	$1,194,951
Culver City	Infra Manager by CHEC	40	40	216	52%	113.3	$6,200,000	$9,451,612
Diamond Bar	Micro PAVER 5.2	70	70	293	-13%	-37.8	$2,600,000	$2,264,902
Downey	Infrastructure Management Services (IMS)	80	71	503	-14%	-68.6	$7,642,000	$6,600,018
Duarte	No PMS System	NS	70	110	-13%	-14.2	$1,520,214	$1,324,283
El Monte	Pavement Condition Inventory	2	55	363	11%	39.5	$1,500,000	$1,663,040
El Segundo	Micro PAVER 5.1	65	65	130	-6%	-8.0	$932,000	$874,333

Table 1 – Normalized Backlog Cost Estimates Based on 2002 Needs (continued)

(1) Jurisdiction	(2) PMS System	(3) Provided PCI Threshold	(4) Correlated Threshold for 3R Work	(5) Lane Miles[1]	(6) % Difference to Selected or Average CPCI	(7) Lane Mile Difference	(8) Unfunded (+) / Surplus (-) 2002 Backlog[2]	(9) "Normalized" 2002 Backlog[3]
Gardena	MTC PMS	55	55	220	11%	23.9	$980,000	$1,086,520
Glendale	SuperPMS (ITX Stanley)	7	70	790	-13%	-101.8	$0	$0
Glendora	No PMS System	NS	70	350	-13%	-45.1	$4,831,517	$4,208,813
Hawaiian Gardens	Willdan PMS (0-1 scale)	0.03	74	38	-18%	-6.7	$0	$0
Hawthorne	In House	70	70	390	-13%	-50.3	$1,372,800	$1,195,868
Hermosa Beach	Micro PAVER 5.1	40	40	88	52%	46.3	$1,218,935	$1,858,210
Hidden Hills	No PMS System	NS	70	2	-13%	-0.3	$27,640	$24,078
Huntington Park	Pavementview Plus	50	50	171	22%	37.6	$716,000	$873,207
Industry	No PMS System	NS	55	175	11%	19.0	-$920,000	-$1,019,998
Inglewood	Pavement Management System Inc.	41	63	444	-3%	-14.2	$1,000,000	$967,907
Irwindale	MTC PMS	70	70	58	-13%	-7.5	$2,800,000	$2,439,126
La Canada-Flintridge	Engineer's judgment	NS	55	180	11%	19.5	$2,483,477	$2,753,415
La Habra Heights	No PMS System	NS	58	82	5%	4.2	$1,133,251	$1,191,440
La Mirada	L.A. County Road Dep.	4	55	260	11%	28.3	$5,036,352	$5,583,771
La Puente	Micro PAVER 5.2	40	40	145	52%	76.2	$2,006,683	$3,059,094
La Verne	CarteGraph	55	55	235	11%	25.5	$5,106,000	$5,660,989
Lakewood	In House	70	63	425	-3%	-13.6	$7,325,000	$7,089,919
Lancaster	In House	2.1	60	1,137	2%	18.5	$14,963,000	$15,206,932
Lawndale	MTC PMS 7.5	65	65	85	-6%	-5.3	$1,174,711	$1,102,026
Lomita	No PMS System	NS	53	21	15%	3.2	$5,068	$5,831
Long Beach	Micro PAVER 5.2	55	55	1,900	11%	206.5	$66,270,000	$73,473,118
Lynwood	In House	3	74	215	-18%	-37.8	$3,800,000	$3,131,310
Malibu	MTC PMS	50	50	94	22%	20.6	$1,299,092	$1,584,324
Manhattan Beach	PMS (Stantec)	5	50	264	22%	58.0	$3,648,514	$4,449,592
Maywood	Willdan PMS (0-1 scale)	0.03	74	160	-18%	-28.2	$4,700,000	$3,872,936
Monrovia	Pavement Condition Inventory	92	58	189	5%	9.7	$2,000	$2,103
Montebello	Micro PAVER	55	55	300	11%	32.6	$4,146,038	$4,596,686
Monterey Park	Berryman & Henigar	60	70	275	-13%	-35.0	$3,800,535	$3,316,299
Norwalk	Charles Abbot Assoc	61	34	580	78%	454.5	$2,800,000	$4,994,305
Palmdale	Cititech	53	71	803	-14%	-111.5	$20,800,000	$17,912,712
Palos Verdes Estates	Micro PAVER 5.1	80	80	150	-24%	-35.7	$0	$0
Paramount	Micro PAVER	70	70	167	-13%	-21.5	$3,791,939	$3,303,220

Table 1 – Normalized Backlog Cost Estimates Based on 2002 Needs (continued)

(1) Jurisdiction	(2) PMS System	(3) Provided PCI Threshold	(4) Correlated Threshold for 3R Work	(5) Lane Miles[1]	(6) % Difference to Selected or Average CPCI	(7) Lane Mile Difference	(8) Unfunded (+) / Surplus (-) 2002 Backlog[2]	(9) "Normalized" 2002 Backlog[3]
Pasadena	In House	26	37	775	64%	497.3	$6,220,000	$10,211,494
Pico Rivera	Pavementview Plus	40	40	320	52%	167.8	$1,191,960	$1,817,088
Pomona	Infra Manager by CHEC	80	80	725	-24%	-172.4	$15,000	$11,433
Rancho Palos Verdes	Micro PAVER	60	60	607	2%	9.9	$350,000	$355,706
Redondo Beach	Stantec Super PMS	7	70	291	-13%	-37.5	$4,030,000	$3,510,599
Rolling Hills Estates	Willdan PMS (0-1 scale)	0.03	75	95	-19%	-17.8	$27,640	$22,473
Rosemead	Micro PAVER	70	70	212	-13%	-27.3	$330,000	$287,468
San Dimas	MTC StreetSaver Version 8	75	75	250	-19%	-46.8	$319,784	$259,998
San Fernando	In House	65	60	106	2%	1.7	$3,250,000	$3,302,983
San Gabriel	MTC PMS	42	42	183	45%	82.7	$14,100,000	$20,471,234
San Marino	MTC PMS 7.5	70	70	132	-13%	-17.0	$1,824,257	$1,589,140
Santa Clarita	MTC PMS	60	60	760	2%	12.4	$11,409,460	$11,595,461
Santa Fe Springs	Micro PAVER	70	70	286	-13%	-36.9	$4,145,250	$3,610,995
Santa Monica	Micro PAVER	70	70	360	-13%	-46.3	$0	$0
Sierra Madre	In House	82	58	78	5%	4.0	$1,077,970	$1,133,321
Signal Hill	No PMS System	NS	75	120	-19%	-22.4	$2,217,600	$1,803,002
South El Monte	No PMS System	NS	74	304	-18%	-53.5	$4,201,319	$3,462,008
South Gate	Micro PAVER 5.2	70	70	267	-13%	-34.4	$3,689,974	$3,214,397
South Pasadena	Micro PAVER	70	70	130	-13%	-16.8	$1,796,617	$1,565,062
Temple City	L.A. County Road Dep.	NS	55	147	11%	16.0	$800,000	$886,955
Torrance	MTC PMS	40	40	726	52%	380.8	$47,132,000	$71,850,545
Vernon	MTC PMS	65	65	146	-6%	-9.0	$2,000,000	$1,876,251
Walnut	No PMS System	NS	70	245	-13%	-31.6	$500,000	$435,558
West Covina	MTC StreetSaver Version 8	70	70	566	-13%	-72.9	$390,624	$340,279
West Hollywood	MTC PMS 7.5	50	50	97	22%	21.3	$630,204	$768,573
Westlake Village	No PMS System	NS	70	73	-13%	-9.4	$1,003,341	$874,027
Whittier	Charles Abbot Assoc	70	45	600	34%	204.8	$4,418,400	$5,926,879
Countywide Average[3]			61					
Totals				51,497			$775,087,758	$815,203,986

