Draft Findings and Conclusions Report
for the City of Fort Lauderdale

Pavement Management System Implementation Using PAVER™

Project No. 11846

September 23, 2013

Plan Design Enable

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Khant Myat, Engineer
City of Fort Lauderdale, Engineering Division
100 N. Andrews Avenue, 5th Floor
Fort Lauderdale, Florida 33301

Re: Draft Findings and Conclusions Report for Pavement Management System Implementation Using PAVER™

Dear Mr. Myat:

Attached please find Atkins' Draft Findings and Conclusions Report for Pavement Management System Implementation Using PAVER™, complete with work plan scenario data in PDF format according to Task Order #1, which was approved by the City's Committee Meeting on March 5, 2013 (CAM #13-0136).

Thank you for the opportunity to provide pavement management services to the City. Feel free to contact me at 800.597.7275, ext. 4013451, or victor.herrera@atkinsglobal.com if you need additional information.

Sincerely,

Victor H. Herrera, PE
Southeast Florida Manager, Engineering
0007.100034107.0913

Cc: Scott McDonald
Mike Fayyaz, Assistant City Engineer

*All report references to PAVER™ are synonymous with MicroPAVER™

Contents

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Chapter 1:
Introduction

Atkins was contracted by the City of Fort Lauderdale, Florida, to implement a pavement management system for the City's (500-centerline-mile) pavement network. The scope of the project consisted of the following tasks:

- Establishing PAVER™ inventory/creating database
- Performing a citywide pavement condition assessment
- Entering inspection data/updating the database
- Developing work plan scenarios
- Summarizing report/project documentation
- Training for PAVER™ Sustainment Management Systems (SMS) software

Atkins completed this project on time and within budget by employing the management principles outlined in the project approach:

- Assist the City in achieving its pavement management goals in a timely and cost-effective manner
- Provide a clear map of the process as it moves from task to task
- Create opportunities for the City and Atkins to communicate and interact throughout the project

This project was a comprehensive pavement management system implementation including development of a database containing validated inventory information, inspection data collected in compliance with American Society for Testing and Materials (ASTM) D-6433-11 standards of practice, objectively computed pavement condition index (PCI) values for each section, pavement life-cycle models developed from updated data, cost tables created in collaboration with City staff, and work plan scenarios designed to provide realistic views of future budget and condition models. The overall goals of the implementation were intended to accomplish the following:

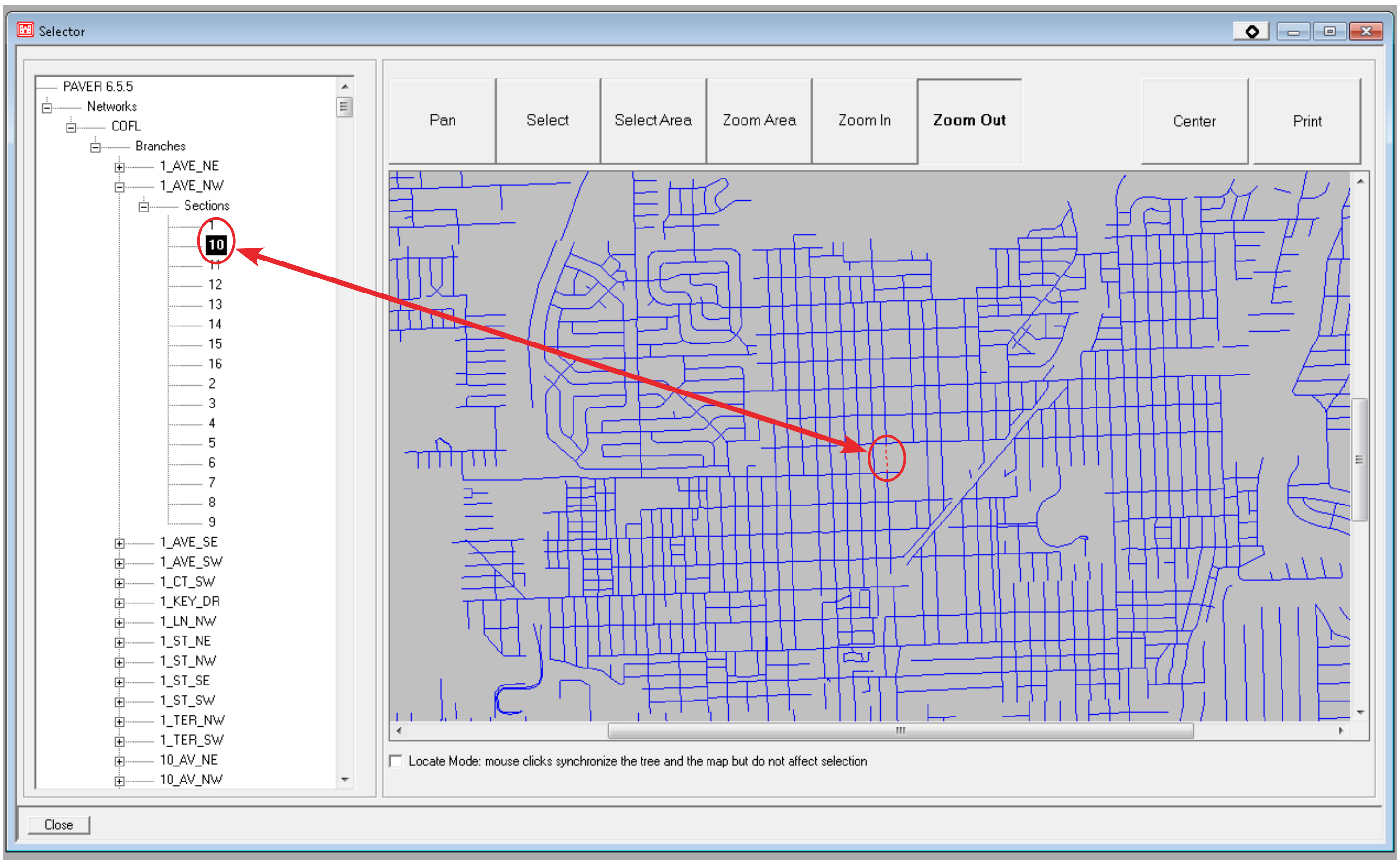
- Provide the City with a verified, up-to-date inventory of its pavement network that includes age, quantity, area, and use category data.
- Establish a baseline of objectively computed condition index data that can be used by the City to prioritize work planning and accurately represent current pavement status.
- Leverage pavement data to create life-cycle models that can assist the City in extending pavement life network-wide.
- Produce engineering-based work plans designed to model various budget scenarios and provide decision support to maximize return on investment of limited financial resources.
- Increase awareness of pavement condition and provide defensible and justifiable budgets to decision makers.

Atkins applied quality control measures throughout the project to ensure data integrity, cost control, and schedule adherence.

Quality control measures included:

- PAVER™ database data verification – Inventory and inspection tasks
- Pavement distress identification clarification and data collection process check – Inspection task
- Comparable organization cost and life-cycle model cross checks – Work planning (with prediction modeling) task

Chapter 2 of this report details the work that was carried out during each task. Chapter 3 provides current inventory and condition data. Finally, Chapter 4 outlines three budget scenarios that will provide decision support information for the City's future planning activities.



The City's new PAVER™ database contains section segmentation with information detail and linkage to the City's GIS system.

Chapter 2:
Task Detail

Task 1 – Inventory/PAVER™ Database Creation

Atkins received GIS maps from the City complete with the City's best estimate of the inventory information required by PAVER™. These elements included:

- Network, Branch, and Section IDs
- Section Rank
- Surface Type
- Last Construction Date
- Length and Width of each section (GIS segment)
- Branch Use Category

Due to the difficulty involved in gathering Last Construction Date and Surface Type information, the City estimated these values for sections for which it did not have exact information. As the City moves forward with its use of this management system, these estimated values will be replaced with actual data.

The initial inventory data set—in GIS shapefile format—was received by Atkins and converted into a PAVER™ database. Quality control was performed on the initial data set, which became the map for the condition data collection process.

Task 2 – Inspection

This task involved collecting inspection data on the entire pavement network. Prior to finalizing this requirement, Atkins created a new PAVER™ database with updated (verified) inventory data. This new database utilized existing City GIS segmentation (intersection to intersection) to establish a pavement network sectioned in compliance with both PAVER™ guidelines and pavement segments verified during the inspection. Atkins created an updated shape file for the City complete with required inventory elements — and developed an updated PAVER™ database from that information. The new database was quality-checked using the PAVER™ Database Verification Tool to identify missing or incomplete data. The inspection team spent 3 weeks in the field collecting inspection data in accordance with ASTM D-6433 standards of practice. This included distress identification following PAVER™ inspection manual guidelines and the proper establishment of representative samples. Atkins performed quality control on the inspection team by performing ride-along observation and post-process sample spot checks.