Notes:
1. Lane miles given for major and secondary arterials only. One lane mile is 5,280 feet by 12 feet.
2. Backlog data provided by jurisdictions in 2002 Survey. Normalized PCI thresholds may vary from the provided PCI threshold – in some cases + over 10 points. Variations in PMS results are caused by many factors relative to the individual system correlated (either through correlation curves or surrogate cites. Refer to the project report and technical memoranda for additional discussion.
3. The average CPCI is based on correlatable systems only.
4 Table revised from original to correct spreadsheet error

Appendix B
Example Correlation Tool

MTA PCI Correlation Tool
Instruction Sheet

Description

The MTA PCI Correlation Tool is a user-friendly spreadsheet that converts the 3R threshold of a jurisdiction's pavement condition index (PCI) to a normalized, countywide PCI (CPCI). This tool enables the MTA to calculate the overall threshold value for 3R work for the County of Los Angeles given knowledge of pavement management systems and 3R PCI thresholds. This tool is only applicable to the jurisdictions of Los Angeles County and exclusively developed for MTA.

The MTA PCI Correlation Tool was developed in a Microsoft Excel Spreadsheet format by the PB Team for MTA Task Order PS-4310-1268-01-5-1.

PCI Correlator Tab

The PCI Correlator Tab is the main interface where all the input and output data are located. The first column lists, in alphabetical order, all the jurisdicitons in Los Angeles County that maintain streets with public access. For each jurisdiction, the user can select a pavement management system in the second column and enter a PCI threshold value for the selected system in the third column. These two columns are highlighted in yellow. It should be noted that users are only allowed to select from the list of available PMS systems. Contact the PB Team if new PMS systems need to be added to this Tool.

Once data is entered, the Correlation Tool will automatically convert jurisdiction PCI threshold values to the Countywide PCI system and present the CPCI value in the fourth column. The formulas developed to convert jurisdicton PCI threshold values to Countywide PCI values are embedded into the Correlation Tool.

At the bottom of the table in the very last row is the average PCI threshold value for the entire County. This value is an average of the PCI thresholds for the county based on standardized PCIs from the local jurisdications. Only correlatable systems are used to calculate the county wide average. (See below for additional description of correlatable systems.)

Data Tabs

Data - Correlation Curves

For the purposes of this Task Order the MTA adopted the US Army Corps of Engineers (USACE) PCI family of curves as the countywide PCI system due to the fact that it found to be the most commonly used basis of PCI rating methodology.

The PCI systems of all jurisdictions were evaluated with respect to their correlatability to the USACE system. For PCI systems that were deemed correlatable to the USACE system, a mathematical regression model was created to translate given threshold ratings to the USACE system. These regression models were developed by comparing specific data points representing similar pavement conditions from the non-USACE PCI system and from the USACE system.

Presented in this Data Tab are data points and mathematical curves for all PMS systems analyzed as part of this Task Order. PMS systems listed in this Data Tab were found to be in use by at least one Los Angeles County jurisdiction at the time of this Task Order.

Data - Estimated Cities

Where systems in use were found to be non-correlatable to the USACE system or where jurisdictions were found to have no PMS systems in place, a surrogate PCI threshold was developed using data from at least two jurisdictions (with a correlatable system) having the following similar characteristics:

General topographic conditions (flat, hilly)
General soil conditions (alluvial plain, coastal, non-erodible)
General traffic volumes (low, medium, high)
General truck volumes (low, medium, high)

The numerical average of the correlatable PCI thresholds from the two similar jurisdictions was used to represent the PCI threshold value of the non-correlatable jurisdiction. The term "surrogate" is used for PCI's generated using this method.

<u>Spreadsheet Format</u>

Most areas in this Tool are read-only, except for the areas highlighted in yellow in the PCI Correlator Tab under the columns, Provided PCI Threshold and Pavement Management Software. In these yellow highlighted cells, the user is allowed to alter and save any entries and edits.

The format protection serves to permit users to select from known and available pavement management systems and to prevent users from making unintentional calculations and edits.

MTA Correlation Tool

Jurisdiction	Pavement Management Software (Local System)	Provided PCI Threshold[1]	Threshold Correlated to CPCI[2]
Agoura Hills	Willdan PMS (0-1 scale)	NS	70
Alhambra	In House	81	58
Arcadia	Micro PAVER	60	60
Artesia	No PMS System	NS	74
Avalon	No PMS System	NS	62
Azusa	In House	20	65
Baldwin Park	Pavement Management System Inc.	5.5	80
Bell	Nichols Consulting Engineers	50	50
Bell Garden	Micro PAVER	70	70
Bellflower	5-Year Pavement Rehabilitation	65	74
Beverly Hills	Hansen's PMS	6.5	58
Bradbury	No PMS System	NS	65
Burbank	CarteGraph	55	55
Calabasas	Willdan PMS (0-1 scale)	0.03	70
Carson	Check PMS Plus	2	63
Cerritos	Infrastructure Management Services (IMS)	85	78
Claremont	Micro PAVER	65	65
Commerce	No PMS System	NS	55
Compton	Micro PAVER	70	70
Covina	Infra Manager by CHEC	85	85
Cudahy	Willdan PMS (0-100 scale)	50	74
Culver City	Infra Manager by CHEC	40	40
Diamond Bar	Micro PAVER 5.2	70	70
Downey	Infrastructure Management Services (IMS)	80	71
Duarte	No PMS System	NS	70
El Monte	Pavement Condition Inventory	2	55
El Segundo	Micro PAVER 5.1	65	65
Gardena	MTC PMS	55	55
Glendale	SuperPMS (ITX Stanley)	7	70
Glendora	No PMS System	NS	70
Hawaiian Gardens	Willdan PMS (0-1 scale)	0.03	74
Hawthorne	In House	70	70
Hermosa Beach	Micro PAVER 5.1	40	40
Hidden Hills	No PMS System	NS	70
Huntington Park	Pavementview Plus	50	50
Industry	No PMS System	NS	55
Inglewood	Pavement Management System Inc.	41	63
Irwindale[4]	MTC PMS	70	70
La Canada-Flintridge	Engineer's judgment	NS	55
La Habra Heights	No PMS System	NS	58
La Mirada	L.A. County Road Dep.	4	55
La Puente	Micro PAVER 5.2	40	40
La Verne	CarteGraph	55	55
Lakewood	In House	70	63
Lancaster	In House	2.1	60
Lawndale	MTC PMS 7.5	65	65
Lomita	No PMS System	NS	53
Long Beach	Micro PAVER 5.2	55	55
Los Angeles City	Micro PAVER	60	60
Los Angeles County Unincorporated[3]	LACDPW	3	70
Lynwood	In House	3	74
Malibu	MTC PMS	50	50
Manhattan Beach	PMS (Stantec)	5	50

Jurisdiction	Pavement Management Software (Local System)	Provided PCI Threshold[1]	Threshold Correlated to CPCI[2]
Maywood	Willdan PMS (0-1 scale)	0.03	74
Monrovia	Pavement Condition Inventory	92	58
Montebello	Micro PAVER	55	55
Monterey Park	Berryman & Henigar	60	70
Norwalk	Charles Abbot Assoc	61	34
Palmdale	Cititech	53	71
Palos Verdes Estates	Micro PAVER 5.1	80	80
Paramount	Micro PAVER	70	70
Pasadena	In House	26	37
Pico Rivera	Pavementview Plus	40	40
Pomona	Infra Manager by CHEC	80	80
Rancho Palos Verdes	Micro PAVER	60	60
Redondo Beach	Stantec Super PMS	7	70
Rolling Hills Estates	Willdan PMS (0-1 scale)	0.03	75
Rosemead	Micro PAVER	70	70
San Dimas	MTC StreetSaver Version 8	75	75
San Fernando	In House	65	60
San Gabriel	MTC PMS	42	42
San Marino	MTC PMS 7.5	70	70
Santa Clarita	MTC PMS	60	60
Santa Fe Springs	Micro PAVER	70	70
Santa Monica	Micro PAVER	70	70
Sierra Madre	In House	82	58
Signal Hill	No PMS System	NS	75
South El Monte	No PMS System	NS	74
South Gate	Micro PAVER 5.2	70	70
South Pasadena	Micro PAVER	70	70
Temple City	L.A. County Road Dep.	NS	55
Torrance	MTC PMS	40	40
Vernon	MTC PMS	65	65
Walnut	No PMS System	NS	70
West Covina	MTC StreetSaver Version 8	70	70
West Hollywood	MTC PMS 7.5	50	50
Westlake Village	No PMS System	NS	70
Whittier	Charles Abbot Assoc	70	45
Average Countywide PCI Threshold Value for 3R Work			**61**
Most Frequent Threshold Correlated to CPCI			**70**

Notes:

1 - Values entered in this column, "Provided PCI Threshold," are taken from the 2004 MTA PCI survey data. Jurisdictions noted as "NS" indicates that the jurisdiction did not specify a threshold value for 3R work. In the case where jurisdictions provided ranges or levels for 3R work threshold, the midpoint of the range or the value best representing the level was entered as the Provided PCI Threshold.

2 - PCI Threshold Normalized to Countywide PCI (CPCI). In some cases CPCI thresholds may be different even if provided thresholds are the same, as CPCIs are surrogate values.

3 - The PMS system used by Los Angeles County in 2002 was used for this determination. LAC will be going to Stantec MPMS in the future.

4 - The most frequent threshold correlated to CPCI was used for Irwindale since no PCI threshold was reported in their survey.

Normalized Cost Estimates Based on 2002 Needs

Select CPCI Threshold		70

Jurisdiction	PMS System	Provided PCI Threshold	Correlated Threshold for 3R Work	Lane Miles[1]	% Difference to Selected CPCI	Lane Mile Difference	Unfunded (+) / Surplus (-) 2002 Backlog[2]	"Normalized" 2002 Backlog
1	2	3	4	5	6	7	8	9
Agoura Hills	Willdan PMS (0-1 scale)	NS	70	134	0%	0.0	$1,672,100	$1,672,100
Alhambra	In House	81	58	330	21%	68.3	$562,500	$678,879
Arcadia	Micro PAVER	60	60	500	17%	83.3	$0	$0
Artesia	No PMS System	NS	74	62	-5%	-3.4	$2,940,000	$2,781,081
Avalon	No PMS System	NS	62	12	13%	1.5	$165,842	$187,241
Azusa	In House	20	65	192	8%	14.8	$300,000	$323,077
Baldwin Park	Pavement Management System Inc.	5.5	80	229	-13%	-28.6	$3,162,045	$2,766,790
Bell	Nichols Consulting Engineers	50	50	86	40%	34.6	$1,194,059	$1,671,683
Bell Garden	Micro PAVER	70	70	101	0%	0.0	$1,986,440	$1,986,440
Bellflower	5-Year Pavement Rehabilitation	65	74	246	-5%	-13.3	$530,000	$501,351
Beverly Hills	Hansen's PMS	6.5	58	214	21%	44.3	$0	$0
Bradbury	No PMS System	NS	65	6	8%	0.5	$88,449	$95,253
Burbank	CarteGraph	55	55	546	27%	148.9	$7,545,790	$9,603,733
Calabasas	Willdan PMS (0-1 scale)	0.03	70	164	0%	0.0	$651,700	$651,700
Carson	Check PMS Plus	2	63	420	11%	46.7	$2,792,000	$3,102,222
Cerritos	Infrastructure Management Services	85	78	364	-10%	-37.5	$0	$0
Claremont	Micro PAVER	65	65	231	8%	17.8	$1,585,840	$1,707,828
Commerce	No PMS System	NS	55	153	27%	41.7	$2,114,480	$2,691,156
Compton	Micro PAVER	70	70	415	0%	0.0	$500,000	$500,000
Covina	Infra Manager by CHEC	85	85	274	-18%	-48.4	$3,786,715	$3,118,471
Cudahy	Willdan PMS (0-100 scale)	50	74	62	-5%	-3.4	$1,450,132	$1,371,746
Culver City	Infra Manager by CHEC	40	40	216	75%	162.0	$6,200,000	$10,850,000
Diamond Bar	Micro PAVER 5.2	70	70	293	0%	0.0	$2,600,000	$2,600,000
Downey	Infrastructure Management Services	80	71	503	-1%	-4.3	$7,642,000	$7,576,507
Duarte	No PMS System	NS	70	110	0%	0.0	$1,520,214	$1,520,214
El Monte	Pavement Condition Inventory	2	55	363	27%	99.1	$1,500,000	$1,909,091
El Segundo	Micro PAVER 5.1	65	65	130	8%	10.0	$932,000	$1,003,692
Gardena	MTC PMS	55	55	220	27%	60.0	$980,000	$1,247,273
Glendale	SuperPMS (ITX Stanley)	7	70	790	0%	0.0	$0	$0
Glendora	No PMS System	NS	70	350	0%	0.0	$4,831,517	$4,831,517
Hawaiian Gardens	Willdan PMS (0-1 scale)	0.03	74	38	-5%	-2.1	$0	$0
Hawthorne	In House	70	70	390	0%	0.0	$1,372,800	$1,372,800
Hermosa Beach	Micro PAVER 5.1	40	40	88	75%	66.2	$1,218,935	$2,133,137