Task 3 – Data Entry/Database Update

After all inspection data was collected, it was then uploaded into the current (production) copy of the PAVER™ database. Once the data upload was complete, Atkins validated the information using tools internal to the PAVER™ application. This data will provide the baseline to perform both prediction model construction and, ultimately, meaningful work planning activities.

Task 4 – Life-Cycle Model/Cost Table Development

Using Fort Lauderdale-specific data, Atkins constructed prediction models (life-cycle curves) that accurately represented the degradation curves of pavement families within the City's network. Based on actual data, the following families were created:

- Section Ranks B & C/Surface type AAC
- Section Rank D/Surface type AAC

These families were created based on data provided by the City with the following considerations:

- It is likely that many of the sections listed as AAC (Asphalt overlay) are actually AC (full-depth asphalt/original construction). The City can change surface types of the sections it is certain of as it uses the system.
- Section rank letters are defined as follows:
  - – B = Arterials
  - – C = Collectors
  - – D = Locals/Residentials

Atkins was able to assign the AAC/B+C (Arterials/Collectors) to the respective City of Fort Lauderdale (CFL) sections as the inventory information provided allowed for the calculation of a reasonable model. In the case of the AAC/D (Residential) model, estimated Last Construction Date data that was provided did not allow for the calculation of a realistic model. In the absence of a CFL model, Atkins assigned a predefined model (Name: Asphalt Secondary Roads) that was determined to effectively represent the CFL residential sections. Moving forward, Last Construction Date information should be updated as the City is able to confirm last Major Maintenance and Repair (M&R) event dates. This will allow the City to utilize its inspection data to influence the condition prediction process by creating and assigning CFL-specific models. Rank assignments can be changed easily and in real time as needs and usage change.

Organization-specific models capture CFL-specific influencing factors such as climate, soil, traffic volume, construction, and maintenance practices, and allow the program to more accurately predict future conditions. Atkins also worked with the City to derive accurate and organization-specific cost tables to be used in Task 5.

Task 5 – Pavement Management Scenarios

Once Atkins verified data from the previous tasks, the first step in producing work plans was to develop pavement family life-cycle models and organization-specific cost tables. Next, cost tables were derived from information provided by the City, and their current list of work practices and cost model (M&R) families were then created to more efficiently connect sections with their appropriate cost tables for increased accuracy in cost estimating during work planning. After consulting with the City, Atkins developed three work plan scenarios around the following parameters:

- 10-year plan using a $1M/year budget (Major M&R) and $200K/year budget (Localized repair work) – current City parameters
- 10-year plan with an unlimited budget
- 10-year plan with the goal of eliminating the backlog of work by year 10

Results for each of these scenarios include a condition distribution table, funded and unfunded totals, and section-level work item recommendations for the first 2 fiscal years of each plan.

Task 6 – PAVER™ Sustainment Management Systems (SMS) Training

Finally, Atkins provided the City with 2 days of training on the PAVER™ SMS. Training goals were as follows:

- Provide the City with a comprehensive overview of the PAVER™ process.
- Clarify the inventory requirements imposed by PAVER™.
- Provide ASTM D6433-11 standard guidelines for future inspection data collection efforts.
- Define the process of creating prediction models.
- Acquaint the City with work plan scenario development in PAVER™.

Chapter 3:
Pavement Network Condition Data

The following table represents section condition totals for the entire pavement network. Sections in this table are grouped by their age at the time of the last inspection (Age Category column). From there, remaining columns represent data from the set of sections falling into that particular age group. Column headings represent information about each section group that is relevant to the management process. To view data about individual sections (condition and work item recommendations), see Chapter 4: Work Planning Data.

Age Category	Average Age At Inspection	Total Area (sf)	Number of Sections	Arithmetic Average PCI	PCI Standard Deviation	Weighted Average PCI
0–02	1.72	2,087,004.91	191	79.24	12.61	77.86
03–05	4.29	8,665,723.18	809	80.69	13.10	80.54
06–10	7.67	19,619,229.92	2,040	81.76	12.22	81.96
11–15	12.30	5,170,300.26	405	79.65	12.78	79.32
16–20	18.21	7,515,256.31	686	78.13	15.14	76.88
21–25	21.21	1,449,672.36	135	76.53	12.09	78.09
26–30	29.95	21,983,033.28	1,925	78.59	17.73	78.80
over 40	112.00	16,111.10	1	85.00	0.00	85.00
all	15.75	66,506,331.33	6,192	79.90	14.69	79.74

In addition to the summary data in the table above, Atkins is including a PDF file named “CFL Section Condition Report.” This report contains condition data for every section in the database.