Select CPCI Threshold		70

Jurisdiction	PMS System	Provided PCI Threshold	Correlated Threshold for 3R Work	Lane Miles[1]	% Difference to Selected CPCI	Lane Mile Difference	Unfunded (+) / Surplus (-) 2002 Backlog[2]	"Normalized" 2002 Backlog
Hidden Hills	No PMS System	NS	70	2	0%	0.0	$27,640	$27,640
Huntington Park	Pavementview Plus	50	50	171	40%	68.4	$716,000	$1,002,400
Industry	No PMS System	NS	55	175	27%	47.7	-$920,000	-$1,170,909
Inglewood	Pavement Management System Inc.	41	63	444	11%	49.3	$1,000,000	$1,111,111
Irwindale	MTC PMS	70	70	58	0%	0.0	$2,800,000	$2,800,000
La Canada-Flintridge	Engineer's judgment	NS	55	180	27%	49.0	$2,483,477	$3,160,789
La Habra Heights	No PMS System	NS	58	82	21%	17.0	$1,133,251	$1,367,716
La Mirada	L.A. County Road Dep.	4	55	260	27%	70.9	$5,036,352	$6,409,903
La Puente	Micro PAVER 5.2	40	40	145	75%	108.9	$2,006,683	$3,511,695
La Verne	CarteGraph	55	55	235	27%	64.1	$5,106,000	$6,498,545
Lakewood	In House	70	63	425	11%	47.2	$7,325,000	$8,138,889
Lancaster	In House	2.1	60	1,137	17%	189.5	$14,963,000	$17,456,833
Lawndale	MTC PMS 7.5	65	65	85	8%	6.5	$1,174,711	$1,265,073
Lomita	No PMS System	NS	53	21	32%	6.8	$5,068	$6,694
Long Beach	Micro PAVER 5.2	55	55	1,900	27%	518.2	$66,270,000	$84,343,636
Los Angeles City	Micro PAVER	60	60	23,014	17%	3835.7	$380,775,500	$444,238,083
Los Angeles County Unincorporated	LACDPW	3	70	3,131	0%	0.0	$57,500,000	$57,500,000
Lynwood	In House	3	74	215	-5%	-11.6	$3,800,000	$3,594,595
Malibu	MTC PMS	50	50	94	40%	37.6	$1,299,092	$1,818,729
Manhattan Beach	PMS (Stantec)	5	50	264	40%	105.6	$3,648,514	$5,107,919
Maywood	Willdan PMS (0-1 scale)	0.03	74	160	-5%	-8.6	$4,700,000	$4,445,946
Monrovia	Pavement Condition Inventory	92	58	189	21%	39.1	$2,000	$2,414
Montebello	Micro PAVER	55	55	300	27%	81.8	$4,146,038	$5,276,776
Monterey Park	Berryman & Henigar	60	70	275	0%	0.5	$3,800,535	$3,806,953
Norwalk	Charles Abbot Assoc	61	34	580	105%	607.6	$2,800,000	$5,733,224
Palmdale	Cititech	53	71	803	-1%	-9.2	$20,800,000	$20,562,939
Palos Verdes Estates	Micro PAVER 5.1	80	80	150	-13%	-18.8	$0	$0
Paramount	Micro PAVER	70	70	167	0%	0.0	$3,791,939	$3,791,939
Pasadena	In House	26	37	775	88%	685.6	$6,220,000	$11,722,308
Pico Rivera	Pavementview Plus	40	40	320	75%	240.0	$1,191,960	$2,085,930
Pomona	Infra Manager by CHEC	80	80	725	-13%	-90.6	$15,000	$13,125
Rancho Palos Verdes	Micro PAVER	60	60	607	17%	101.2	$350,000	$408,333
Redondo Beach	Stantec Super PMS	7	70	291	0%	0.0	$4,030,000	$4,030,000
Rolling Hills Estates	Willdan PMS (0-1 scale)	0.03	75	95	-7%	-6.3	$27,640	$25,798

Normalized Cost Estimates Based on 2002 Needs

Select CPCI Threshold		70

Jurisdiction	PMS System	Provided PCI Threshold	Correlated Threshold for 3R Work	Lane Miles[1]	% Difference to Selected CPCI	Lane Mile Difference	Unfunded (+) / Surplus (-) 2002 Backlog[2]	"Normalized" 2002 Backlog
Rosemead	Micro PAVER	70	70	212	0%	0.0	$330,000	$330,000
San Dimas	MTC StreetSaver Version 8	75	75	250	-7%	-16.7	$319,784	$298,465
San Fernando	In House	65	60	106	17%	17.7	$3,250,000	$3,791,667
San Gabriel	MTC PMS	42	42	183	67%	122.0	$14,100,000	$23,500,000
San Marino	MTC PMS 7.5	70	70	132	0%	0.0	$1,824,257	$1,824,257
Santa Clarita	MTC PMS	60	60	760	17%	126.7	$11,409,460	$13,311,037
Santa Fe Springs	Micro PAVER	70	70	286	0%	0.0	$4,145,250	$4,145,250
Santa Monica	Micro PAVER	70	70	360	0%	0.0	$0	$0
Sierra Madre	In House	82	58	78	21%	16.1	$1,077,970	$1,300,998
Signal Hill	No PMS System	NS	75	120	-7%	-8.0	$2,217,600	$2,069,760
South El Monte	No PMS System	NS	74	304	-5%	-16.4	$4,201,319	$3,974,221
South Gate	Micro PAVER 5.2	70	70	267	0%	0.0	$3,689,974	$3,689,974
South Pasadena	Micro PAVER	70	70	130	0%	0.0	$1,796,617	$1,796,617
Temple City	L.A. County Road Dep.	NS	55	147	27%	40.1	$800,000	$1,018,182
Torrance	MTC PMS	40	40	726	75%	544.5	$47,132,000	$82,481,000
Vernon	MTC PMS	65	65	146	8%	11.2	$2,000,000	$2,153,846
Walnut	No PMS System	NS	70	245	0%	0.0	$500,000	$500,000
West Covina	MTC StreetSaver Version 8	70	70	566	0%	0.0	$390,624	$390,624
West Hollywood	MTC PMS 7.5	50	50	97	40%	38.8	$630,204	$882,286
Westlake Village	No PMS System	NS	70	73	0%	0.0	$1,003,341	$1,003,341
Whittier	Charles Abbot Assoc	70	45	600	54%	323.9	$4,418,400	$6,803,774
Grand Totals				51,497			$775,087,758	$935,815,304
Average			61					

1. Lane miles given for major and secondary arterials only. One lane mile is 5280 feet by 12 feet.
2. Backlog data provided by jurisdictions in 2002 Survey. Normalized PCI thresholds may vary from the provided PCI threshold – in some cases + over 10 points. Variations in PMS results are caused by many factors relative to the individual system correlated (either through correlation curves or surrogate cites. Refer to the project report and technical memoranda for additional discussion.

Non-correlated and Surrogate Jurisdictions

Non-Correlated Jurisdiction	Jurisdicitons with Similar Conditions				Surrogate Jurisdictions	Threshold of "Surrogate" Jurisdiction	Estimated Threshold
	Soil Type	+ Topographic Condition	+Traffic Volumes	+Truck Volumes			
Agoura Hills	South Pasadena, Alhambra, Palmdale, Palos	South Pasadena, Alhambra, Palmdale, Palos Verdes	South Pasadena, Plamdale	South Pasadena, Palmdale	South Pasadena	70	70
					Palmdale	71	
Alhambra	Whittier, South Pasadena	Whittier, South Pasadena	Whittier, South Pasadena	Whitter, South Pasadena	Whittier	45	58
					South Pasadena	70	
Artesia	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Cerritos, Downey, Paramount, South Gate	Cerritos, Downey, Paramount, South Gate	Cerritos, Downey, Paramount, South Gate	Cerritos	78	74
					Downey	71	
Avalon	Use Systemwide Average						62
Azusa	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas	75	65
					La Verne	55	
Baldwin Park	Covina, San Dimas, La Verne	Covina, San Dimas, La Verne	Covina, San Dimas, La Verne	Covina, San Dimas, La Verne	Covina	85	80
					San Dimas	75	
Bellflower	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Paramount, South	Bell, Bell Garden, Cerritos, Downey, Paramount, South	Bell, Bell Garden, Cerritos, Downey, Paramount, South	Cerritos	78	74
					Downey	71	
Beverly Hills	Arcadia, Burbank, Glendale, Pasadena	Arcadia, Burbank, Pasadena	Burbank, Pasadena	Burbank, Pasadena	Burbank	55	58
					Arcadia	60	
Bradbury	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas, La Verne	San Dimas	75	65
					La Verne	55	
Calabasas	South Pasadena, Alhambra, Palmdale, Palos	South Pasadena, Alhambra, Palmdale, Palos Verdes	South Pasadena	South Pasadena	South Pasadena	70	70
					Palmdale	71	
Carson	Compton, Gardena, Hawthorne, Long Beach	Compton, Gardena, Hawthorne	Gardena, Hawthorne	Gardena, Hawthorne	Gardena	55	63
					Compton	70	
Commerce	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera	40	55
					Santa Fe Springs	70	
County and Unincorporated	Diamond Bar, Palmdale, Torrance	Diamond Bar, Palmdale, Torrance	Diamond Bar, Palmdale, Torrance	Diamond Bar, Palmdale, Torrance	Diamond Bar	70	70
					Palmdale	71	
Cudahy	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Cerritos	78	74
					Downey	71	
Duarte	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont	65	70
					San Dimas	75	
El Monte	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera	40	55
					Santa Fe Springs	70	
Glendora	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont	65	70
					San Dimas	75	
Hawthorne	In House is same as Micro Paver						70
Hawaiian Gardens	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Cerritos, Paramount	Cerritos, Paramount	Cerritos, Paramount	Cerritos	78	74
					Paramount	70	

Non-correlated and Surrogate Jurisdictions

Non-Correlated Jurisdiction	Jurisdicitons with Similar Conditions				Surrogate Jurisdictions	Threshold of "Surrogate" Jurisdiction	Estimated Threshold
	Soil Type	+ Topographic Condition	+Traffic Volumes	+Truck Volumes			
Hidden Hills	To be added (assume similar to Calabasas)	To be added (assume similar to Calabasas)	To be added (assume similar to Calabasas)	To be added (assume similar to Calabasas)	South Pasadena	70	70
					Palmdale	71	
Industry	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera	40	55
					Santa Fe Springs	70	
Inglewood	Compton, Gardena, Hawthorne, Long Beach	Compton, Gardena, Hawthorne	Compton, Gardena, Hawthorne	Compton, Gardena	Compton	70	63
					Gardena	55	
La Canada-Flintridge	Arcadia, Glendale, Pasadena, West Hollywood	Arcadia, Pasadena, West Hollywood	Pasadena, West Hollywood	Pasadena, West Hollywood	Arcadia	60	55
					West Hollywood	50	
La Habra Heights	Whittier, South Pasadena	Whittier, South Pasadena	Whittier, South Pasadena	Whitter, South Pasadena	Whittier	45	58
					South Pasadena	70	
La Mirada	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Pico Rivera	40	55
					Santa Fe Springs	70	
Lakewood	Compton, Gardena, Hawthorne, Long Beach	Compton, Gardena, Hawthorne	Gardena, Hawthorne	Gardena, Hawthorne	Gardena	55	63
					Compton	70	
Lancaster	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Palmdale, Bell	Palmdale, Bell	Palmdale	71	60
					Bell	50	
Lomita	El Segundo, Torrance	El Segundo, Torrance	El Segundo, Torrance	El Segundo, Torrance	El Segundo	65	53
					Torrance	40	
Lynwood	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Cerritos	78	74
					Downey	71	
Maywood	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Cerritos	78	74
					Downey	71	
Monrovia	Arcadia, Burbank, Glendale, Pasadena	Arcadia, Burbank, Pasadena	Arcadia, Burbank	Arcadia, Burbank	Arcadia	60	58
					Burbank	55	
Pasadena	Modified MicroPaver 1-70 (y = 100/70*x)						37
Rolling Hills Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar	70	75
					Palos Verdes Estates	80	
San Fernando	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Palmdale, Huntington Park	Palmdale, Huntington Park	Palmdale	71	60
					Huntington Park	50	
Sierra Madre	Arcadia, Glendale, Pasadena, West Hollywood	Arcadia, Burbank, Pasadena	Burbank, Pasadena	Burbank, Pasadena	Burbank	55	58
					Arcadia	60	
Signal Hill	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar, Palos Verdes Estates	Diamond Bar	70	75
					Palos Verdes Estates	80	
South El Monte	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Bell, Bell Garden, Cerritos, Downey, Huntington Park,	Cerritos	78	74
					Downey	71	