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Chapter 4:
Work Planning Data

Three scenarios were considered in the production of the work planning data:

- 10-year plan using a $1M/year budget (Major M&R), $200K/year budget (localized repair)
- 10-year plan with an unlimited budget
- 10-year plan with the goal of eliminating the backlog of work by year 10

The following information is provided in addition to these scenario plans:

1) A network-level condition plot of all four scenarios on one chart
2) Individual "Cost of the Plan"—tables that will illustrate condition and financial trends for each scenario. Comparison of these plans will provide the City with penalty cost of deferred maintenance data—per scenario.
3) A section-level work item recommendation, with pavement condition index (PCI) effects, for the first 2 years of each plan.

Work Plan Observations/Recommendations

- The **Unlimited** scenario provides funding to every work item recommended during the exact FY in which it was recommended. This is an optimized scenario that takes maximum advantage of the established Critical PCI levels and available funds. The presentation of this scenario is intended to show what issues currently exist, how much it would cost to address those issues, and the best case predicted network condition (PCI) that would follow. This scenario also provides a baseline against which additional plans can be compared.
- The **Backlog Elimination** scenario is a more practical approach to bringing the negative financial and condition effects of delayed maintenance under control. With respect to City of Fort Lauderdale (CFL) data, this scenario represents a 30% cost increase over the 10-year period of the plan. This increase represents the penalty cost of deferred maintenance. These penalty costs are the result of the increased cost of performing the work—and continued degradation of the section in question. The period of time required to eliminate the backlog can be adjusted in the work plan setup, with the longer terms producing the higher penalty cost amounts.

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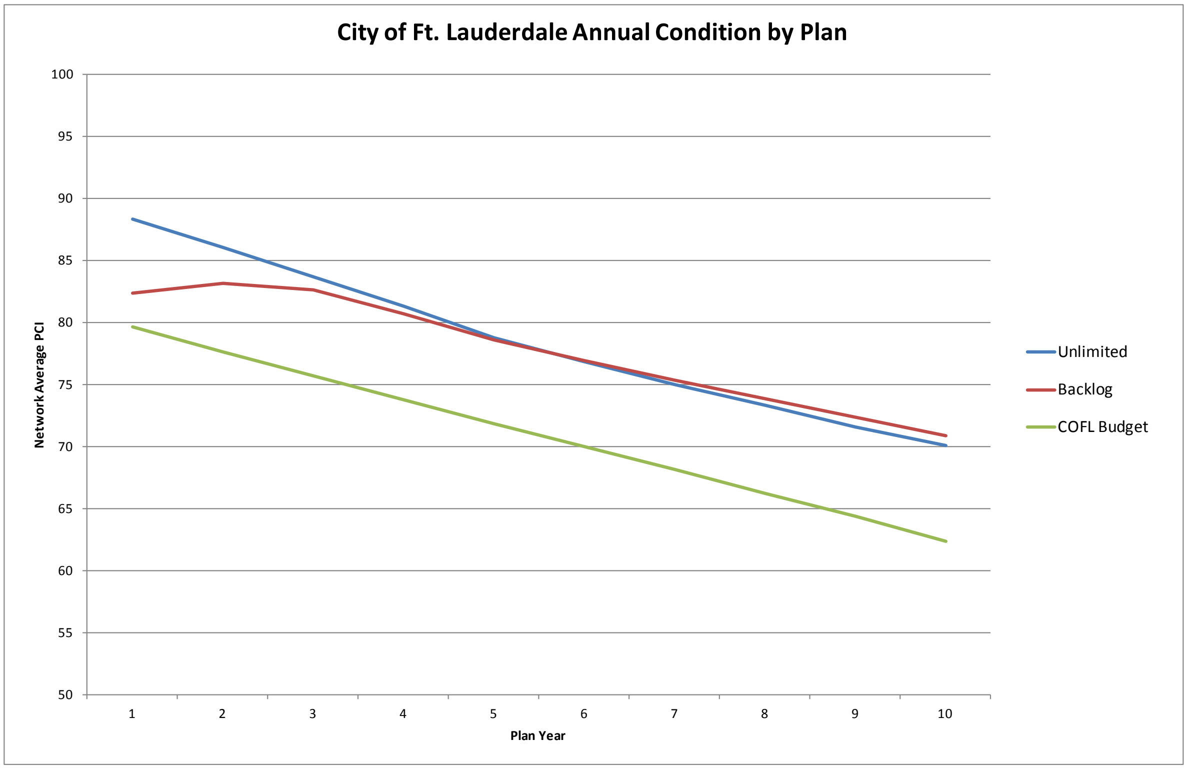
- The annual funding scenario numbers provided by CFL ($1M/year for Major M&R – $200K/year for localized repair), when compared to the unlimited budget baseline, represents an increase of 177% in required funding over the same 10-year period. This again shows the penalty cost of deferring maintenance from the optimum timing.
- Critical PCI values are determined based on the dynamics of the models to which they are connected. The Critical PCI represents the point on the respective model—for that specific family of sections—where it is most cost effective to switch the management approach from repair to replace. The Critical PCI levels can be changed to create new scenario options—understanding that any changes will impact the ability of PAVER™ to suggest optimum work types and timings.
- PAVER™ recommends "Major Above Critical" replacement work for sections that contain an excessive amount of load-related distress as recorded in the latest inspection event. "Excessive amount" percentages are determined by PAVER™ and are incorporated into the ASTM process. The City will take the "Above Critical" recommendation on a case-by-case basis. In the **Unlimited** scenario, the "Major Above Critical" category of work represents approximately 48% of the Major work recommended in the first year—a significant amount. In the other scenarios, this work will be spread out over multiple years of the plan.
- Ultimately, the results of the work plan are intended to provide the City with an objective view of the future. The data provides an opportunity for the City to conduct informed and proactive annual project planning that will optimize the pavement network condition and pavement management budgeting process.