Non-correlated and Surrogate Jurisdictions

Non-Correlated Jurisdiction	Jurisdicitons with Similar Conditions				Surrogate Jurisdictions	Threshold of "Surrogate" Jurisdiction	Estimated Threshold
	Soil Type	+ Topographic Condition	+Traffic Volumes	+Truck Volumes			
Temple City	Norwalk, Pico Rivera, San Gabriel, Santa Fe Springs	Norwalk, Pico Rivera, San Gabriel	Norwalk, Pico Rivera, San Gabriel, San Marino	Norwalk, Pico Rivera, San Gabriel	Pico Rivera	40	55
					Santa Fe Springs	70	
Walnut	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont, San Dimas	Claremont	65	70
					San Dimas	75	
Westlake Village	South Pasadena, Alhambra, Palmdale, Palos	South Pasadena, Alhambra, Palmdale, Palos Verdes	South Pasadena, Palmdale	South Pasadena, Palmdale	South Pasadena	70	70
					Palmdale	71	

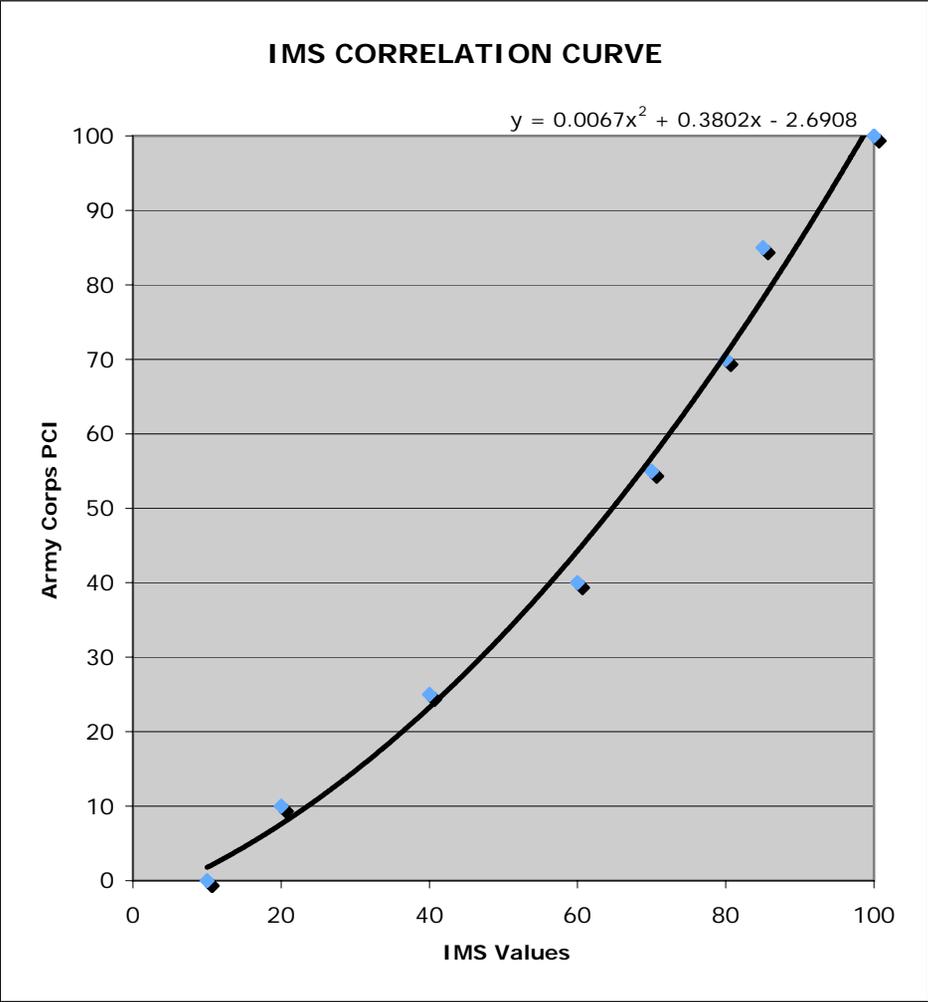# Infrastructure Management Services (IMS)

Typical Decision Tree for Army Corps

100-85	Excellent
84-70	Very Good
69-55	Good
54-40	Fair
39-25	Poor
24-10	Very Poor
9-0	Failed

Typical Decision Tree for IMS

100-85	Excellent	Crack Seal
84-80	Very Good	Slurry Seal
79-70	Good	Thin Overlay
69-60	Fair	Thick Overlay
59-40	Poor	Surface Replacement
39-10	Very Poor	Total Reconstruction

| IMS	ACOE
10	0
20	10
40	25
60	40
70	55
80	70
85	85
100	100

IMS is on a scale from 10-100 instead of 0-100

IMS CORRELATION CURVE

$y = 0.0067x^2 + 0.3802x - 2.6908$

(Chart: Army Corps PCI vs IMS Values)

STANTEC CORRELATION CURVE

Use SDI value - not the PQI - and multiply by 10 to get a value comparable to the Army Corps PCI.

Stantec	ACOE
0	0
1	10
2	20
3	30
4	40
5	50
6	60
7	70
8	80
9	90
10	100

STANTEC CORRELATION CURVE
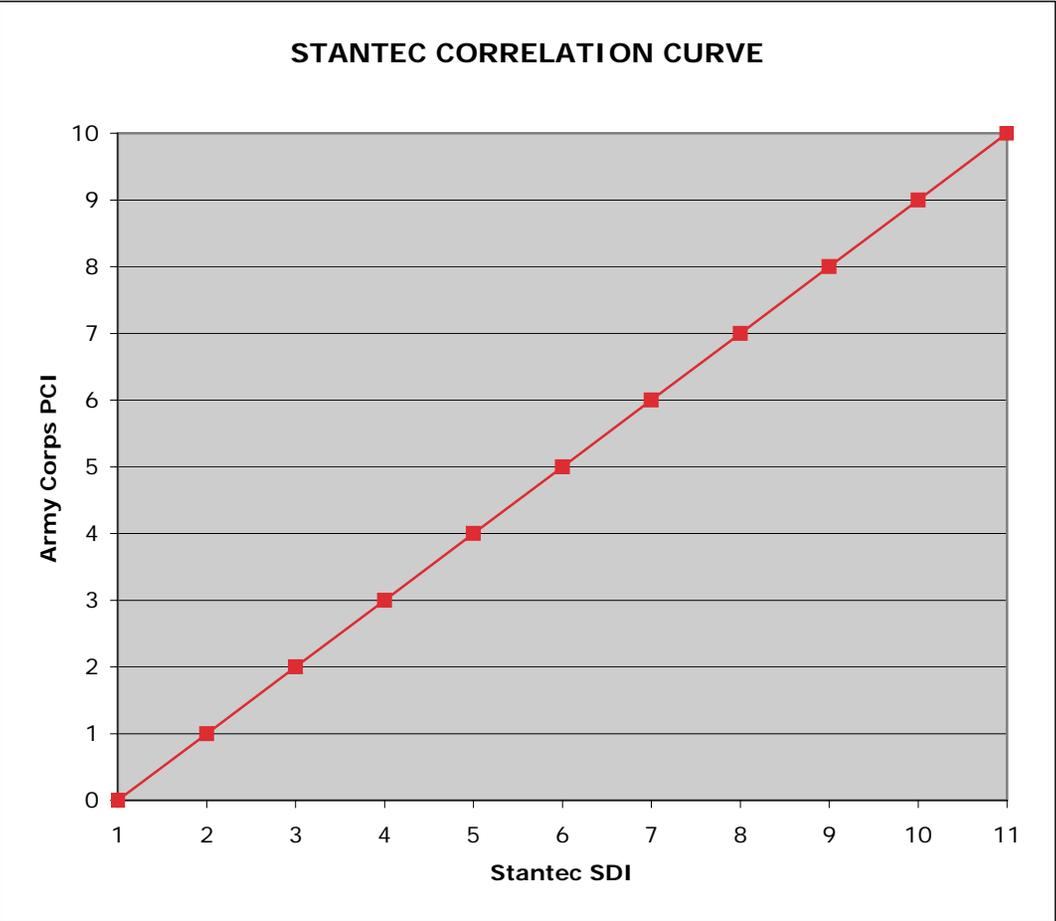
BERRYMAN & HENIGAR CORRELATION CURVE

Berryman & Henigar's system provides a PCI value from 0-100 with 60 being the threshold for 3R work.

B&H	ACOE
0	0
60	70
100	100

BERRYMAN & HENIGAR CORRELATION CURVE

$y = -0.0042x^2 + 1.4167x + 3E\text{-}14$

Army Corps PCI

Berryman & Henigar PCI

ITX STANLEY CORRELATION CURVE

Stanley's system provides a PCI value from 0-10 with 7 being the threshold for 3R work.
This essentially correlates to the Army Corps if you multiply by a factor of 10.
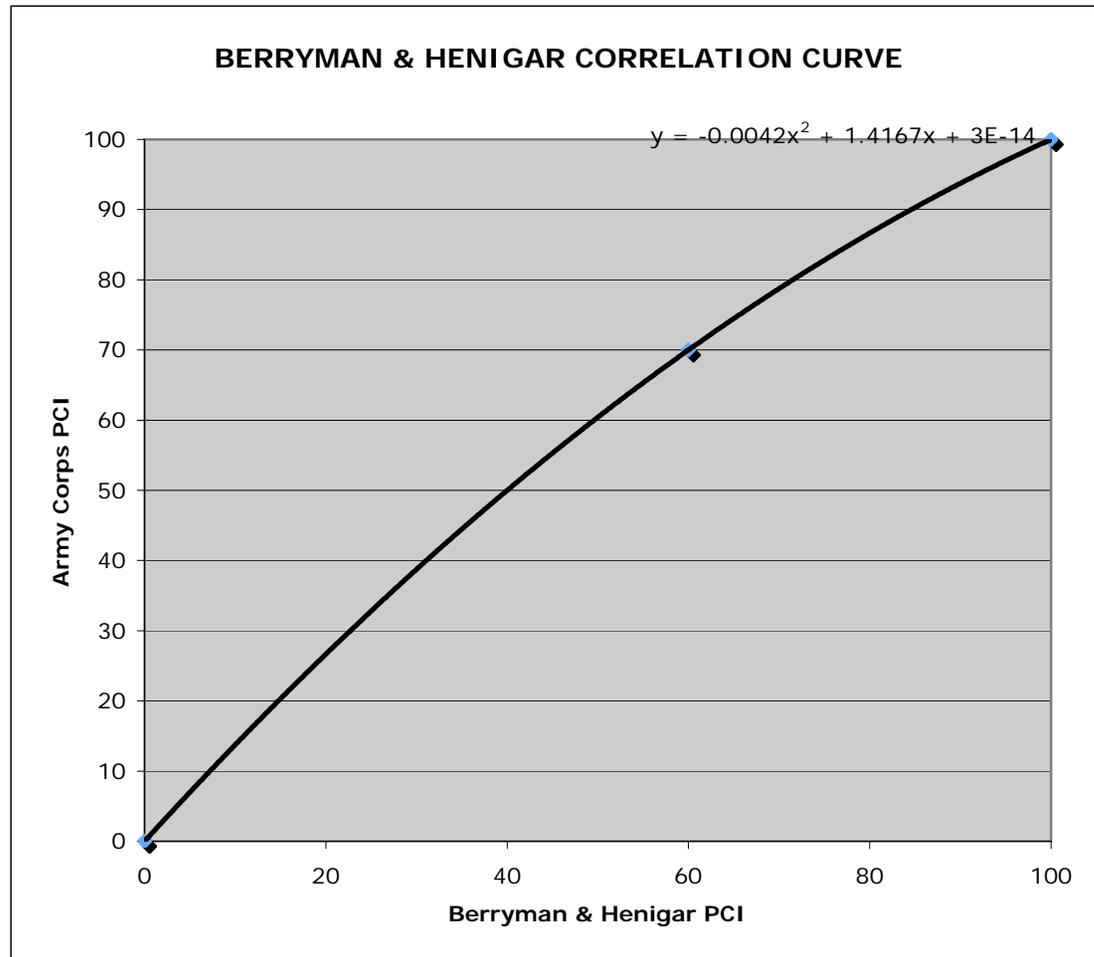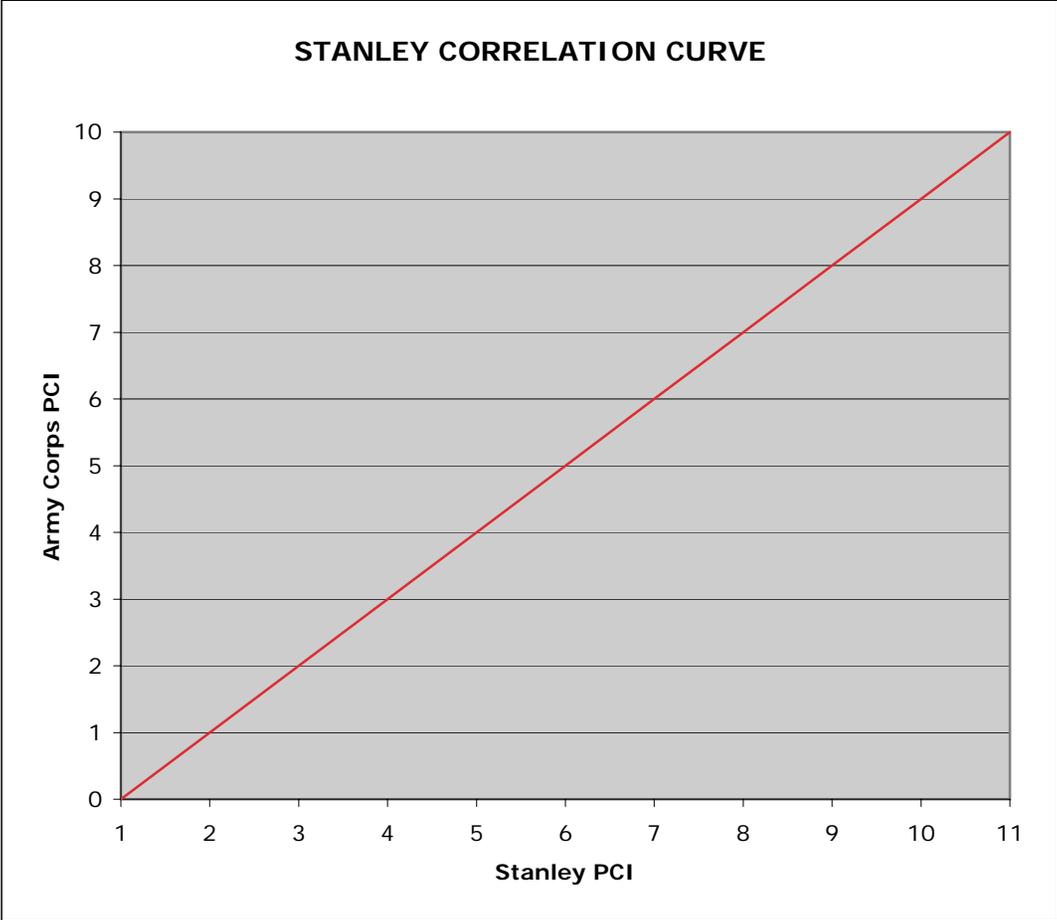
Stanley	ACOE
0	0
1	10
2	20
3	30
4	40
5	50
6	60
7	70
8	80
9	90
10	100