Scenario PCI Projections



Scenario	Branch	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
Unlimited Budget	<all>	88.32	86.05	83.64	81.29	78.76	76.82	74.98	73.28	71.60	70.09
Backlog Elimination	<all>	82.34	83.17	82.60	80.69	78.59	76.94	75.36	73.87	72.39	70.89
CFL Budget	<all>	79.65	77.65	75.68	73.74	71.83	69.97	68.11	66.24	64.33	62.33

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Cost of Scenario Tables

Work Plan Scenario: Unlimited Budget

FY	Condition/PCI	Funded	Unfunded
2014	88.32	$16,564,323.44	$0.00
2015	86.05	$664,017.01	$0.00
2016	83.64	$907,807.35	$0.00
2017	81.29	$1,308,090.81	$0.00
2018	78.76	$1,217,253.33	$0.00
2019	76.82	$2,186,466.65	$0.00
2020	74.98	$2,381,177.85	$0.00
2021	73.28	$2,610,498.44	$0.00
2022	71.60	$2,683,330.88	$0.00
2023	70.09	$3,140,802.55	$0.00
	Total:	**$33,663,768.31**	
			Total Cost: $33,663,768.31

Work Plan Scenario: CFL Budget ($1M/$200K)

FY	Condition/PCI	Funded	Unfunded
2014	79.65	$1,199,587.73	$15,650,617.81
2015	77.65	$1,199,501.22	$18,731,954.90
2016	75.68	$1,199,686.29	$22,829,627.24
2017	73.74	$1,199,600.44	$28,766,955.13
2018	71.83	$1,199,517.19	$34,108,208.53
2019	69.97	$1,199,394.60	$39,220,867.50
2020	68.11	$1,199,971.32	$45,105,173.13
2021	66.24	$1,199,811.90	$53,123,755.53
2022	64.33	$1,199,702.78	$64,838,671.03
2023	62.33	$1,198,469.86	$81,136,383.78
	Total:	**$11,995,243.33**	
			Total Cost: $93,131,627.11

Work Plan Scenario: Backlog Elimination

FY	Condition/PCI	Funded	Unfunded
2014	82.34	$4,464,875.27	$12,281,436.26
2015	83.17	$4,464,741.38	$11,910,484.48
2016	82.60	$4,463,684.28	$12,396,497.02
2017	80.69	$4,463,848.23	$10,694,449.34
2018	78.59	$4,464,692.76	$7,745,324.06
2019	76.94	$4,464,343.65	$5,681,749.59
2020	75.36	$4,458,352.33	$3,781,658.37
2021	73.87	$4,446,673.41	$2,068,271.20
2022	72.39	$4,454,753.24	$350,282.89
2023	70.89	$3,456,413.88	$0.00
	Total:	**$43,602,378.43**	
			Total Cost: $43,602,378.43

Included with this document is an Excel file named "CFL 10yr Work Plan Scenarios" that includes the following information:

- The PCI projections (Network Average) Graph
- The three Work Plan scenario tables (above)
- FY14 and FY15 Work Item recommendations for all three scenarios

Section-Level Work Item Recommendations—with Resulting PCI

Due to the volume of data, these reports are included within the accompanying PDF file of this documentation.

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