STANLEY CORRELATION CURVE

CITITECH CORRELATION CURVE

Cititech's system provides a PCI value from 0-100. Palmdale is the only jursdiction using this system.
They report that they review any segments with a PCI value between 40 and 70 for 3R work.

Cititech	ACOE
0	0
40	70
70	70
100	100

CITITECH CORRELATION CURVE

$y = -0.0076x^2 + 1.6813x + 3.0464$

Army Corps PCI

Cititech PCI
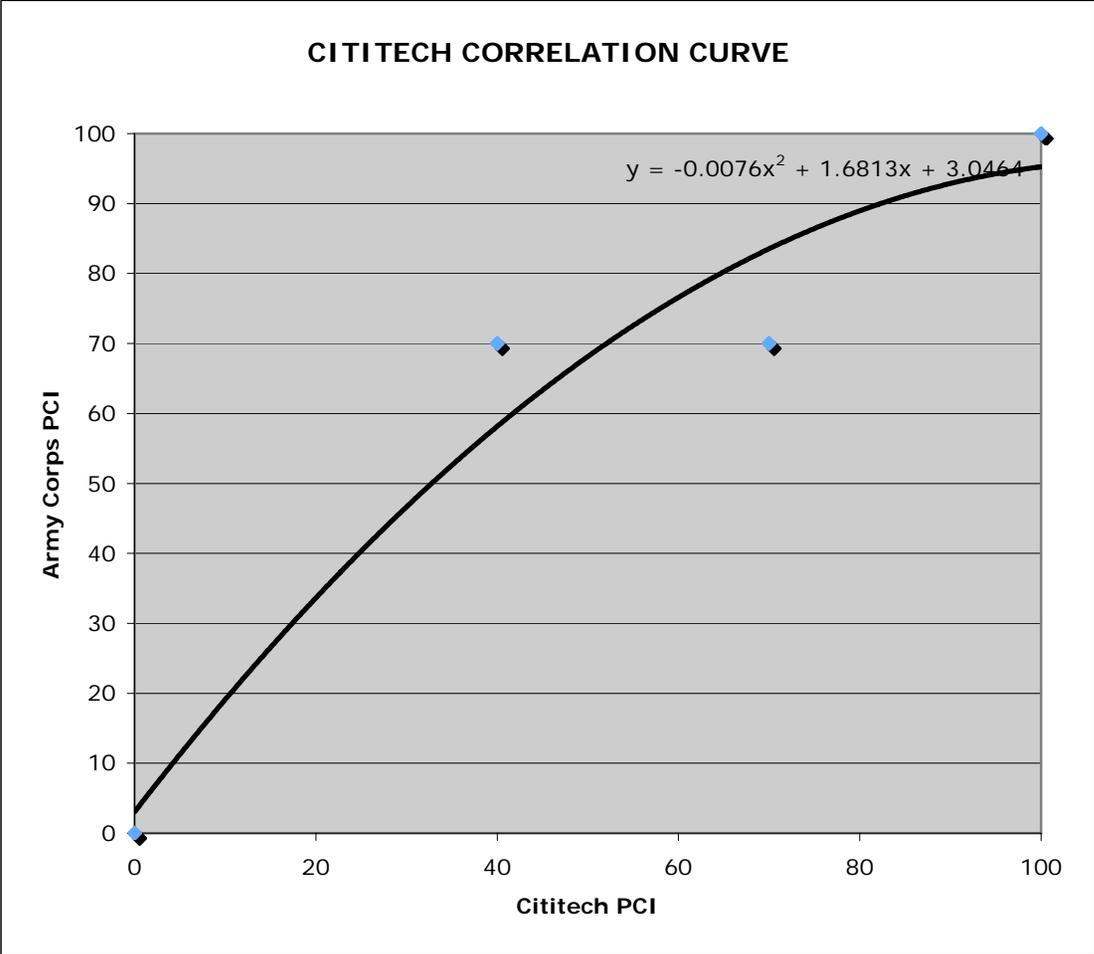
CAA CORRELATION CURVE

A series of test values were used to compute results using both the CAA system and an Army Corps system.
A curve was developed from this data. See the spreadsheet on the next page for data.

Comparison

	CAA	ACOE
1	53	28
2	97	95
3	80	56
4	93	83
5	86	53
6	58	38
7	100	100
8	0	0

CAA CORRELATION CURVE

$y = 0.0102x^2 - 0.0838x + 1.3442$

A (y-axis)

CAA PCI (x-axis)